

Waste Remediation Services Ltd
Waikaikai Landfarm
Monitoring Programme
Annual Report
2017-2018

Technical Report 2018-63

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Executive summary

Waste Remediation Services Ltd (WRS) operates a drilling waste landfarm (Waikaikai Landfarm) located off Lower Manutahi Road at Manutahi, South Taranaki, in the Mangaroa catchment.

This report for the period July 2017 to June 2018 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess WRS's environmental and consent compliance performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of their activities.

WRS holds one resource consent, which include a total of 32 conditions setting out the requirements that the WRS must satisfy.

The consent allows WRS to discharge drilling waste from hydrocarbon exploration and production activities, oily wastes from wellsites and contaminated soil onto and into land via landfarming at the Waikaikai Landfarm.

During the monitoring period, WRS demonstrated an overall high level of environmental performance.

The Council's monitoring programme for the year under review included four inspections, 16 water samples and two composite soil samples collected for physicochemical analysis.

The monitoring showed that elevated salts observed primarily in one monitoring well over the last few monitoring periods had reduced to below its consent derived value. Soil analysis undertaken post the application of contaminated soil from the former BP service station in Patea, indicated no non-compliances. The consent holder had provided all necessary consent related notifications and associated pre-screening analysis during the monitoring period. The monitoring indicated that WRS is having a negligible impact through the exercise of consent.

There were no unauthorised incidents recording non-compliance in respect of this consent holder during the period under review.

During the year, WRS demonstrated a high level of environmental and a high level of administrative performance with the resource consent.

For reference, in the 2017-2018 year, consent holders were found to achieve a high level of environmental performance and compliance for 76 % of the consents monitored through the Taranaki tailored monitoring programmes, while for another 20 % of the consents, a good level of environmental performance and compliance was achieved.

In terms of overall environmental and compliance performance by the consent holder over the last several years, this report shows that the consent holder's performance is improving from a good to a high level in the year under review.

This report includes recommendations for the 2018-2019 year.

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1 Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2017 to June 2018 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by Waste Remediation Services Ltd (WRS). WRS operates a landfarm situated on Lower Manutahi Road at Manutahi, South Taranaki in the Mangaroa catchment.

The report includes the results and findings of the monitoring programme implemented by the Council in respect of the consent held by WRS that relate to discharges of drilling waste within the Mangaroa catchment under the practice known as landfarming.

One of the intents of the *Resource Management Act 1991* (RMA) is that environmental management should be integrated across all media, so that a consent holder's use of water, air, and land should be considered from a single comprehensive environmental perspective. Accordingly, the Council generally implements integrated environmental monitoring programmes and reports the results of the programmes jointly. This report discusses the environmental effects of the WRS's use of land. It is the sixth annual report by the Council for Waikaikai Landfarm and the fourth report with WRS as consent holders.

1.1.2 Structure of this report

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

- consent compliance monitoring under the RMA and the Council's obligations;
- the Council's approach to monitoring sites through annual programmes;
- the resource consents held by the WRS in the Mangaroa catchment;
- 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/catchment.

Section 2 presents 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.

Section 4 presents recommendations to be implemented in the 2018-2019 monitoring year.

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

1.1.3 The Resource Management Act 1991 and monitoring

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

- a. the neighbourhood or the wider community around an activity, 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 (for example recreational, cultural, or aesthetic); and
- e. risks to the neighbourhood or environment.

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

1.1.4 Evaluation of environmental and administrative performance

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

Environmental performance is concerned with actual or likely effects on the receiving environment from the activities during the monitoring year. Administrative performance is concerned with the Company's approach to demonstrating consent compliance in site operations and management including the timely provision of information to Council (such as contingency plans and water take data) in accordance with consent conditions.

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

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

Environmental Performance

High: No or inconsequential (short-term duration, less than minor in severity) breaches of consent or regional plan parameters resulting from the activity; no adverse effects of significance noted or likely in the receiving environment. The Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices or infringement notices in relation to such impacts.

Good: Likely or actual adverse effects of activities on the receiving environment were negligible or minor at most. There were some such issues noted during monitoring, from self reports, or in response to unauthorised incident reports, but these items were not critical, and follow-up inspections showed they have been dealt with. These minor issues were resolved positively, co-operatively, and quickly. The Council was not obliged to issue any abatement notices or infringement notices in relation to the minor non-compliant effects; however abatement notices may have been issued to mitigate an identified potential for an environmental effect to occur.

For example:

- High suspended solid values recorded in discharge samples, however the discharge was to land or to receiving waters that were in high flow at the time;
- Strong odour beyond boundary but no residential properties or other recipient nearby.

Improvement required: Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent minor non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.

Poor: Likely or actual adverse effects of activities on the receiving environment were significant. There were some items noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent moderate non-compliant activity could elevate an 'improvement required' issue to this level. Typically there were grounds for either a prosecution or an infringement notice in respect of effects.

Administrative performance

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

Good: Perhaps some administrative requirements of the resource consents were not met at a particular time, however this was addressed without repeated interventions from the Council staff. Alternatively adequate reason was provided for matters such as the no or late provision of information, interpretation of 'best practical option' for avoiding potential effects, etc.

Improvement required: Repeated interventions to meet the administrative requirements of the resource consents were made by Council staff. These matters took some time to resolve, or remained unresolved at the end of the period under review. The Council may have issued an abatement notice to attain compliance.

Poor: Material failings to meet the administrative requirements of the resource consents. Significant intervention by the Council was required. Typically there were grounds for an infringement notice.

For reference, in the 2017-2018 year, consent holders were found to achieve a high level of environmental performance and compliance for 76% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 20% of the consents, a good level of environmental performance and compliance was achieved.

1.2 Process description

Drilling waste

Waste drilling material is produced during well drilling for hydrocarbon exploration. The primary components of this waste are drilling fluids (muds) and rock cuttings. Drilling fluids are engineered to perform several crucial tasks in the drilling of a hydrocarbon well. These include: transporting cuttings from the drill bit to the well surface for disposal; controlling hydrostatic pressure in the well; supporting the sides of the hole and preventing the ingress of formation fluids; and lubricating and cooling the drill bit and drill pipe in the hole.

Drilling fluids

Oil and gas wells may be drilled with either synthetic based mud (SBM) or water based mud (WBM). As the names suggest, these are fluids with either water (fresh or saline) or synthetic oil as a base material, to which further compounds are added to modify the physical characteristics of the mud (for example mud weight or viscosity). More than one type of fluid may be used to drill an individual well. In the past, oil based muds (OBM) (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. SBM use olefins, paraffins or esters as a base material. While this is technically still a form of oil based fluid, these fluids have been engineered to remove polycyclic

aromatic hydrocarbons, reduce the potential for bioaccumulation, and accelerate biodegradation compared with OBM.

Common constituents of WBM and SBM include weighting agents, viscosifiers, thinners, lost circulation materials (LCM), pH control additives, dispersants, corrosion inhibitors, bactericides, filtrate reducers, flocculants and lubricants. Of these, the naturally occurring clay mineral barite (barium sulphate) is generally the most common additive. It is added to most drilling muds as a wetting and weighting agent.

Drilling fluids may be intentionally discharged in bulk for changes to the drilling fluid programme or at the completion of drilling. Depending on operational requirements and fluid type and properties, fluids may be re-used in multiple wells.

Cuttings

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.

Landfarming

The landfarming process has typically been used in the Taranaki region to assist the ultimate 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 producing high quality clover-based pastures and thus increasing the value of the land from about \$3-4,000/ha to \$30-40,000/ha (2013).

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

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 levelling 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 levelled 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.

The landfarming process utilised at the Waikaikai Landfarm site was initially undertaken on a single application basis. This means dedicated spreading areas receive only single applications of waste. When disposal is complete, the area will be reinstated and monitored until consent surrender criteria have been met.

In a previous monitoring period the consent was varied to allow for the re-application of impacted soils to an area which was initially utilised for landfarming in 2012. The consent holder undertook analysis to quantify the concentrations of specific parameters in the soil which stipulated the area of land was within surrender criteria. Thus the decision was undertaken to allow for the second application of material.

More recently the consent holder requested the surrender of the areas of site which had been re-utilised for the landfarming and as a result of the request additional soil sampling was undertaken by the Council.

1.3 Site location and description

WRS operates a drilling waste landfarm off Manutahi Road, Manutahi. The site is owned by P. F. and K. M. Wards, trading under the name Waikaikai Farms Ltd. The predominant land use was previously dairy farming. The site location is detailed in Figure 1. The predominant soil type has been identified as black loamy sand and vegetation growth consists mostly of pasture. Test pitting and the logging of boreholes on site indicated a relatively shallow water table. Test bores were augured to 10 m both around the waste holding pit area and to the south-western site boundary, revealing alternating layers of sand and clays. Bore construction also revealed localised peat layers within some augured cores (approximately 4–8 m below surface). Average annual rainfall for the site is 1,043 mm (taken from the nearby Patea monitoring station).

Origin Energy Ltd's Kauri D wellsite is situated in the eastern corner of the site, and there is a small coastal lake inland and to the northeast (up gradient) of the storage pit area. Both of these features are presented in Figure 1.



Figure 1 WRS Waikaikai Landfarm with regional insert

Summary of the site data is presented below:

Site data:	Waikaikai Landfarm
Location	
Word descriptor:	Lower Manutahi Road, Manutahi, Taranaki
Map reference:	E 1719720
(NZTM)	N 5605515
Mean annual rainfall:	1,043 m
Mean annual soil temperature:	15.1°C
Mean annual soil moisture:	32.9%
Elevation:	~45 m
Geomorphic position:	Dune back slope
Erosion / deposition:	Erosion
Vegetation:	Pasture, dune grasses
Parent material:	Aeolian/alluvial deposits
Drainage class:	Free/well-draining

1.4 Resource consents

1.4.1 Discharges of wastes to land

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

WRS holds discharge permit 5956-2.0 to cover the discharge of drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsites and contaminated soil onto and into land via landfarming. This permit was originally issued by the Council on 22 March 2002. The consent was transferred to WRS in November 2014. On the 19 April 2017 under Section 87(e) of the RMA, it was renewed. It is due to expire on 1 June 2034.

- Condition 1 sets out definitions;
- Condition 2 states the location of the activities;
- Condition 3 requires the consent holder to adopt the best practicable option to prevent or minimise any environmental effects;
- Condition 4 requires the consent holder to install a minimum of three groundwater monitoring wells;
- Condition 5 stipulates that all storage cells utilised for the storage of material shall be lined with a fit for purpose synthetic liner;
- Condition 6 requires the consent holder to check the integrity of the storage pits/cell liners within a 24 month period;
- Condition 7 requires the site to be operated in accordance with a Management Plan;
- Conditions 8 to 12 set out the requirements for notifications, monitoring and reporting;
- Condition 13 to 22 stipulates the discharge limits;
- Conditions 23 to 25 stipulate the receiving environmental limits with respect to water;
- Conditions 26 to 30 detail the receiving environmental limits for soil and the surrender criteria;
- Condition 31 concerns archaeological remains; and
- Condition 32 is an amendment and review condition.

The permit is attached to this report in Appendix I.

This summary of consent conditions may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consent which is appended to this report.

Table 1 Consent table

Consent number	Purpose	Granted	Review	Expires
5956-2.0	To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsite's, and contaminated soil onto and into land via landfarming	19 April 2017	2019	1 June 20134

1.5 Monitoring programme

1.5.1 Introduction

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

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

The monitoring programme for the site consisted of four primary components.

1.5.2 Programme liaison and management

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

- ongoing liaison with resource consent holders over consent conditions and their interpretation and application;
- in discussion over monitoring requirements;
- preparation for any consent reviews, renewals or new consent applications;
- advice on the Council's environmental management strategies and content of regional plans; and
- consultation on associated matters.

1.5.3 Site inspections

The WRS Waikaikai site was inspected four times during the monitoring period. Additional inspections were also undertaken during sampling runs. Inspections focused on the following aspects:

- observable and/or ongoing effects upon soil and groundwater quality associated with the land disposal process;
- effective incorporation of material, application rates and associated earthworks;
- integrity and management of storage facilities ;
- dust and odour effects in proximity of the site boundaries;
- housekeeping and site management and;
- the neighbourhood was surveyed for environmental effects.

Please see Section 2.1 for the inspections undertaken in this monitoring period.

1.5.4 Chemical sampling

Compliance Monitoring

Waikakai landfarm consent 5956-2.0, this consent stipulates the requirements to be met by the consent holder for this activity.

To enable the Council to monitor the state of the landfarming process and the remediation programme with respect to possible surrender sampling. Samples of soil and groundwater are collected.

Soil sampling is undertaken to monitor the quality of the landfarming undertaken in the first instance. It also serves as a marker for the degree of remediation undertaken in the landfarming process at the time of sample collection. These samples are collected annually. From a compliance perspective it allows the Council to quantify the quality of the process and it allows for comparison to any consent holder provided data.

The methodology utilised by the Council for collecting soil samples across the land farmed area is adapted from the Guidelines for the Safe Application of Biosolids to land in New Zealand (2003).

To collect the sample, a soil corer is inserted to a depth of 400 mm +/- to encompass the zone of application. Ten soil cores are collected, spaced 10 meters apart. These ten soil cores are then composited to gain one representative soil sample of an application area. An example of an extracted soil core is provided in Photo 1.



Photo 1 An example of an extracted soil core

In this monitoring period two soil samples were collected. The analysis criteria had been modified in the previous period through the inclusion of total recoverable heavy metal testing after discussion with the consent holder. Specifically, the concentration of heavy metals within the receiving environment must not exceed the following concentration: (Condition 28 of consent 5956-2.0).

Condition 28 of consents 5956-2.0

The concentration of metals and salts in the soil layer containing the discharge shall comply with the following criteria:

Metal/ Salt	Maximum value (mg/kg)
Arsenic ¹	17
Barium – Barite ²	10,000
Extractable Barium ²	250

Cadmium ¹	0.8
Chromium ³	600
Copper ³	100
Lead ¹	160
Nickel ³	60
Mercury	1
Zinc ³	300
¹ SCS – Rural Residential MfE 2011b; ² Alberta Environment 2009; ³ NZWWA 2003, lowest of protection of human health and ecological receptors. (Biosolids to land)	

Soil analysis parameters

- Total heavy metals (arsenic, cadmium, chromium, copper, mercury, nickel, lead and zinc);
- Calcium, chloride, conductivity, magnesium, potassium, sodium , total soluble salts and sodium adsorption ratio (SAR);
- Total petroleum hydrocarbons: C₇-C₉, C₁₀-C₁₄, C₁₅-C₃₆ and C₇-C₃₆, poly-cyclic aromatic hydrocarbons and mono-cyclic aromatic hydrocarbons ; and
- Moisture factor, ammoniacal nitrogen and nitrate/nitrite nitrogen.

Groundwater monitoring

Groundwater monitoring is also undertaken at this landfarm. The facility, as required by consent, contains an active groundwater monitoring network which is comprised of five groundwater monitoring wells.

Three of the five wells were sampled four times this monitoring year to account for seasonal fluctuation and to assess for any adverse effects resulting from the exercise of the consent. The remaining two wells were sampled on two occasions. The results are presented in Section 2.2.

The sampling was conducted through a peristaltic pump and field parameters are captured via a YSi flow through cell and a multi parameter probe. The samples are collected once field parameters have been stable within 10 % for three consecutive readings.

Groundwater analysis parameters

- Barium (dissolved and acid soluble), chloride, conductivity (@ 20°C), sodium, total dissolved salts (TDS), pH; and
- Benzene, ethylbenzene, total petroleum hydrocarbons (speciated), toluene, meta-xylene, ortho-xylene.
- In-situ readings: pH, conductivity, dissolved oxygen (DO), oxidation and reduction potential (ORP) and temperature.

1.5.5 Review of consent holder data

In accordance with consent 5956-2.0, and specifically conditions 11 and 12 of the consent WRS must provide the Council with an annual report. This report contains the information required in condition 11 and 12 of the consent.

The annual report was provided by the consent holder for this period, it is attached in appendix II.

2 Results

2.1 Inspections

24 August 2017

At the time of inspection the following was observed: Pit one contained muds and liquids, with the pond level at the balance pipe. Liquids from pit one were being conveyed into pit two which was full of water with some windblown emulsified oily surface sludge noticeable around the pit. No issues were noted regarding the conditions of the pit liners. The unlined pit was empty and no ponding of stormwater was evident. The surrounding spreading areas appeared healthy, and had a good covering of pasture.

18 October 2017

At the time of inspection the following was observed: On arrival the gates to the site were locked, upon entry the site appeared tidy with no obvious issues. The unlined pit was empty with no stormwater ponding present, while the liners in the other pits were in good repair. A follow up was recommended with regard to the origin of un-notified waste on site¹.

23 April 2018

At the time of inspection the following was observed: All pit liners were in good repair, and the unlined pit remained empty. Pit one contained only drilling muds, and some residual surface hydrocarbons were found in the lined oily waste pit. Excavation works were underway, preparing to an area to landfarm the impacted soil from the BP petrol station in Patea. The northern extent of the spreading area was located at 39.69342S, 174.39671E, and the top soil that had been removed was stockpiled. Numerous soil deliveries were received while the inspection was being conducted, although it appeared that no spreading or incorporation had occurred. All historic spreading areas had good pasture cover and appeared healthy.

11 June 2018

At the time of inspection the following was observed: Pit one contained muds and some surface hydrocarbons were present. The second pit contained only stormwater and the unlined pit was empty. The top soil that had been excavated previously was stockpiled around three sides of the spreading area, and was stable. The Patea BP petrol station impacted soil had been spread across the area and was incorporated. The historic spreading areas had good pasture cover which appeared healthy, and no muds were identified at the soil surface.

¹ Noted by the Council's investigating officer during the August and October 2017 inspection rounds was the presence of residual drilling material within the storage cells. However, no notification had been received by the consent holder, other than for the material to be transported to the other WRS landfarm at Manawapou. Further investigation and discussion with the consent holder identified a contractor had discharged 35m³ of drilling mud in to a WRS Waikaikai Landfarm storage cell. However, the material was due to be at WRS Symes Manawapou Landfarm. Upon realisation of the mistake the material was sucked out of the pits by the contractor and discharged at its intended destination, WRS Symes Manawapou Landfarm.

2.2 Groundwater sampling

The Waikaikai Landfarm contains five purpose built groundwater monitoring wells. These wells, which were a consented obligation, are situated in two locations (Figure 2). Three wells are located down gradient from the lined storage cells (GND2290, 2291 and 2293). The intention of these wells is to assess the groundwater in the immediate vicinity of the storage cells. The remaining two wells (GND2294 and 2294) are situated on the south western boundary of the landfarm to assess for any potential of offsite migration.

In this monitoring period the monitoring wells situated in close proximity to the storage cells were monitored on four occasions to account for seasonal variation. The additional two monitoring wells situated to the south west of the storage cells were monitored on two occasions. The rationale for the limited monitoring of these two monitoring wells was specifically related to surrounding landfarmed areas, which were recently found (2016-2017 monitoring period Technical Report 2017-41) to be compliant with surrender soil condition. Moving forward these two wells will continue to be monitored biannually until the final landfarmed area in this parcel of land is complete.

Analysis of the site specific monitoring wells is provided in the following Tables 2 to 6.



Figure 2 WRS Waikaikai groundwater monitoring well locations

Table 2 GND2290 2017-2018 monitoring results

GND2290	Site	GND2290	GND2290	GND2290	GND2290
	Collected	23 Nov 2017	16 Jan 2018	8 May 2018	22 Jun 2018
Parameter	Time	11:30	13:15	11:30	13:00
Barium Acid Soluble	g/m ³	0.060	0.032	0.058	<0.11
Barium (dissolved)	g/m ³	0.057	0.030	0.059	0.046
Chloride	g/m ³	45.8	61.5	49.8	50
Conductivity	mS/m@20°C	48.7	55.5	50.0	48.0
Sodium	g/m ³	36.4	28.6	28.3	26
pH	pH	6.6	6.6	6.6	6.7
Temperature	°C	16.4	17.6	17.0	15.8
C ₇ -C ₉ TPH	g/m ³	<0.06	<0.06	<0.06	<0.06
C ₁₀ -C ₁₄ TPH	g/m ³	<0.2	<0.2	<0.2	<0.2
C ₁₅ -C ₃₆ TPH	g/m ³	<0.4	<0.4	<0.4	<0.4
C ₇ - C ₃₆ TPH	g/m ³	<0.7	<0.7	<0.7	<0.7
Benzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Toluene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Xylene M	g/m ³	<0.002	<0.002	<0.002	<0.002
Xylene O	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Total Dissolved Salts	g/m ³	376.8	429.4	386.9	320

Table 3 GND2291 2017-2018 monitoring results

GND2291	Site	GND2291	GND2291	GND2291	GND2291
	Collected	23 Nov 2017	16 Jan 2018	8 May 2018	22 June 2018
Parameter	Time	11:00	12:40	11:05	12:25
Barium Acid Soluble	g/m ³	0.015	0.010	0.0158	<0.11
Barium (dissolved)	g/m ³	0.014	0.007	0.0152	0.014
Chloride	g/m ³	267	319	268	260
Conductivity	mS/m@20°C	110	130	119	129.5
Sodium	g/m ³	60.1	64.2	67.1	70
pH	pH	6.2	6.2	6.2	6.4
Temperature	°C	16.4	17.0	16.7	15.5
C ₇ -C ₉ TPH	g/m ³	<0.06	<0.06	<0.06	<0.06
C ₁₀ -C ₁₄ TPH	g/m ³	<0.2	<0.2	<0.2	<0.2
C ₁₅ -C ₃₆ TPH	g/m ³	<0.4	<0.4	<0.4	<0.4
C ₇ - C ₃₆ TPH	g/m ³	<0.7	<0.7	<0.7	<0.7
Benzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Toluene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Xylene M	g/m ³	<0.002	<0.002	<0.002	<0.002
Xylene O	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Total Dissolved Salts	g/m ³	851.1	1,005.8	920.7	820

Table 4 GND2292 2017-2018 monitoring results

GND2292	Site	GND2292	GND2292	GND2292	GND2292
	Collected	23 Nov 2017	16 Jan 2018	8 May 2018	22 Jun 2018
Parameter	Time	10:30	12:20	10:40	11:50
Barium Acid Soluble	g/m ³	0.40	0.44	0.31	0.32
Barium (dissolved)	g/m ³	0.40	0.44	0.32	0.32
Chloride	g/m ³	987	887	768	760
Conductivity	mS/m@20°C	278	290	262	282
Sodium	g/m ³	359	315	282	310
pH	pH	6.2	6.0	6.1	6.4
Temperature	°C	16.4	18.5	16.9	14.5
C ₇ -C ₉ TPH	g/m ³	<0.06	<0.06	<0.06	<0.06
C ₁₀ -C ₁₄ TPH	g/m ³	<0.2	<0.2	<0.2	<0.2
C ₁₅ -C ₃₆ TPH	g/m ³	<0.4	<0.4	<0.4	<0.4
C ₇ - C ₃₆ TPH	g/m ³	<0.7	<0.7	<0.7	<0.7
Benzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Toluene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Xylene M	g/m ³	<0.002	<0.002	<0.002	<0.002
Xylene O	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Total Dissolved Salts	g/m ³	2,150.9	2,243.8	2,027.1	1,720

Table 5 GND2293 2017-2018 monitoring results

GND2293	Site	GND2293	GND2293
	Collected	16 Jan 2018	22 Jun 2018
Parameter	Time	11:05	10:30
Barium Acid Soluble	g/m ³	0.33	0.33
Barium (dissolved)	g/m ³	0.32	0.32
Chloride	g/m ³	347	420
Conductivity	mS/m@20°C	136	169
Sodium	g/m ³	80.8	92
pH	pH	6.7	6.7
Temperature	°C	17.5	15.3
C ₇ -C ₉ TPH	g/m ³	<0.06	<0.06
C ₁₀ -C ₁₄ TPH	g/m ³	<0.2	<0.2
C ₁₅ -C ₃₆ TPH	g/m ³	<0.4	<0.4
C ₇ - C ₃₆ TPH	g/m ³	<0.7	<0.7
Benzene	g/m ³	<0.0010	<0.0010
Ethylbenzene	g/m ³	<0.0010	<0.0010
Toluene	g/m ³	<0.0015	<0.0010
Xylene M	g/m ³	<0.002	<0.002
Xylene O	g/m ³	<0.0010	<0.0010
Total Dissolved Salts	g/m ³	1,052.2	1,080

Table 6 GND2294 2017-2018 monitoring results

GND2294	Site	GND2294	GND2294
	Collected	16 Jan 2018	22 Jun 2018
Parameter	Time	11:45	11:10
Barium Acid Soluble	g/m ³	0.006	<0.11
Barium (dissolved)	g/m ³	0.006	<0.005
Chloride	g/m ³	53.4	53
Conductivity	mS/m@20°C	33.2	36.6
Sodium	g/m ³	31.2	34
pH	pH	7.5	7.7
Temperature	°C	18.1	14.2
C ₇ -C ₉ TPH	g/m ³	<0.06	<0.06
C ₁₀ -C ₁₄ TPH	g/m ³	<0.2	<0.2
C ₁₅ -C ₃₆ TPH	g/m ³	<0.4	<0.4
C ₇ - C ₃₆ TPH	g/m ³	<0.7	<0.7
Benzene	g/m ³	<0.0010	<0.0010
Ethylbenzene	g/m ³	<0.0010	<0.0010
Toluene	g/m ³	<0.0010	<0.0010
Xylene M	g/m ³	<0.002	<0.002
Xylene O	g/m ³	<0.0010	<0.0010
Total Dissolved Salts	g/m ³	256.9	230

Groundwater monitoring of the Waikakai Landfarm in the 2017-2018 monitoring period detailed the following:

- Total Petroleum Hydrocarbon (TPH, all chains) concentrations were all below the limit of detection for these analytes across all five wells.
- Benzene, toluene, ethylene and xylenes (BTEX) were also below the limit of detection in all wells.
- Total dissolved salts in monitoring well GND2292 have remained higher than the other wells, although levels when compared to the last monitoring period have decreased noticeably, and now sit below the conditional limit set in consent 5956-2.0. The values ranged from 1,720 g/m³ on 22 June 2018 to 2,243.8 g/m³ on 16 January 2018. The remaining four wells ranged from 230 g/m³ in GND2294 on 22 June 2018 to 1,080 g/m³ in GND2293 on June 22 2018 also.
- Chloride concentrations were also elevated in well GND2292, ranging from 760-987 g/m³. GND2293 detailed the next highest concentration, ranging from 347-420 g/m³.
- Sodium concentrations followed a similar theme, with the highest concentration found at GND2292 359 g/m³ in November 2017. The second highest concentration was found at GND2293, 92 g/m³ in June 2018. This indicates a significant decrease in sodium concentration when compared to the previous monitoring period, as on 22 May 2017 a concentration of 509 g/m³ was recorded.
- Groundwater conductivity followed a similar theme to the salt concentrations, with GND2292 the highest, ranging from 262-290 mS/m@20°C.
- Temperature in the groundwater remained quite steady throughout the year, ranging from 14.2°C (lowest, GND2294, June 2018) to 18.5°C (highest, GND2292, January 2018).
- Barium, both acid soluble and dissolved, ranged from 0.006 g/m³ acid soluble (GND2294, January 2018) and <0.005 g/m³ dissolved (also GND2294, June 2018) to 0.44 g/m³ acid soluble (GND2292, January 2018) and dissolved with a highest concentration of 0.44 g/m³ (also GND2292, January 2018).

2.3 Soil sampling

The Council collected two composite soil samples this monitoring period. The results are shown in Table 7 below. An image which details the soil transects collected in this period is provided in the following Figure 3.

Table 7 Waikaikai Landfarm soil sample results 2017-2018 monitoring period

WRS Waikaikai soil analysis		Site	Transect A	Transect B
Parameter	Unit	Consent limit	22/06/2018	22/06/2018
Dry Matter (Env)	g/100g as rcvd		96	95
1-Methylnaphthalene	mg/kg dry wt		< 0.011	< 0.011
2-Methylnaphthalene	mg/kg dry wt		< 0.011	< 0.011
Acenaphthene	mg/kg dry wt		< 0.011	< 0.011
Acenaphthylene	mg/kg dry wt		< 0.011	< 0.011
Anthracene	mg/kg dry wt		< 0.011	< 0.011
Benzo[a]anthracene	mg/kg dry wt		0.015	< 0.011
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.027*	< 0.011	< 0.011
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt		< 0.03	< 0.03
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt		< 0.03	< 0.03
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt		< 0.011	< 0.011
Benzo[e]pyrene	mg/kg dry wt		0.012	< 0.011
Benzo[g,h,i]perylene	mg/kg dry wt		< 0.011	< 0.011
Benzo[k]fluoranthene	mg/kg dry wt		< 0.011	< 0.011
Chrysene	mg/kg dry wt		0.013	< 0.011
Phenanthrene	mg/kg dry wt		< 0.011	< 0.011
Pyrene	mg/kg dry wt	160*	< 0.011	< 0.011
Fluoranthene	mg/kg dry wt		< 0.011	< 0.011
Fluorene	mg/kg dry wt		< 0.011	< 0.011
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt		< 0.011	< 0.011
Perylene	mg/kg dry wt		0.02	< 0.011
Dibenzo[a,h]anthracene	mg/kg dry wt		< 0.011	< 0.011
Naphthalene	mg/kg dry wt	7.2*	< 0.06	< 0.06
Benzene	mg/kg dry wt	1.1*	< 0.05	< 0.05
Toluene	mg/kg dry wt	82*	< 0.05	< 0.05
Ethylbenzene	mg/kg dry wt	59*	< 0.05	< 0.05
m&p-Xylene	mg/kg dry wt	59*	< 0.10	< 0.10
o-Xylene	mg/kg dry wt	59*	< 0.05	< 0.05
Total hydrocarbons (C ₇ - C ₃₆)	mg/kg dry wt		< 70	< 70
C ₁₅ - C ₃₆	mg/kg dry wt	1,300*	< 40	< 40
C ₁₀ - C ₁₄	mg/kg dry wt	150*	< 20	< 20
C ₇ - C ₉	mg/kg dry wt	210*	< 8	< 8

WRS Waikaikai soil analysis		Site	Transect A	Transect B
Parameter	Unit	Consent limit	22/06/2018	22/06/2018
Chloride	mg/kg dry wt	700*	6	11
Total Recoverable Calcium	mg/kg dry wt		3,500	3,800
Total Recoverable Sodium	mg/kg dry wt	460*	350	370
Total Recoverable Potassium	mg/kg dry wt		126	135
Total Recoverable Magnesium	mg/kg dry wt		1,440	1,620
Total Recoverable Arsenic	mg/kg dry wt	17	< 2	< 2
Total Recoverable Cadmium	mg/kg dry wt	0.8	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	600	9	12
Total Recoverable Copper	mg/kg dry wt	100	7	9
Total Recoverable Lead	mg/kg dry wt	160	0.8	1
Total Recoverable Mercury	mg/kg dry wt	1	< 0.10	< 0.10
Total Recoverable Nickel	mg/kg dry wt	60	5	6
Total Recoverable Zinc	mg/kg dry wt	300	38	48
Conductivity	mS/m	290*	< 20	< 20
pH	pH		6.5	6.5
Sodium Absorption Ratio (SAR)		18*	0.8	1.3
Soluble Salts	mg/kg dry wt		< 500	< 500
Nitrate-N + Nitrite-N	mg/kg dry wt		< 1.0	< 1.0
Ammonium-N	mg/kg dry wt		< 5	< 5
*relates to surrender concentrations				

The soil analysis undertaken in the 2017-2018 monitoring period is provided above in Table 7. The table contains the consented concentrations (consent 5956-2.0) which must not be exceeded, which is specific for heavy metal analysis. Consented analysis with an asterisk indicates surrender concentrations, which is the concentrations of which target analytes need to be below to be considered for surrender.

When compared to the consented analysis concentrations (Table 7) the resultant analysis detailed no exceedance. Note the analysis provided by transects A and B of the soil, are related to the post incorporation of material from the former BP Patea Service Station.



Figure 3 Soil sampling transect 22 June 2018

2.4 Provision of consent holder data

The consent holder provided notifications as required by consent 5956-2.0. These notifications allowed the Council with an understanding of the planned stockpiling and farming of material in the 2017-2018 monitoring period.

A description of the material delivered in the 2017-2018 monitoring period is provided in the following Table 8. An annual report, as required by the consent was provided by the consent holder this period and is appended in appendix II.

2.4.1 Delivery record

Table 8 Consent holder provided delivery record WRS Waikaikai Landfarm 2017-2018

Date	Operator	Source	Composition	Quantity	Farmed or stored in 17-18
18 April 2018	BP	Patea Service Station	Impacted soil with low levels of hydrocarbons	860 m ³	Directly spread on newly landfarmed area
04 May 2018	Westside Corporation	Manutahi D	Separator sands with some residual oil	39 m ³	Stored
24 May 2018	Westside Corporation	Rimu B	Produced water and cement returns	62.5 m ³	Stored
24 June 2018	Westside Corporation	Manutahi B2	Produced water and cement returns	443 m ³	Stored
30 June 2018	Westside Corporation	Kauri E2	Produced water and well work over fluid	70 m ³	Stored

2.4.2 Spreading record

The impacted soil from the former BP service station in Patea (860 m³) was landfarmed this period. The other deliveries were stored for the remainder of the period and are planned to be farmed in the early 2018-2019 monitoring period. Of note, this consent holder is able to store waste for a period of up to 24 months prior to landfarming.

2.5 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, for example provision of advice and information, or investigation of potential or actual causes of non-compliance or failure to maintain good practices. A pro-active approach that in the first instance avoids issues occurring is favoured.

The Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The incident register includes events where the 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).

In the 2017-2018 period, the Council was not required to undertake any significant additional investigations and interventions, or record incidents, in association with WRS's conditions in their resource consent or provisions in Regional Plans.

3 Discussion

3.1 Discussion of site performance

For the majority of the current monitoring period the Waikaikai Landfarm was inactive. Though contained within the storage cells was the delivery from the previous monitoring period from TAG Oil's Pukatea wellsite. This was to be farmed this period, though the consent holder may hold material within lined storage cells for a period not longer than 24 months.

The site also received material for another WRS landfarm due to an error by the delivery subcontractor. On this occasion 35 m³ of material was discharged briefly into a lined storage cell, prior to being rectified and re-delivered to its original destination, Symes Manawapou, which is the consent holder's other landfarm,

The facility did undertake one landfarming exercise this period, it farmed contaminated soils from the former BP Patea service station tank validation, Manutahi D and stockpiled 2016-2017 TAG Oil material. The material from the tank validation was quantified by a third party. This was discharged to land and incorporated during April and May 2018, in area W1810. Notifications of material and associated quantified analysis, a requirement of the consent, were provided by the consent holder.

Further deliveries of land farmable material were subsequently notified by the consent holder prior to and when they were received, including the consent required pre-screening analysis. The pre-screening analysis is provided in the appendix II, along with the consent holder's annual report.

No other issues were reported by the Council's investigating officer during inspections.

3.2 Environmental effects of exercise of consents

Effects associated with the exercise of consent 5956-2.0 in the 2017-2018 monitoring period were minor. In the previous monitoring period one monitoring well located in close proximity to the storage cells held a concentration of TDS above the consented limit of 2,500 g/m³. This effect which was first observed at the tail end of the 2014 year and resulted in a maximum elevation of TDS to 6,112 g/m³ (February 2015). However since that date it has been observed to be slowly reducing.

In this period, the impacted well of GND2292 reduced to below the consent limit and subsequent monitoring in the upcoming 2018-2019 period indicated that this concentration of TDS continues to reduce.

Soil analysis, undertaken post the soil incorporation from the former BP service station, found minimal concentrations of concern.

Additional material currently stored on site, in lined storage cells, will need to be farmed within the proposed time frame of 24 months, as per consent conditions. The Council will continue to monitor consent compliance at the Waikaikai landfarm.

Previously landfarmed areas were reported to hold good ground cover which appeared healthy.

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 9.

Table 9 Summary of performance for consent 5956-2.0

Purpose: 5956-2.0 To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsite's and contaminated soil onto and into land via landfarming		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Definitions of material	N/A	Yes
2. Application area detailed on attached map	Landfarming occurred in specific area	Yes
3. Adoption of Best Practicable Option (BPO)	Inspections	Yes
4. Groundwater monitoring well installation	Inspections and sampling	Yes
5. Cell lined with fit for purpose liner	Inspections, unlined cell and contents removed between Sep and Nov 2016	Yes
6. Storage cell integrity check every 24 months	To be undertaken within the next 24 months	Yes
7. Operation in accordance with management plan	Inspections/ management plan received June 2017	Yes
8. Notify TRC 48 hours prior to transfer of waste to disposal site	Notifications received	Yes
9. Notify TRC 48 hours prior to landfarming wastes	Notifications received	Yes
10. Representative waste sample from each source and each type of waste 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; d) barium, calcium, chloride, magnesium, sodium, potassium, sodium adsorption ratio, nitrogen and pH, and e) heavy metals; arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc.	Submitted	Yes
11. Record keeping	Annual report provided and mud delivery log provided. All consent notifications provided by consent holder this period.	Yes
12. Annual Report	Report received	Yes

Purpose: 5956-2.0 To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsite's and contaminated soil onto and into land via landfarming

Condition requirement	Means of monitoring during period under review	Compliance achieved?
13. No discharge within 25 meters of surface water or property boundaries	Inspections	Yes
14. No hydraulic fracturing fluids	Record check	Yes
15. Contaminated soil may only be brought to site after it has been assessed by condition 10 of this consent and by the Chief Executive	Yes, contaminated soil assessed and agreed prior to being brought to site	Yes
16. All waste brought to site must be landfarmed as soon as practicable but no later than 24 months after delivery date	Ongoing	Yes
17. Application of drilling material thickness	Inspections and review of consent holder data	Yes
18. No ponding or overland flow after one hour of application	Inspections	Yes
19. As soon as practicable after landfarming shall mix with native topsoil with a minimum of 250 mm	Inspections	Yes
20. Maximum application rate of 20,000 mg/kg at any point after incorporation	Inspections and sampling	Yes
21. Secondary application of material is permitted if the standards of condition 29 have been met and the Chief Executive has considered this analysis appropriate	Not required this period	Yes
22. Revegetation as soon as practicable	Achieved	Yes
23. Shall not exceed a value of 2,500 g/m ³ Total Dissolved Salts within any groundwater or surface water	Monitoring	Yes
24. Consent shall not lead or be liable to lead to contaminants entering a surface water body	Monitoring	Yes
25. Shall not result in any adverse impacts on groundwater and or surface water	Minor impacts in terms of salinity, though below consent conditions and reducing	Yes
26. Conductivity must be less than 400 mSm ⁻¹ . If background soil has an conductivity greater than 400 mSm ⁻¹ , then conductivity after disposal shall not exceed original conductivity by more than 100 mSm ⁻¹	Inspections and sampling	Yes

Purpose: 5956-2.0 To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsite's and contaminated soil onto and into land via landfarming		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
27. Sodium absorption ratio [SAR] must be less than 18.0, if background SAR exceeds 18.0 then increase shall not exceed 1.0	Inspections and sampling	Yes
28. The concentration of metals and salts in the soil layer containing the discharge shall comply with certain criteria	Sampling	Yes
29. Prior to expiry/cancellation of consent these levels must not be exceeded: a) Conductivity, 290 mSm ⁻¹ b) Chloride, 700 g/m ³ c) Total dissolved salts, 2,500 g/m ³ d) Sodium, 460 g/m ³ e) MAH's/PAH MfE 1999 CS NZ Table 4.12 f) TPH CCME 2008 Table 5.2 Ecological direct contact	Surrender sampling recently undertaken 2016-2017 monitoring period, all parameters bar sodium within surrender concentrations as stipulated by this condition, sodium absorption ratio (SAR) indicated low SAR, below 4 across all soil samples collected (2012-2017)	Yes
30. Consent cannot be surrendered until standards in condition 29 have been met	No consent surrender	N/A
31. Notification of discovery of archaeological remains	None this monitoring period	N/A
32. Review, amend, delete		N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

Table 10 Evaluation of environmental performance over time

Year	Consent no	High	Good	Improvement req	Poor
2011-2012	5956-1				1
2012-2013	5956-1				1
2013-2014	5956-1			1	
2014-2015	5956-1.7		1		
2016-2017	5956-2.0		1		
2017-2018	5956-2.0	1			
Totals		1	2	1	2

During the year, WRS demonstrated a high level of environmental and high level of administrative performance with the resource consents as defined in Section 1.1.4.

3.4 Recommendations from the 2016-2017 Annual Report

In the 2016-2017 Annual Report, it was recommended:

1. THAT monitoring of consented activities at Waikaikai Landfarm in the 2017-2018 year continue at the same level as in 2016-2017 (or) unless the site begins to stockpile and landfarm whereby the option for additional soil samples (four additional) to be added to the programme will be exercised.
2. THAT the option for a review of resource consent in June 2018, as set out in condition 32 of the consent, not be exercised, on the grounds that conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent.

Recommendation 1 was undertaken without the requirement for additional soil samples.

Recommendation 2 was not required this monitoring period, as the current consent conditions appear fit for purpose.

Alterations to monitoring programmes for 2018-2019

In designing and implementing the monitoring programmes for land discharges in the region, the Council has taken into account:

- the extent of information already made available through monitoring or other means to date;
- its relevance under the RMA;
- the Council's obligations to monitor consented activities and their effects under the RMA;
- the record of administrative and environmental performances of the consent holder; and
- reporting to the regional community.

The Council also takes into account the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki exercising resource consents.

It is proposed that for 2018-2019 monitoring period that the monitoring of consented activities at Waikaikai Landfarm in the 2018-2019 year continue at the same level as in 2017-2018 (or) unless the site continues to stockpile and landfarms additional areas, other than the one currently on-going. Whereby the option for additional soil samples (four additional) to be added to the programme will be exercised.

Groundwater analysis of monitoring wells GND2293 and GND2294 will be undertaken biannually until the final landfarmed area within this specific area is complete and surrendered.

It should be noted that the proposed programme represents a reasonable and risk-based level of monitoring for the site in question. The Council reserves the right to subsequently adjust the programme from that initially prepared, should the need arise if potential or actual non-compliance is determined at any time during 2018-2019.

3.5 Exercise of optional review of consent

Resource consent 5956-2.0 provides for an optional review of the consent in June 2019. Condition 32 allows the Council to review the consent, if there are grounds that suggest that a review is required.

Based on the results of monitoring in the year under review, and in previous years as set out in earlier annual compliance monitoring reports, it is considered that there are no grounds that require a review to be pursued.

4 Recommendations

1. It is proposed that for 2018-2019 monitoring period that the monitoring of consented activities at Waikaikai Landfarm in the 2018-2019 year continue at the same level as in 2017-2018 (or) unless the site continues to stockpile and landfarms additional areas, other than the one currently on-going. Whereby the option for additional soil samples (four additional) to be added to the programme will be exercised.
2. Groundwater analysis of monitoring wells GND2293 and GND2294 will be undertaken biannually until the final landfarmed area within this specific area is complete and surrendered.
3. THAT should there be issues with environmental or administrative performance in 2018-2019 period, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.
4. THAT the option for a review of resource consent in June 2019, as set out in condition 32 of the consent not be exercised, on the grounds that the consent is fit for purpose.

Glossary of common terms and abbreviations

The following abbreviations and terms may be used within this report:

As	Arsenic.
Biomonitoring	Assessing the health of the environment using aquatic organisms.
Bund	A wall around a tank to contain its contents in the case of a leak.
Conductivity	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 ³ s ⁻¹).
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
g/m ² /day	grams/metre ² /day.
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.
Incident register	The incident register contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
L/s	Litres per second.
m ²	Square Metres.
MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
mS/m	Millisiemens per metre.
Mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
NH ₄	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH ₃	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO ₃	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.

O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
Pb*	Lead.
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
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	<i>Resource Management Act 1991</i> and including all subsequent amendments.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).
TDS	Total dissolved salts
Turb	Turbidity, expressed in NTU.
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 a Science Services Manager.

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Appendix I

Resource consents held by Waste Remediation Services Ltd

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

Consent number	Purpose	Granted	Review	Expires
5956-2.0	To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsite's, and contaminated soil onto and into land via landfarming	19 Aril 2017	2019	1 June 20134

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

Name of
Consent Holder: Waste Remediation Services Limited
PO Box 7150
New Plymouth 4341

Decision Date: 19 April 2017

Commencement Date: 19 April 2017

Conditions of Consent

Consent Granted: To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsites, and contaminated soil onto and into land via landfarming

Expiry Date: 1 June 2034

Review Date(s): Annually until June 2020 and then every three years thereafter

Site Location: Lower Manutahi Road, Manutahi
(Property owner: Waikaikai Farms Limited)

Grid Reference (NZTM) 1720190E-5605380N

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 all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. For the purposes of this consent the following definitions shall apply:
 - a) drilling wastes consist of; drilling fluids and cuttings from drilling operations with water based muds, and drilling fluids and cuttings from drilling operations with synthetic based muds;
 - b) oily wastes from wellsites consist of; sludge removed from tanks and separators, slops oil removed from well cellars, tank wax which builds up in separators and tanks, oily formation sand, contaminated ground material from leaks and spills;
 - c) contaminated soil refers specifically to the hydrocarbon contaminated soil;
 - d) storage means a discharge of wastes from vehicles, tanks, or other containers onto land for the purpose of temporary storage prior to landfarming, but without subsequently spreading onto, or incorporating the discharged material into the soil within 48 hours;
 - e) landfarming means the discharge of 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. This consent authorises the application of material to land only within the area indicated on the attached map.
3. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.
4. Prior to the exercise of this consent, the consent holder shall after consultation with the Chief Executive, Taranaki Regional Council, install a minimum of three groundwater monitoring bores. The bores shall be at locations and to depths that enable monitoring to determine any change in groundwater quality resulting from the exercise of this consent. The bores shall be installed in accordance with NZS 4411:2001 and all associated costs shall be met by the consent holder. The bores shall be sampled prior to stockpiling or landfarming for baseline water quality parameters and concentrations of contaminants.
5. Any pits intended for the storage of solid or liquid wastes shall be lined with high-grade (fit for purpose) synthetic liners or equivalent so that they retain liquid without leakage through the base or side walls.
6. At intervals not exceeding 24 months the consent holder shall check the integrity of the pit liners, repair or replace liners as required and demonstrate to the Chief Executive, Taranaki Regional Council they retain liquid as required by condition 5.

7. The site shall be operated in accordance with a 'Management Plan' prepared by the consent holder and approved by the Chief Executive, Taranaki Regional Council, acting in a certification capacity. The plan shall detail how the site will be managed to achieve compliance with the consent conditions of this consent and shall include as a minimum:
- a) control of site access;
 - b) procedures for notification to Council of disposal activities;
 - c) procedures for the receipt and stockpiling of drilling wastes onto the site;
 - d) procedures for the management of stormwater recovered from, or discharging from, the drilling waste stockpiling area;
 - e) procedures for demonstrating storage cell integrity;
 - f) methods used for the mixing and testing of different waste types;
 - g) procedures for landfarming drilling wastes and or contaminated soil (including means of transfer from stockpiling area, means of spreading, and incorporation into the soil);
 - h) contingency procedures;
 - i) sampling regime and methodology; and
 - j) post-landfarming management, monitoring and site reinstatement.

Notification and sampling requirements

8. The consent holder shall notify the Chief Executive, Taranaki Regional Council, (by emailing worknotification@trc.govt.nz) at least 48 hours prior to permitting wastes onto the site for storage. Notification shall include the following information:
- a) the consent number;
 - b) the name of the well and wellsite, or other source, from which the waste was generated;
 - c) the type of waste to be stored; and
 - d) the volume of waste to be stored.
9. The consent holder shall notify the Chief Executive, Taranaki Regional Council, (by emailing worknotification@trc.govt.nz) at least 48 hours prior to landfarming stored 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)/or location from which the waste was generated;
 - c) the type(s) of waste to be landfarmed;
 - d) the volume and weight of the waste to be landfarmed;
 - e) the specific concentrations of Metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn), Salts (Barium, Calcium, Chloride, Magnesium, Sodium, Potassium) and Sodium Adsorption Ratio. Hydrocarbons (Total Petroleum Hydrocarbons, Mono Cyclic Aromatic Hydrocarbons and Poly Cyclic Aromatic Hydrocarbons) and Nitrogen in the waste prior application to land;
 - f) results of sampling undertaken in accordance with condition 8, including in a spreadsheet compatible format;
 - g) proposed loading rate and required area calculations showing compliance with condition 18; and
 - h) the specific location and area over which the waste will be landfarmed.

10. 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 (C₆-C₉, C₁₀-C₁₄, C₁₅-C₃₆);
 - b) benzene, toluene, ethylbenzene, and xylenes;
 - c) polycyclic aromatic hydrocarbons screening;
 - d) barium, calcium, chloride, magnesium, sodium, potassium, sodium adsorption ratio, nitrogen and pH, and
 - e) heavy metals; arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc.

The consent holder shall record the data from these results onto a master spreadsheet to be supplied to the Taranaki Regional Council in accordance with conditions 8 and 9.

Monitoring and reporting

11. The consent holder shall keep records of the following:
- a) wastes from each individual well/ source;
 - b) analytical composition of wastes;
 - c) stockpiling area(s);
 - d) volumes of material stockpiled;
 - e) landfarming area(s), including a map showing individual disposal areas with GPS co-ordinates and up-to-date GIS shapefiles;
 - 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.
12. The consent holder shall provide to the Chief Executive, Taranaki Regional Council:
- a) by 31 August of each year, a report on all records required to be kept in accordance with conditions 8, 9, 10 and 11 for the period of the previous 12 months, 1 July to 30 June;
 - b) monthly records of all movements of waste to the site in spreadsheet format, including source, material type, transporter, volumes and receiving storage pit.

Discharge Limits

13. No discharge shall take place within 25 metres of surface water or property boundaries.
14. Waste brought to the site shall not contain any hydraulic fracturing fluids.
15. Contaminated soil may be brought to the site only after the Chief Executive, Taranaki Regional Council has assessed the analysis required by condition 10 and advised that the material is suitable for bioremediation.
16. All wastes must be landfarmed as soon as practicable, but no later than 24 months after being brought onto the site.
17. For the purposes of landfarming, solid 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.
18. For the purposes of landfarming, liquid wastes shall be applied to land:
 - a) at a rate such that there is no overland flow of liquids; and
 - b) at a rate such that no ponded liquids remain after one hour, after application.
19. When landfarming, as soon as practicable following the application of solid wastes to land, the consent holder shall mix the wastes with, as a minimum, the top 250 mm of native soil.
20. The hydrocarbon concentration in the soil over the landfarming area shall not exceed 20,000 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.
21. The secondary application of material to land may only occur if:
 - a) the areas of application meet the standards of surrender as shown in conditions 28 and 29 of this consent;
 - b) the Chief Executive, Taranaki Regional Council, having considered the appropriate soil analysis, has confirmed that the standards specific in a) above have been met.
22. 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 environmental limits for water

23. The exercise of this consent shall not result in a level of total dissolved salts within any surface or groundwater of more than 2,500 gm³.
24. The exercise of this consent, including the design, management and implementation of the discharge, shall not lead or be liable to lead to contaminants entering a surface water body.
25. The exercise of this consent shall not result in any adverse impacts on groundwater as a result of leaching, or on surface water including aquatic ecosystems, and/or result in a change to the suitability of use of the receiving water as determined by the Chief Executive, Taranaki Regional Council

Receiving environmental limits for soil

26. The conductivity of the soil/waste layer after application shall be less than 400 mSm, or alternatively, if the background soil conductivity exceeds 400 mSm, the landfarming of waste shall not increase the soil conductivity by more than 100 mSm.
27. The application of waste shall not increase the sodium adsorption ratio (SAR) of the soil by more than 2.0 and in no case shall the SAR of the soil/waste layer exceed 18.0 after application.
28. The concentration of metals and salts in the soil layer containing the discharge shall comply with the following criteria:

Metal/ Salt	Maximum value (mg/kg)
Arsenic ¹	17
Barium – Barite ²	10,000
Extractable Barium ²	250
Cadmium ¹	0.8
Chromium ³	600
Copper ³	100
Lead ¹	160
Nickel ³	60
Mercury	1
Zinc ³	300
¹ SCS – Rural Residential MfE 2011b; ² Alberta Environment 2009; ³ NZWWA 2003, lowest of protection of human health and ecological receptors. (Biosolids to land)	

29. From 1 March 2034 (three months prior to the consent expiry date), constituents in the soil at any depth less than 500 mm (below ground level) shall not exceed the standards shown in the following table:

Constituent	Standard
Conductivity	Not greater than 290 mS/m
Chloride	Not greater than 700 mg/kg
Sodium	Not greater than 460 mg/kg
Total Soluble Salts	Not greater than 2500 mg/kg
TPH Fraction	Guideline Value Agricultural Ecological Direct Soil Contact (Fine Sand) From table 5.2
F1 (C6-C10)	210
F2 (>C10-C16)	150
F3 (>C16-C34)	1300
F4 (>C34)	5600
Canadian Council of Ministers of the Environment (CCME), in the document Canada Wide Standard for Petroleum Hydrocarbons (PHC) in Soil: Scientific Rationale, 2008. Table 5.2	
Soil Type/ Contaminant	Depth of contamination
	Surface (<1m) (mg/kg)
SANDY Silt	
MAHs	
Benzene	1.1
Toluene	82
Ethylbenzene	59
Xylene	59
PAHs	
Naphthalene	7.2
Non-carc (Pyrene)	160
Benzo(a)pyrene	0.027
Table 4.12 SANDY SILT Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MfE 1999)	

MAHs - benzene, toluene, ethylbenzene, xylenes

PAHs - naphthalene, non-carc. (pyrene), benzo(a)pyrene eq.

TPH - total petroleum hydrocarbons (C7-C9, C10-C14, C15-C36)

The requirement to meet these standards shall not apply if, before 1 March 2034, the consent holder applies for a new consent to replace this consent when it expires, and that application is not subsequently withdrawn.

30. This consent may not be surrendered unless the standards in condition 29 have been met.
31. 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.

32. 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 annually until 2020 and every three years thereafter, 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 19 April 2017

For and on behalf of
Taranaki Regional Council

A D McLay
Director - Resource Management

The consent holder's attention is drawn to MPI's "Food safety and animal welfare guidance if spreading rocks and minerals from drilling oil and gas wells on land" (July 2015) which provides guidance to producers and processors of food, including farmers, on how ensure food safety and animal welfare if spreading rocks and minerals from drilling oil and gas wells on land. Should you require further information, please contact Mary Western (MPI, Wellington) or visit <https://www.mpi.govt.nz/document-vault/8698> for the report.

Advice Note (included at the request of DITAG)

The consent holder's attention is drawn to MPI's "New Zealand Code of Practice for the Design and Operation of Farm Dairies (NZCP1) which restricts:

- The discharge of specified wastes to land used for grazing of milking animals; and*
- The use of feed from land which has had specified wastes applied to it.*

Should you require further information, please contact a Dairy Industry Technical Advisory Group (DITAG) representative or visit <http://www.foodsafety.govt.nz/elibrary/industry/dairy-nzcp1-design-code-of-practice/amdt-2.pdf> (specifically section 6.4 Disposal of effluent and other wastes and section 7.8 Purchased Stock Food) or contact an operation dairy processing company regarding conditions of supply.



Total consented area for Waikaikai Landfarm (in yellow) as authorised by consent 5956-2.0

Appendix II

Annual Report



31 October 2018

Chief Executive
Taranaki Regional Council
Private Bag 713
47 Cloten Road
Stratford
Attention Nathan Crook

Dear Nathan

RE: Resource Consent 5956 -2.0 - Waikakai (Wards) – Waikakai Farms Ltd, 78 Lower Manutahi Road, RD 2, Patea

As required under special condition 12 of resource consent 5956-2.0, please find all relevant information recorded from the operational period 1 July 2017 to 30 June 2018 relating to stockpiling and landspreading activities undertaken at Waste Remediation Services (WRS) Waikakai disposal site. It is the fourth the report completed by WRS following the previous periods;

2014-15

2015-16

2016-17

This report is designed to follow on from the previously submitted 2016-17 consent monitoring report and is as such focussed on activities, records and results from the 2017-18 period. This report is structured into 6 sections, as per the following:

1. Overview and Background
2. Wastes Received for Disposal
3. Disposal and Rehabilitation Operations (preparatory earthworks, landspreading/ incorporation and rehabilitation - comprising topsoil application, sowing, additional works)
4. Monitoring
5. Additional Consent Requirements
6. Summary

1. OVERVIEW AND BACKGROUND

WRS began operating the Waikaikai disposal site in 2014, after the original disposal consent 5956-1 was transferred to them by the landowner of the site, following an unsuccessful attempt at operating the disposal site by a different third party operator. Between 2014 and the currently reported on year (2017-18), operations at the site have improved, as reflected in the TRC consent compliance ratings for these years. Similarly to WRS's other site (Manawapou, consent 7795-1) there have been intermittent periods of activity at the site, reflecting fluctuating levels of activity within the local drilling industry. During the 2016-17 period, consent 5956-1.7 was superseded by the current consent, 5956-2.0.

2017-2018 has seen a reasonable level of activity at the Waikaikai site. The previous period (2016-17) had been relatively quiet, but the site received some drilling mud and produced water from TAG's A2 and E8 wells for stockpiling. At the beginning of the reporting period on 1 July 2017, this material remained in storage awaiting spreading.

Drilling waste was received from two Westside wells, Manutahi B2 and Manutahi A2, during the 2017-2018 period, and small quantities of production wastes were received from Westside's production facilities at Manutahi D. Hydrocarbon impacted soil was also delivered to site from Allied Petroleum's Patea petrol station site. Further details are given in Section 2.

Spreading of this material and the drilling wastes already onsite from TAG's A2 and E8 wells commenced in an area referred to as W1810 in the later part of the operational year. This area is just being completed at time of reporting.

Monitoring of the site undertaken in the 2017-18 year by both the Taranaki Regional Council (TRC) and WRS management has shown the operations undertaken at Waikaikai to be compliant with consent conditions, and no incidents have been recorded against the site in 2017-18.

2. WASTES RECEIVED FOR DISPOSAL

Waste Types and Volumes

WRS's Waikaikai site is consented to dispose of a wider range of wastes than at the Manawapou site, with the addition of oily wastes. The following material was received for disposal in 2017-18:

Water based muds (WBM) and cuttings were received onsite from two Westside wells during the 2017-18 operational period. 62.5 m³ of drilling muds and cuttings were delivered to the Waikaikai site from Rimu B wellsite on 25 May 2018.

443 m³ of drilling muds and cuttings were delivered to the Waikaikai site from Manutahi B2 well between 25 June 2018 and 30 June 2018. It should be noted that deliveries from this well continued into July 2018 and will therefore be reported on in the 2018-19 consent report.

35 m³ of drilling mud and cuttings were also transferred to this site from WRS' Manawapou site. This material was from TAG's Cheal D1 well.

39 m³ of separator sands were received from Westside's Manutahi D Production Station for disposal at the Waikaikai site between 4 May 2018 and 8 May 2018.

860 m³ of hydrocarbon impacted soil was also received onsite from Allied Petroleum's redevelopment of the existing BP Patea petrol station site between 23 April 2018 and 5 May 2018.

The site received a total of 1,349.5 m³ of drilling/production waste and impacted soil during the reporting period. Full details of these drilling/production waste and impacted soil deliveries can be found in the attached mud register, Appendix C.

Waste Characterisation

Consent 5956-2.0 requires the site operator to sample and keep records of waste chemical composition. Composite samples are taken (generally by wellsite staff prior to transport) across each waste stream before materials leave the wellsite for delivery. WRS also takes pre-spreading samples from the pits prior to landspreading for further waste characterisation. All samples are sent to RJ Hill Laboratories for analyses. Results were forwarded by WRS and more latterly transmitted directly by RJ Hills to TRC for their records and for cross referencing purposes. Results are kept and logged by WRS, and are used to calculate required spreading areas as per condition 17 of consent 5956-2.0 to ensure the hydrocarbon limit in condition 20 is adhered to. Additionally, consent 5956-2.0 condition 15 requires WRS to present predisposal results to the TRC for any contaminated soil intending for disposal, to assess for suitability on a case-by-case basis.

The summary table below gives the basic details of the pre-disposal samples for the Waikaikai site in 2017-18.

WRS sample	RJ Hill job	Disposal site	Source	Client	Date received	Date reported
N/A*	1934243	Waikaikai	Impacted soil	Allied	1-Mar-18	12-Mar-18
KB1944	1982549	Waikaikai	Pre-spread	Various	16-May-18	30-May-18
KB1945	1999222	Waikaikai	Rimu B	Westside	14-Jun-18	28-Jun-18

*BTW supplied results

PDF copies of these results are attached to this report as part of Appendix D. Excel/CSV format results can be supplied upon request if required. By volume, the majority of material received at the site in 2017-18 was the impacted soil from Allied Petroleum's Patea site. BTW, who undertook the site investigation for clients Allied Petroleum, characterised this waste as part of the site investigation/remediation and supplied their results to WRS. These indicated relatively low levels of hydrocarbons were present (TPH <10,000 g/m³), there were low levels of BTEX in some of the samples, and heavy metal concentrations were all well within the guideline values given in consent condition 28.

The final slurry mix sample KB1944/1982549 taken prior to spreading area W1810 showed slightly higher concentrations of total hydrocarbons (TPH 114,000 mg/kg dry wt), relatively low concentrations of chloride, sodium and potassium, and low heavy metals concentrations. This material was deemed appropriate for disposal via landfarming at the site by the TRC.

3. DISPOSAL AND REHABILITATION OPERATIONS

In the 2017-18 period there has been one extended episode of spreading and final disposal of waste material into a 1.6 Ha area identified as W1810 on the site map (Appendix B). This included the contaminated soil from Allied Patea, the drilling wastes from Westside's wells, production wastes from Manutahi D site, and the drilling wastes from TAG's wells stockpiled in 2016-17. As at the Manawapou site, material is handled using a mixture of stockpiling and/or direct spreading depending on wellsite activity, storage capacity, predisposal results, contractor scheduling, weather patterns and several other factors. As such, episodes of spreading may vary in duration and can even be intermittent.

The landspreading processes employed at this site are detailed in the site management plan. WRS closely monitors spreading operations to ensure contractors are consistent with the procedures outlined in the management plan and to ensure application thickness and ponding consent conditions are adhered to. The inspection notices received from the TRC evidence these processes were implemented satisfactorily during 2017-18. Appendix A contains some photos taken during spreading operations at Waikaikai during the year. In one of these photos, there is some ponding of rainwater on top of an incorporated section of material. As can be seen in the photo, it is distinctly different in appearance from ponded drilling mud (water clarity).

As of the time of reporting (October 2018) final rehabilitation of area W1810 is being undertaken by WRS contractors in accordance with the requirements of consent 5956-2.0.

4. MONITORING

Site Inspections - WRS

WRS closely supervise site operations to ensure all contractors are following best practice as per the site operation management plan and conditions specified in consent 5956-2.0. Regular site inspections, at least monthly, are also undertaken during periods of inactivity at the site. The landowner also provides continual surveillance of the site and feedback to WRS should there be a need.

Site Inspections – TRC

WRS has received four inspection notices from the TRC for the 2017-18 year. All notices indicated the TRC inspector was satisfied with the physical state of the site, and with operations being undertaken around the time of inspection. Copies of the TRC inspection notices are attached as Appendix F.

Receiving Environment soil Sampling

During the 2017-18 period receiving environment sampling was exclusively undertaken by TRC staff, following negotiations held in the previous period. TRC staff had always undertaken groundwater sampling at the site, and had also undertaken soil sampling for a reduced suite of parameters as a quality control measure. TRC field staff now complete all soil sampling for the full suite of parameters and report results to WRS when required. To the knowledge of WRS management, all soil sampling undertaken in 2017-18 has yielded results compliant with the limits specified in consent 5956-2.0.

As stated in the previous report, surrender sampling has been conducted at all previous landspreading areas W1407-W1611 as identified in the site map, Appendix B. These areas have been deemed fit for surrender as per conditions 29-30 of consent 5956-2.0.

5. ADDITIONAL CONSENT REQUIREMENTS

As per condition 3 of consent 5956-2.0, the site management plan has been reviewed and updated and submitted to the TRC. Operations at the Waikaikai landfarm are all undertaken generally in accordance with the WRS' Landfarm Management Plan that covers both the Manawapou and Waikaikai sites. It is a live document and is constantly reviewed and updated as necessary to reflect operational requirements and practices at both sites operated by WRS. This updated plan is attached as Appendix E.

Consent 5956-2.0 condition 6 requires WRS to assess pit liner integrity at regular intervals. The liners from the storage pits at the Waikaikai site remain in a good state of repair as of the time of reporting. There is still one unlined pit present on the site, but this has not been used for any waste storage during the 2017-18 year. This pit, Pit 4 was completely cleaned out and decommissioned during the 2016-17 monitoring period.

Pasture establishment and ongoing vegetation coverage are monitored by TRC and by WRS in partnership with the landowner at the Waikaikai site. If either the landowner or the TRC are not satisfied with vegetation coverage at the site, WRS and their contractors will work with the landowner to address any issues. In 2017-18 no significant coverage issues were identified. The TRC inspecting officer noted in their inspection notices that vegetation cover in historic spreading areas was satisfactory. Photos of site vegetation are included in Appendix A.

6. SUMMARY

Compared to the previous period, there was a reasonable level of activity at the Waikaikai site in 2017-18, mainly towards the end of the operational year. Drilling and production wastes from Westside and soil from Allied Petroleum were combined with material already stockpiled onsite and spread through area W1810, and rehabilitation processes were initiated. Historic spreading areas have met surrender criteria, and no incidents/significant issues have been identified at the site. WRS anticipates a relatively busy year ahead at this site in 2018-19.

Waste Remediation Services Ltd

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Email: keith@wrsLtd.co.nz

Appendix A Field Photographs

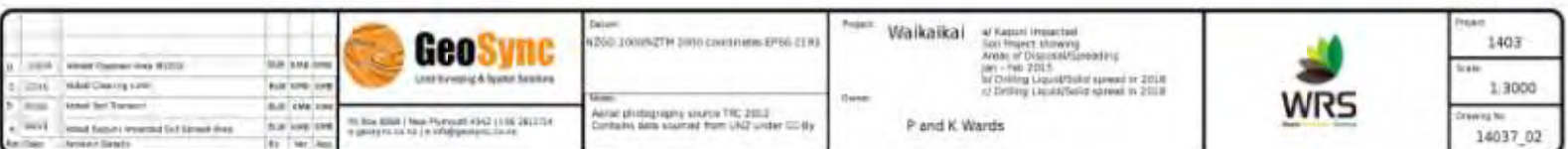
Photographs of W1810 post-spreading (top) and vegetation cover of historic spreading areas (below).





id	area (ha)	consent no	start date	end date	MUD
kDM	1.73	5956-1			NA
W1407	2.28	5956-1	2014-06-02	2014-07-31	OL/S
W1408	1.8	5956-1	2014-08-01	2014-08-10	OL/S
W1504	5.7	5956-1.7	2015-01-14	2015-04-30	S
W1611	0.63	5956-1.7	2016-10-11	2016-11-29	OL/S
W1810	1.6	5956-2.0	2018-04-01	2018-10-31	SW/OL/S/S

Mud Type Codes
SW=Stormwater
DL/S = Drilling Liquids/Solids
IS = Impacted Soils
NA = Not available



Appendix D RJ Hill Laboratories Chemical Results



Certificate of Analysis

Page 1 of 4

Client:	BTW Company Limited	Lab No:	1934243	SPV1
Contact:	Dave Bolger	Date Received:	01-Mar-2018	
	C/- BTW Company Limited	Date Reported:	12-Mar-2018	
	PO Box 551	Quote No:	90764	
	New Plymouth 4340	Order No:	180170	
		Client Reference:		
		Submitted By:	Dave Bolger	

Sample Type: Sludge

Sample Name:	Pile 1 28-Feb-2018 12:40 pm	Pile 2 28-Feb-2018 12:50 pm	Pile 3 28-Feb-2018 1:00 pm	Pile 4 28-Feb-2018 1:10 pm	
Lab Number:	1934243.1	1934243.2	1934243.3	1934243.4	

Individual Tests

Dry Matter	g/100g as rcvd	88	91	91	90	-
Total Recoverable Boron	mg/kg dry wt	< 20	< 20	< 20	< 20	-
Total Recoverable Potassium	mg/kg dry wt	270	310	250	240	-
Total Recoverable Sodium	mg/kg dry wt	530	540	750	680	-
Chloride*	mg/kg dry wt	67	18	220	200	-
Total Nitrogen*	g/100g dry wt	< 0.13	< 0.13	< 0.13	< 0.13	-

Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg

Total Recoverable Arsenic	mg/kg dry wt	< 2	< 2	< 2	< 2	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	-
Total Recoverable Chromium	mg/kg dry wt	12	10	13	13	-
Total Recoverable Copper	mg/kg dry wt	10	10	11	11	-
Total Recoverable Lead	mg/kg dry wt	1.3	1.3	1.4	1.4	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	-
Total Recoverable Nickel	mg/kg dry wt	6	5	7	6	-
Total Recoverable Zinc	mg/kg dry wt	55	45	60	59	-

BTEX in Soil by Headspace GC-MS

Benzene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	-
Toluene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	-
Ethylbenzene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	-
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.10	< 0.10	0.12	-
o-Xylene	mg/kg dry wt	0.47	< 0.05	2.2	6.4	-

Polycyclic Aromatic Hydrocarbons Screening in Soil

1-Methylnaphthalene	mg/kg dry wt	6.0	0.162	13.0	31	-
2-Methylnaphthalene	mg/kg dry wt	8.5	0.047	21	54	-
Perylene	mg/kg dry wt	< 0.12	< 0.011	< 0.11	< 0.11	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt	< 0.3	< 0.03	< 0.3	< 0.3	-
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt	< 0.3	< 0.03	< 0.3	< 0.3	-
Acenaphthylene	mg/kg dry wt	< 0.12	< 0.011	< 0.11	< 0.11	-
Acenaphthene	mg/kg dry wt	< 0.12	0.017	0.94	2.5	-
Anthracene	mg/kg dry wt	0.45	0.025	0.85	1.80	-
Benzo[a]anthracene	mg/kg dry wt	0.23	0.030	0.28	0.56	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.12	< 0.011	0.11	< 0.11	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.12	0.011	0.16	0.31	-
Benzo[e]pyrene	mg/kg dry wt	< 0.12	< 0.011	0.11	0.27	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.12	< 0.011	< 0.11	< 0.11	-



This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

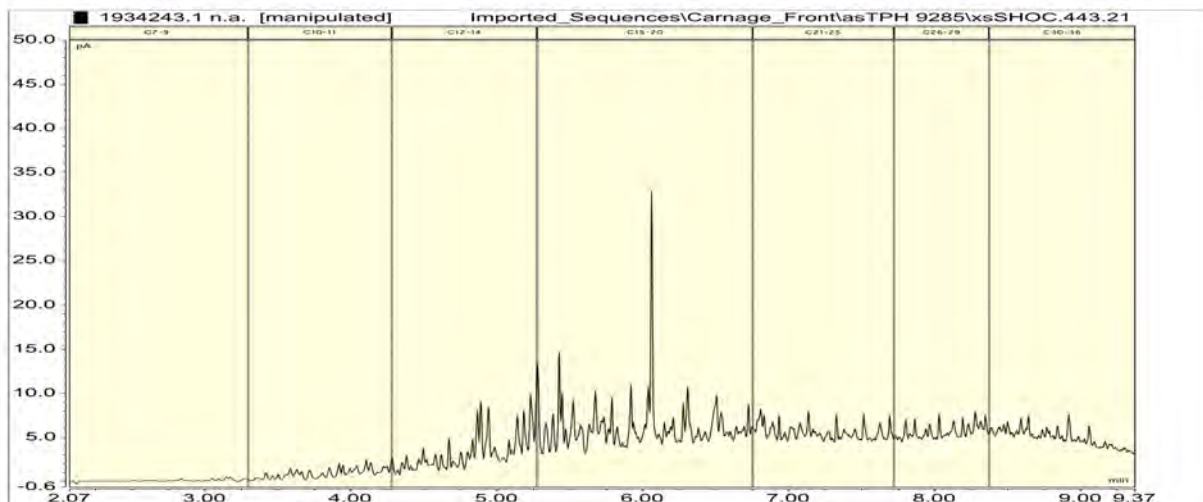
Sample Type: Sludge

Sample Name:		Pile 1 28-Feb-2018 12:40 pm	Pile 2 28-Feb-2018 12:50 pm	Pile 3 28-Feb-2018 1:00 pm	Pile 4 28-Feb-2018 1:10 pm	
Lab Number:		1934243.1	1934243.2	1934243.3	1934243.4	
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Benzo[k]fluoranthene	mg/kg dry wt	< 0.12	< 0.011	< 0.11	< 0.11	-
Chrysene	mg/kg dry wt	0.22	0.033	0.41	0.87	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.12	< 0.011	< 0.11	< 0.11	-
Fluoranthene	mg/kg dry wt	0.22	0.025	0.43	0.94	-
Fluorene	mg/kg dry wt	1.88	0.071	3.7	7.8	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.12	< 0.011	< 0.11	< 0.11	-
Naphthalene	mg/kg dry wt	1.2	< 0.06	2.9	12.9	-
Phenanthrene	mg/kg dry wt	3.4	0.124	5.9	13.0	-
Pyrene	mg/kg dry wt	0.22	0.029	0.16	0.32	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 8	< 8	96	380	-
C10 - C14	mg/kg dry wt	320	< 20	980	2,100	-
C15 - C36	mg/kg dry wt	1,540	74	3,400	6,400	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	1,860	74	4,400	8,900	-

1934243.1

Pile 1 28-Feb-2018 12:40 pm

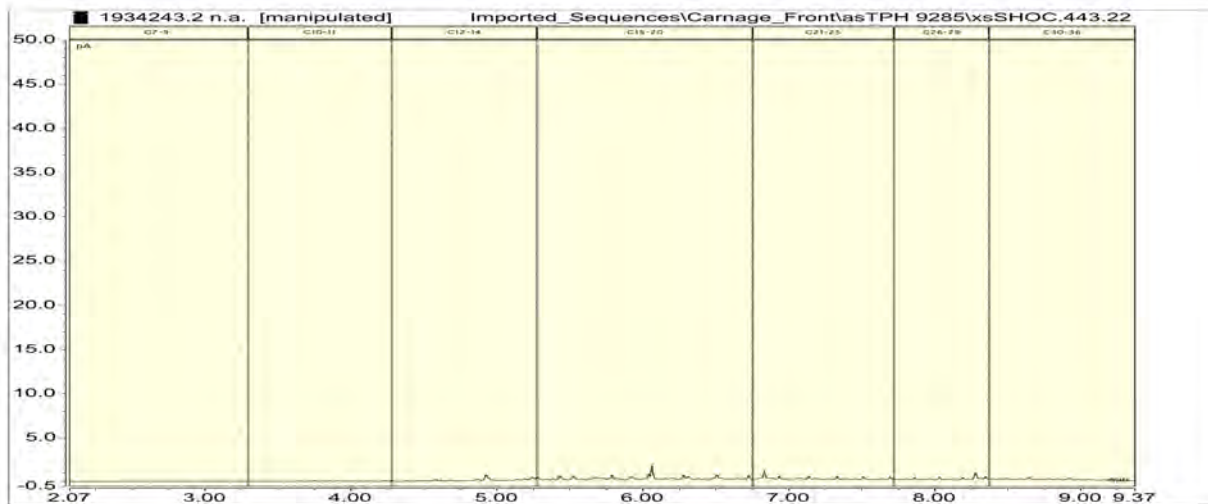
Client Chromatogram for TPH by FID



1934243.2

Pile 2 28-Feb-2018 12:50 pm

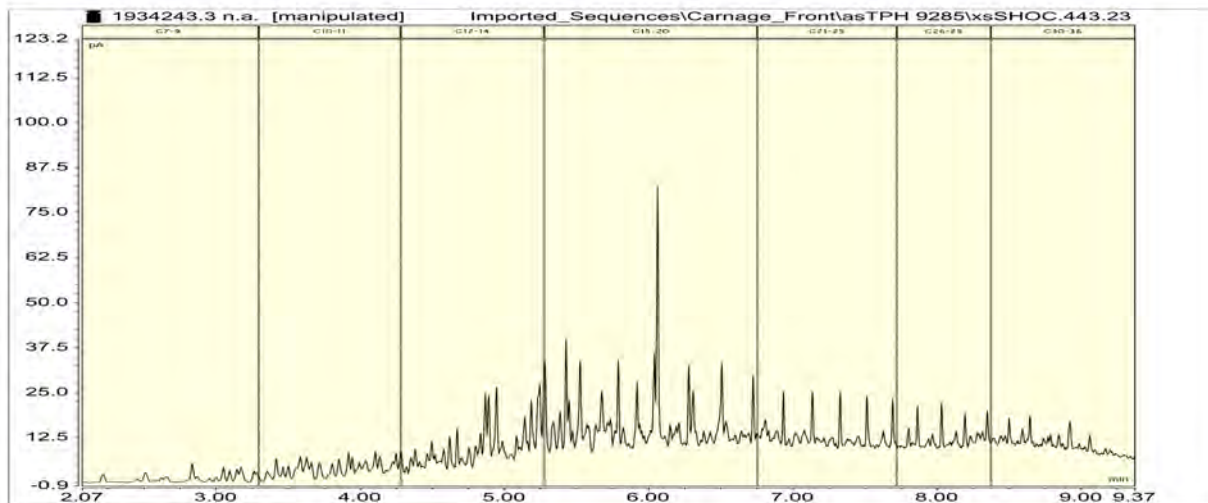
Client Chromatogram for TPH by FID



1934243.3

Pile 3 28-Feb-2018 1:00 pm

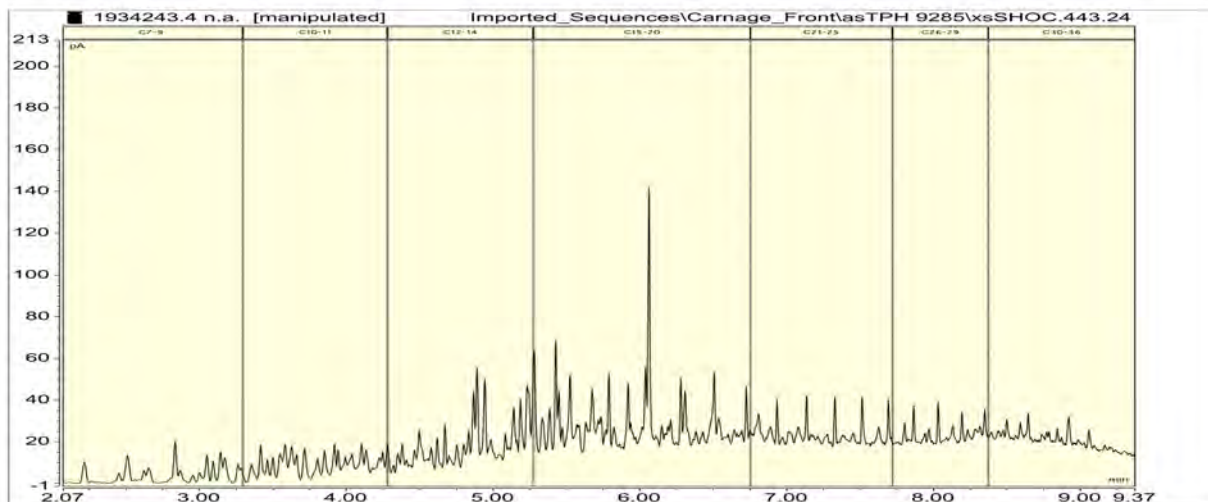
Client Chromatogram for TPH by FID



1934243.4

Pile 4 28-Feb-2018 1:10 pm

Client Chromatogram for TPH by FID



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: Sludge			
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%.	-	1-4
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	0.10 - 4 mg/kg dry wt	1-4
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]	0.05 - 0.10 mg/kg dry wt	1-4
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]	0.002 - 0.05 mg/kg dry wt	1-4
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]	8 - 60 mg/kg dry wt	1-4
TPH + PAH + BTEX profile	Sonication extraction, SPE cleanup, GC & GC-MS analysis	0.002 - 60 mg/kg dry wt	1-4
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	1-4
eslCextn*	(1:5) ratio of sample (g):0.02M potassium dihydrogen ortho-phosphate extractant (mL), analysis by Ion Chromatography. In House.	-	1-4
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-4
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	1-4
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	1-4
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	1-4
Chloride*	Ion Chromatography determination of a potassium phosphate extract of an environmental solid.	3 mg/kg dry wt	1-4
Total Nitrogen*	Catalytic Combustion (900°C, O ₂), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1-4
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	BaP Potency Equivalence calculated from Benzo(a)anthracene x 0.1 + Benzo(b)fluoranthene x 0.1 + Benzo(j)fluoranthene x 0.1 + Benzo(k)fluoranthene x 0.1 + Benzo(a)pyrene x 1 + Chrysene x 0.01 + Dibenz(a,h)anthracene x 1 + Fluoranthene x 0.01 + Indeno(1,2,3-c,d)pyrene x 0.1. Ministry for the Environment. 2011. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health. Wellington: Ministry for the Environment.	0.002 mg/kg dry wt	1-4
Benzo[a]pyrene Toxic Equivalence (TEF)	BaP Toxic Equivalence calculated from Benzo(a)anthracene x 0.1 + BaP x 1 + Benzo(b)fluoranthene x 0.1 + Benzo(k)fluoranthene x 0.1 + Chrysene x 0.01 + Dibenz(a,h)anthracene x 1.1 + Indeno(1,2,3-c,d)pyrene x 0.1. Guidelines for assessing and managing contaminated gasworks sites in New Zealand (GMG) (MfE, 1997).	0.002 mg/kg dry wt	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.

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Ara Heron BSc (Tech)
Client Services Manager - Environmental



Certificate of Analysis

Page 1 of 4

Client:	Waste Remediation Services Limited (WRS)	Lab No:	1982549	SPV1
Contact:	Keith Brodie PO Box 77 Oakura 4345 TARANAKI	Date Received:	16-May-2018	
		Date Reported:	30-May-2018	
		Quote No:	80931	
		Order No:	KB1944 - NZ Courier	
		Client Reference:	Waste characterisation Trade Waste	
		Submitted By:	Keith Brodie	

Sample Type: Sludge

Sample Name:	Wai Westside Pre-Spread 07-May-2018 8:00 am				
Lab Number:	1982549.1				

Individual Tests

Dry Matter	g/100g as rcvd	91	-	-	-	-
Approx Total Dissolved Salts	g/m ³	198	-	-	-	-
Electrical Conductivity (EC)*	mS/m	29.5	-	-	-	-
Total Recoverable Barium	mg/kg dry wt	149	-	-	-	-
Total Recoverable Calcium	mg/kg dry wt	3,100	-	-	-	-
Total Recoverable Magnesium	mg/kg dry wt	2,500	-	-	-	-
Total Recoverable Potassium	mg/kg dry wt	660	-	-	-	-
Total Recoverable Sodium	mg/kg dry wt	360	-	-	-	-
Chloride*	mg/kg dry wt	74	-	-	-	-
pH	pH Units	7.0	-	-	-	-
Total Nitrogen*	g/100g dry wt	< 0.13	-	-	-	-

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	< 0.2	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt	7	-	-	-	-
Total Recoverable Copper	mg/kg dry wt	12	-	-	-	-
Total Recoverable Lead	mg/kg dry wt	8.4	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt	< 0.2	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt	7	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt	48	-	-	-	-

BTEX in Soil by Headspace GC-MS

Benzene	mg/kg dry wt	2.7	-	-	-	-
Toluene	mg/kg dry wt	6.3	-	-	-	-
Ethylbenzene	mg/kg dry wt	1.29	-	-	-	-
m&p-Xylene	mg/kg dry wt	8.6	-	-	-	-
o-Xylene	mg/kg dry wt	3.0	-	-	-	-

Polycyclic Aromatic Hydrocarbons Screening in Soil

1-Methylnaphthalene	mg/kg dry wt	5.4	-	-	-	-
2-Methylnaphthalene	mg/kg dry wt	10.2	-	-	-	-
Perylene	mg/kg dry wt	2.9	-	-	-	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt	4	-	-	-	-
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt	4	-	-	-	-
Acenaphthylene	mg/kg dry wt	< 5	-	-	-	-
Acenaphthene	mg/kg dry wt	< 5	-	-	-	-

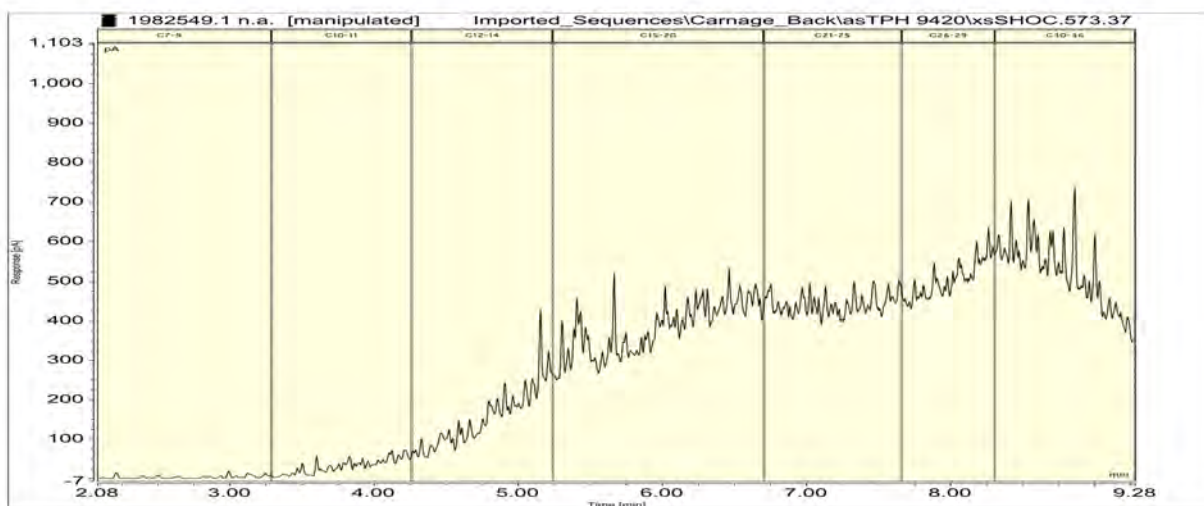


Sample Type: Sludge						
Sample Name:		Wai Westside Pre-Spread 07-May-2018 8:00 am				
Lab Number:		1982549.1				
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Anthracene	mg/kg dry wt	< 5	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 9	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	1.8	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	4.0	-	-	-	-
Benzo[e]pyrene	mg/kg dry wt	4.7	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	1.2	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 1.1	-	-	-	-
Chrysene	mg/kg dry wt	< 5	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 1.1	-	-	-	-
Fluoranthene	mg/kg dry wt	4.4	-	-	-	-
Fluorene	mg/kg dry wt	< 5	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	1.3	-	-	-	-
Naphthalene	mg/kg dry wt	9	-	-	-	-
Phenanthrene	mg/kg dry wt	< 5	-	-	-	-
Pyrene	mg/kg dry wt	8.2	-	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	210	-	-	-	-
C10 - C14	mg/kg dry wt	11,600	-	-	-	-
C15 - C36	mg/kg dry wt	103,000	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	114,000	-	-	-	-

1982549.1

Wai Westside Pre-Spread 07-May-2018 8:00 am

Client Chromatogram for TPH by FID



Analyst's Comments

The matrix in sample 1982549/1 has affected the Polycyclic Aromatic Hydrocarbons analysis. The sample was extracted on less weight, hence the higher detection limits reported.

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: Sludge			
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

Sample Type: Sludge			
Test	Method Description	Default Detection Limit	Sample No
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	0.10 - 4 mg/kg dry wt	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]	0.05 - 0.10 mg/kg dry wt	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]	0.002 - 0.05 mg/kg dry wt	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]	8 - 60 mg/kg dry wt	1
TPH + PAH + BTEX profile	Sonication extraction, SPE cleanup, GC & GC-MS analysis	0.002 - 60 mg/kg dry wt	1
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	1
eslCextn*	(1:5) ratio of sample (g):0.02M potassium dihydrogen ortho-phosphate extractant (mL), analysis by Ion Chromatography. In House.	-	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1
Approx Total Dissolved Salts	Calculation: from Electrical Conductivity.	2 g/m ³	1
Electrical Conductivity (EC)*	Electrical Conductivity measured in 1:5 Solid:Water extract.	0.1 mS/m	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 Calcium	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 Magnesium	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 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 a potassium phosphate extract of an environmental solid.	3 mg/kg dry wt	1
pH	1:2 v/v soil:water slurry after 16±2hrs, pH meter. APHA 4500-H ⁺ B 22 nd ed. 2012.	0.1 pH Units	1
Total Nitrogen*	Catalytic Combustion (900°C, O ₂), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	BaP Potency Equivalence calculated from Benz(a)anthracene x 0.1 + Benzo(b)fluoranthene x 0.1 + Benzo(j)fluoranthene x 0.1 + Benzo(k)fluoranthene x 0.1 + Benzo(a)pyrene x 1 + Chrysene x 0.01 + Dibenz(a,h)anthracene x 1 + Fluoranthene x 0.01 + Indeno(1,2,3-c,d)pyrene x 0.1. Ministry for the Environment. 2011. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health. Wellington: Ministry for the Environment.	0.002 mg/kg dry wt	1
Benzo[a]pyrene Toxic Equivalence (TEF)	BaP Toxic Equivalence calculated from Benzo(a)anthracene x 0.1 + BaP x 1 + Benzo(b)fluoranthene x 0.1 + Benzo(k)fluoranthene x 0.1 + Chrysene x 0.01 + Dibenz(a,h)anthracene x 1.1 + Indeno(1,2,3-c,d)pyrene x 0.1. Guidelines for assessing and managing contaminated gasworks sites in New Zealand (GMG) (MfE, 1997).	0.002 mg/kg 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.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

A handwritten signature in blue ink, consisting of several overlapping loops and a long horizontal stroke extending to the right.

Ara Heron BSc (Tech)
Client Services Manager - Environmental



Certificate of Analysis

Page 1 of 5

Client:	Waste Remediation Services Limited (WRS)	Lab No:	1999222	SPV1
Contact:	Keith Brodie PO Box 77 Oakura 4345 TARANAKI	Date Received:	14-Jun-2018	
		Date Reported:	28-Jun-2018	
		Quote No:	80931	
		Order No:	KB 1945	
		Client Reference:	Waste characterisation trade waste	
		Submitted By:	Keith Brodie	

Sample Type: Sludge

Sample Name:	Rimu B/WAI 12-Jun-2018 8:30 am				
Lab Number:	1999222.1				

Individual Tests

Dry Matter	g/100g as rcvd	70	-	-	-	-
Approx Total Dissolved Salts	g/m ³	5,700	-	-	-	-
Electrical Conductivity (EC)*	mS/m	846	-	-	-	-
Total Recoverable Barium	mg/kg dry wt	172	-	-	-	-
Total Recoverable Calcium	mg/kg dry wt	300,000	-	-	-	-
Total Recoverable Magnesium	mg/kg dry wt	3,500	-	-	-	-
Total Recoverable Potassium	mg/kg dry wt	1,080	-	-	-	-
Total Recoverable Sodium	mg/kg dry wt	430	-	-	-	-
Chloride*	mg/kg dry wt	2,300	-	-	-	-
pH	pH Units	12.6	-	-	-	-
Total Nitrogen*	g/100g dry wt	< 0.13	-	-	-	-

Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg

Total Recoverable Arsenic	mg/kg dry wt	10	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	0.10	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt	84	-	-	-	-
Total Recoverable Copper	mg/kg dry wt	141	-	-	-	-
Total Recoverable Lead	mg/kg dry wt	240	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt	21	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt	260	-	-	-	-

BTEX in Soil by Headspace GC-MS

Benzene	mg/kg dry wt	7.9	-	-	-	-
Toluene	mg/kg dry wt	45	-	-	-	-
Ethylbenzene	mg/kg dry wt	9.8	-	-	-	-
m&p-Xylene	mg/kg dry wt	94	-	-	-	-
o-Xylene	mg/kg dry wt	27	-	-	-	-

Polycyclic Aromatic Hydrocarbons Screening in Soil

1-Methylnaphthalene	mg/kg dry wt	29	-	-	-	-
2-Methylnaphthalene	mg/kg dry wt	47	-	-	-	-
Perylene	mg/kg dry wt	0.057	-	-	-	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt	0.32	-	-	-	-
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt	0.32	-	-	-	-
Acenaphthylene	mg/kg dry wt	0.57	-	-	-	-
Acenaphthene	mg/kg dry wt	1.40	-	-	-	-
Anthracene	mg/kg dry wt	1.12	-	-	-	-



Sample Type: Sludge						
Sample Name:		Rimu B/W AI 12-Jun-2018 8:30 am				
Lab Number:		1999222.1				
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Benzo[a]anthracene	mg/kg dry wt	< 0.014	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.21	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	0.23	-	-	-	-
Benzo[e]pyrene	mg/kg dry wt	0.21	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	0.071	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	0.169	-	-	-	-
Chrysene	mg/kg dry wt	< 0.014	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	0.062	-	-	-	-
Fluoranthene	mg/kg dry wt	0.73	-	-	-	-
Fluorene	mg/kg dry wt	3.4	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	0.043	-	-	-	-
Naphthalene	mg/kg dry wt	19.9	-	-	-	-
Phenanthrene	mg/kg dry wt	5.6	-	-	-	-
Pyrene	mg/kg dry wt	0.33	-	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	1,490	-	-	-	-
C10 - C14	mg/kg dry wt	2,400	-	-	-	-
C15 - C36	mg/kg dry wt	7,800	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	11,700	-	-	-	-
Sample Type: Aqueous						
Sample Name:		Pit 2/W AI 12-Jun-2018 8:30 am				
Lab Number:		1999222.2				
Individual Tests						
pH	pH Units	8.6	-	-	-	-
Electrical Conductivity (EC)	mS/m	1,271	-	-	-	-
Approx Total Dissolved Salts	g/m ³	8,500	-	-	-	-
Total Barium	g/m ³	1.24	-	-	-	-
Total Calcium	g/m ³	99	-	-	-	-
Total Magnesium	g/m ³	8.9	-	-	-	-
Total Mercury	g/m ³	< 0.0021	-	-	-	-
Total Potassium	g/m ³	2,800	-	-	-	-
Sodium Absorption Ratio*		17.5	-	-	-	-
Total Sodium	g/m ³	680	-	-	-	-
Chloride	g/m ³	3,500	-	-	-	-
Total Nitrogen	g/m ³	36	-	-	-	-
Nitrate-N + Nitrite-N	g/m ³	< 0.10	-	-	-	-
Total Kjeldahl Nitrogen (TKN)	g/m ³	36	-	-	-	-
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Arsenic	g/m ³	< 0.021	-	-	-	-
Total Cadmium	g/m ³	< 0.0011	-	-	-	-
Total Chromium	g/m ³	< 0.011	-	-	-	-
Total Copper	g/m ³	< 0.011	-	-	-	-
Total Lead	g/m ³	< 0.0021	-	-	-	-
Total Nickel	g/m ³	< 0.011	-	-	-	-
Total Zinc	g/m ³	< 0.021	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m ³	< 0.0010	-	-	-	-
Toluene	g/m ³	< 0.0010	-	-	-	-
Ethylbenzene	g/m ³	< 0.0010	-	-	-	-
m&p-Xylene	g/m ³	< 0.002	-	-	-	-
o-Xylene	g/m ³	< 0.0010	-	-	-	-

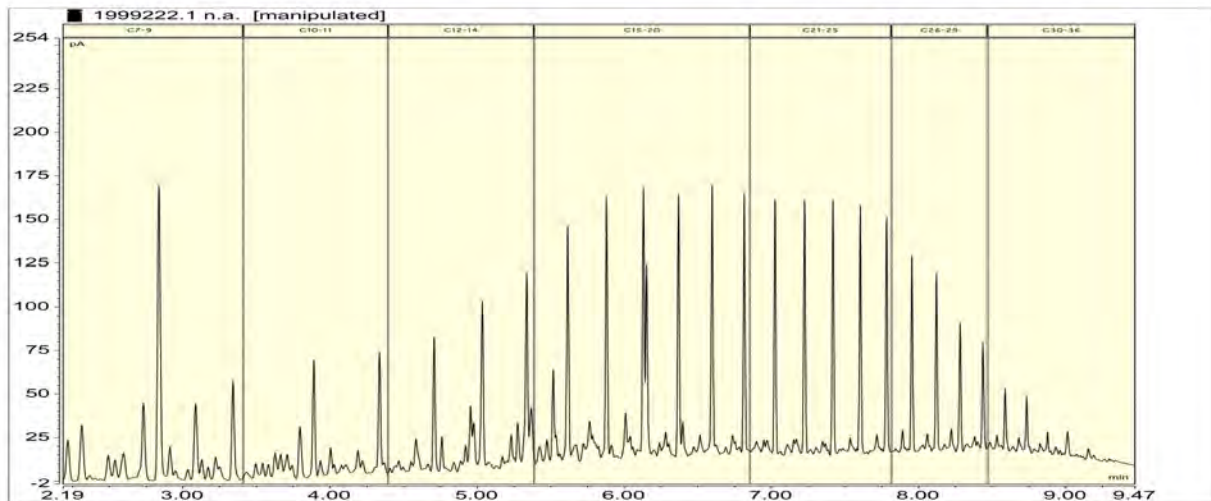
Sample Type: Aqueous

Sample Name:		Pit 2/WAI 12-Jun-2018 8:30 am				
Lab Number:		1999222.2				
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.06	-	-	-	-
C10 - C14	g/m ³	< 1.0	-	-	-	-
C15 - C36	g/m ³	< 2	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m ³	< 4	-	-	-	-

1999222.1

Rimu B/WAI 12-Jun-2018 8:30 am

Client Chromatogram for TPH by FID

**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: Sludge

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
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	0.10 - 4 mg/kg dry wt	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]	0.05 - 0.10 mg/kg dry wt	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]	0.002 - 0.05 mg/kg dry wt	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]	8 - 60 mg/kg dry wt	1
TPH + PAH + BTEX profile	Sonication extraction, SPE cleanup, GC & GC-MS analysis	0.002 - 60 mg/kg dry wt	1
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	1
esiCextn*	(1:5) ratio of sample (g):0.02M potassium dihydrogen ortho-phosphate extractant (mL), analysis by Ion Chromatography. In House.	-	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1
Approx Total Dissolved Salts	Calculation: from Electrical Conductivity.	2 g/m ³	1-2
Electrical Conductivity (EC)*	Electrical Conductivity measured in 1:5 Solid:Water extract.	0.1 mS/m	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

Sample Type: Sludge			
Test	Method Description	Default Detection Limit	Sample No
Total Recoverable Calcium	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 Magnesium	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 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 a potassium phosphate extract of an environmental solid.	3 mg/kg dry wt	1
pH	1:2 v/v soil:water slurry after 16±2hrs, pH meter. APHA 4500-H+ B 22 nd ed. 2012.	0.1 pH Units	1
Total Nitrogen*	Catalytic Combustion (900°C, O ₂), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	BaP Potency Equivalence calculated from Benz(a)anthracene x 0.1 + Benzo(b)fluoranthene x 0.1 + Benzo(j)fluoranthene x 0.1 + Benzo(k)fluoranthene x 0.1 + Benzo(a)pyrene x 1 + Chrysene x 0.01 + Dibenzo(a,h)anthracene x 1 + Fluoranthene x 0.01 + Indeno(1,2,3-c,d)pyrene x 0.1. Ministry for the Environment. 2011. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health. Wellington: Ministry for the Environment.	0.002 mg/kg dry wt	1
Benzo[a]pyrene Toxic Equivalence (TEF)	BaP Toxic Equivalence calculated from Benzo(a)anthracene x 0.1 + BaP x 1 + Benzo(b)fluoranthene x 0.1 + Benzo(k)fluoranthene x 0.1 + Chrysene x 0.01 + Dibenzo(a,h)anthracene x 1.1 + Indeno(1,2,3-c,d)pyrene x 0.1. Guidelines for assessing and managing contaminated gasworks sites in New Zealand (GMG) (MfE, 1997).	0.002 mg/kg dry wt	1

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. APHA 3125 B 22 nd ed. 2012.	0.0011 - 0.021 g/m ³	2
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m ³	2
Total Petroleum Hydrocarbons in Water	Solvent Hexane extraction, GC-FID analysis, Headspace GC-MS FS analysis US EPA 8015B/MfE Petroleum Industry Guidelines [KBIs:2803,10734;26687,3629]	0.06 - 0.7 g/m ³	2
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	2
Total Digestion	Nitric acid digestion. APHA 3030 E 22 nd ed. 2012 (modified).	-	2
Total Digestion with HCl	Nitric/hydrochloric acid digestion. APHA 3030 E 22 nd ed. 2012 (modified).	-	2
pH	pH meter. APHA 4500-H+ B 22 nd ed. 2012. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	2
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 22 nd ed. 2012.	0.1 mS/m	2
Total Barium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22 nd ed. 2012.	0.11 g/m ³	2
Total Calcium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22 nd ed. 2012.	1.1 g/m ³	2
Total Magnesium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22 nd ed. 2012.	0.42 g/m ³	2
Total Mercury	Acid digestion, ICP-MS, screen level. APHA 3125 B 22 nd ed. 2012.	0.0021 g/m ³	2
Total Potassium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22 nd ed. 2012.	1.1 g/m ³	2
Sodium Absorption Ratio (Total)*	Calculation: (sodium / 22.99) / [(calcium / 40.078 + magnesium / 24.305) ^{0.5}].	0.2	2
Total Sodium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22 nd ed. 2012.	0.42 g/m ³	2

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 22 nd ed. 2012.	0.5 g/m ³	2
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m ³ is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m ³ , the Default Detection Limit for Total Nitrogen will be 0.11 g/m ³ .	0.05 g/m ³	2
Nitrate-N + Nitrite-N Screen	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO3- I 22 nd ed. 2012 (modified).	0.10 g/m ³	2
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-Norg D. (modified) 4500 NH ₃ F (modified) 22 nd ed. 2012.	0.10 g/m ³	2
C7 - C9	Head Space, GCMS analysis.	0.06 g/m ³	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.

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