

Waikaikai Farms Limited
Waikaikai Landfarm
Monitoring Programme
Annual Report
2013-2014

Technical Report 2014-77

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Executive summary

Waikaikai Farms Limited holds consent to operate a drilling waste landfarm located off Lower Manutahi Road at Manutahi. After a period of cessation in activity, the site became operational again during the 2013-2014 monitoring period when Waste Remediation Services Limited (WRS) commenced management of the site. This report for the period July 2013-June 2014 describes the monitoring programme implemented by the Taranaki Regional Council to assess the Company's environmental performance during the period under review, and the results and environmental effects of the Company's activities.

In 2013-2014 Waikaikai Farms Limited achieved a 'improvement required' level of environmental performance in respect of this site.

Waikaikai Farms Limited holds one resource consent, which includes a total of 27 conditions setting out the requirements that the Company must satisfy. This consent allows for the discharge of drilling waste consisting of synthetic and water-based muds and rock cuttings and oily waste onto and into land via the process of landfarming.

The Council's monitoring programme for the year under review included four inspections, 21 groundwater samples and six soil samples collected for physicochemical analysis, in addition to the review of monitoring data received from the Company.

The monitoring showed that there were very minor effects detected from site activities on groundwater quality, but that no adverse effects were detected on soil quality. By comparison with previous years, there were some improvements in site operations, however there were also areas where site practices were substandard and there was one Unauthorised Incident (UI) recording non-compliance in respect of this consent holder during the period under review, for which an abatement notice was issued.

An improvement in both of the Company's environmental performance and its consent compliance is desirable.

For reference, in the 2013-2014 year, 60% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 29% demonstrated a good level of environmental performance and compliance with their consents.

This report includes recommendations for the 2014-2015 year.

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1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is the Annual Report for the period July 2013- June 2014 by the Taranaki Regional Council (the Council) describing the monitoring programme associated with the resource consent held by Waikaikai Farms Limited (Waikaikai). Waste Remediation Services Limited (WRS) operates the drilling waste landfarm on behalf of the consent holder. The site is situated off Lower Manutahi Road at Manutahi (Waikaikai Landfarm).

Waikaikai Farms Limited holds one resource consent, which was initially held by Swift Energy Ltd. The original consent was granted on 22 March 2002, permitting the Company to dispose of solids and cuttings from drilling operations at the Kauri D wellsite. This consent was varied in 2003 to include the disposal of synthetic muds, and again in 2005 to include material from other wellsites. At this time, the consent had not been exercised. As such, it was varied again in 2007 to change the lapse date. The consent was transferred twice in 2008, first to Origin Energy Resources (SPV1) Ltd, then Origin Energy Resources (RIMU) Ltd.

The consent was then transferred from Origin Energy Ltd in 2011 to the current consent holder, and was again varied in 2011 to include the disposal of oily waste. During the 2011-2012 monitoring year, Redback Contracting Ltd (Redback) began exercising the consent on behalf of the Company. In the 2012-2013 monitoring year the Council were required to intervene in site operations. Redback were no longer contracted to run the site. After a period of cessation in activity, the site became operational again during the 2013-2014 monitoring period when Waste Remediation Services Limited (WRS) commenced management of the site.

During the 2013-2014 monitoring period, there was a single disposal of approximately 1,200 m³ of predominately water-based cuttings and fluids over an area of approximately 12,000 m². No hydraulic fracturing wastes have been disposed of at this site.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consent held by Waikaikai Farms Limited, to discharge drilling wastes from hydrocarbon exploration and production activities, and oily wastes from wellsites, onto and into land via landfarming. This is the second Annual Report to be prepared by the Council to cover the consent-holder's discharges and their effects at this site.

1.1.2 Structure of this report

Section 1 of this report is a background section. It sets out general information about compliance monitoring under the *Resource Management Act 1991* and the Council's obligations and general approach to monitoring sites through annual programmes, the resource consent held by Waikaikai Farms Limited, the nature of the monitoring

programme in place for the period under review, and a description of the activities and operations conducted at Waikaikai Farms Limited's landfarm site.

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 2014-2015 monitoring year.

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

1.1.3 The Resource Management Act 1991 and monitoring

The *Resource Management Act 1991* (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 (eg, recreational, cultural, or aesthetic);
- (e) risks to the neighbourhood or environment.

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Taranaki Regional Council is recognising the comprehensive meaning of 'effects' inasmuch as is appropriate for each 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 consent performance

Besides discussing the various details of the performance and extent of compliance by the consent holder/s during the period under review, this report also assigns a rating as to each Company's environmental and administrative performance.

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 (i.e. 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 compliance

- **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 2013-2014 year, 60% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 29% demonstrated a good level of environmental performance and compliance with their consents.

1.2 Process description

1.2.1 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.

1.2.2 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 leveling out uneven ground.
3. Waste is transferred to the prepared area by excavator and truck and spread out with a bulldozer. Liquids may be discharged by tanker or a spray system.
4. Waste is allowed to dry sufficiently before being tilled into the soil to the required depth with a tractor and discs.
5. The disposal area is leveled with chains or harrows.

6. Stockpiled or brought in topsoil/clay is applied to aid stability and assist in grass establishment.
7. Fertiliser may be applied and the area is sown in crop or pasture at a suitable time of year.

The landfarming process utilised at the Waikaikai site is 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.

1.3 Site location and description

Waikaikai Farms Ltd operates a drilling waste landfarm off Manutahi Road, Manutahi. The site is owned by the resource consent holders P. F. and K. M. Wards, trading under the name Waikaikai Farms Limited. The predominant land use has previously been dairy farming. The site location is given 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 wastes 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 1043 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.

A summary of site data is presented below:

Site data

Location

Word descriptor:	Lower Manutahi Road, Manutahi, Taranaki
Map reference:	E 1719720
(NZTM)	N 5605515
Mean annual rainfall:	1043 m
Mean annual soil temperature:	15.1°C
Mean annual soil moisture:	32.9%
Elevation:	~45m
Geomorphic position:	Dune backslope
Erosion / deposition:	Erosion
Vegetation:	Pasture, dune grasses
Parent material:	Aeolian / alluvial deposits
Drainage class:	Free / well draining

Table 1 Bore construction data

Bore	Depth (m)	Drilling Formation
GND2290	0.00 – 15.00	Loose soft fine sands
GND2291	0.00 - 1.30	Sand
	1.30 - 6.50	Clay
	6.50 – 10.00	Soft peat
GND2292	0.00 – 1.30	Sand
	1.30 – 8.00	Soft clay / sandy clay
GND2293	0.00 – 7.50	Sand
	7.50 – 10.00	Silty mudstone
GND2294	0.00 – 4.50	Sand
	4.50 – 4.85	Peat
	4.85 – 7.00	Sand
	7.00 – 8.00	Silty mudstone
	8.00 – 9.80	Soft clay
	9.80 – 10.00	Sand

**Figure 1** Aerial photograph showing the layout of Waikaikai Landfarm and approximate regional location (inset)

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.

Waikaikai Farms Limited holds discharge permit 5956-1, to discharge drilling wastes from hydrocarbon exploration and production activities, and oily wastes from wellsites, onto and into land via landfarming. This permit was issued by the Taranaki Regional Council on 22 March 2002 under Section 87(e) of the Resource Management Act. This resource consent is due to expire on 1 June 2016.

Condition 1 sets out definitions.

Condition 2 dictates that the consent holder shall act and comply in accordance with the resource consent and documentation provided.

Condition 3 requires the consent holder to adopt the best practicable option to prevent or minimise any environmental effects.

Conditions 4 to 8 set out the requirements for notifications, monitoring and reporting.

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

Condition 10 prohibits the discharge of fracturing fluids.

Condition 11 dictates the storage of wastes.

Conditions 12 to 18 specify discharge limits, locations and loading rates.

Conditions 19 to 25 specify receiving environment limits for both soil and water.

Condition 26 dictates surrender criteria.

Condition 27 concerns archaeological remains.

The permit is attached to this report in Appendix I.

1.5 Monitoring programme

1.5.1 Introduction

Section 35 of the RMA sets out obligations upon the Taranaki Regional Council to gather information, monitor, and conduct research on the exercise of resource consents, and the effects arising, within the Taranaki region and report upon these.

The 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 Waikaikai Landfarm 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 Taranaki Regional Council in:

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

1.5.3 Site inspections

A total of four scheduled inspections were made of the site during the monitoring period, with regard to the consents for the discharge of drilling waste. Six inspections were conducted at the site during chemical sampling runs, and another two additional inspections of the site were conducted at other times. Inspections focussed 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
- a neighbourhood survey for environmental effects.

1.5.4 Chemical sampling

During the monitoring period the Council collected six composite soil samples from the Waikaikai site. The samples were analysed for chloride, conductivity, hydrocarbons, pH, sodium absorption ratio (SAR) and total soluble salts.

During the monitoring period, five groundwater monitoring wells were each sampled four times. Samples were analysed for pH, temperature, conductivity, chloride, total dissolved solids, sodium, barium, TPH and BTEX.

1.5.5 Review of analytical results

The Council reviewed soil sampling results and the annual report provided by the operators, Waste Remediation Services Limited (WRS), on 1 September 2014. WRS collected representative pre-disposal samples from individual waste streams prior to disposal, and receiving environment soil samples from all spreading areas post waste application. These samples were sent to an independent IANZ accredited laboratory for analysis for a wider range of contaminants. Chemical parameters tested were (all solid/sludge samples):

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

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

2. Results

2.1 Water

2.1.1 Inspections

8 July 2013

No objectionable odours were detected at the time of inspection; however, hydrocarbon odours were noted down-wind of the storage pits. Two lined pits at the site contained materials and the liners appeared in good condition. Waxy hydrocarbons were observed on the surface of both pits; some liquid oily waste had recently been transferred from the larger pit into the smaller one using a digger bucket, and the liquid portion (mostly accumulated rainwater) was pumped back into the larger pit.

Discussions were held with the site owner with regard to notification and sampling requirements; it was outlined that a representative sample was to be taken when any new waste material was delivered. At the time of inspection, approximately 14 cubic metres was stockpiled at the site. Requirements of spreading activities were also discussed, particularly the condition relating to spreading of materials within one year of being brought onto site. The site owner explained that, as very little mud was present at the site during the time of inspection, it was their intention to delay spreading until more mud had been stockpiled to mix with the liquid oily waste for dilution purposes.

Areas where muds had been previously applied were inspected, with the majority of pasture appearing healthy, but there were a few small areas where regrowth was limited. Some muds were identified within the soil profile and some had migrated to surface. The area had been recently mown and fertilised. The site owner advised the inspecting officer that discussions were being held with a potential site operator and

also the possibility of transferring the resource consent to said operator had been discussed. It was re-iterated to the consent holder / site owner that in the interim it was still essential that all required notifications and sampling occurred.

22 November 2013

A site inspection was conducted in conjunction with soil sampling. Two soils samples were taken from transects in spreading area F1. The storage area was inspected and all pits appeared secured and the liners remained intact. Hydrocarbon odours were noted downwind of the storage pits. The pasture appeared reasonably healthy, but there were a few small patches where the pasture had not taken, close to where the old pits were located. Sampling was difficult because of the consolidated mixed mud layer at approximately 100 mm below ground level.

28 January 2014

An inspection was conducted in conjunction with groundwater and soil sampling. The spreading area had been sown and pasture/crop was approximately knee high with small barren areas. Sampling in the barren patches proved difficult, with a solidified mixed mud layer encountered at approximately 40 mm depth in places.

10 February 2014

No recent disposal activities had occurred. One lined pit was present at the site, with plenty of freeboard available and minimal surface oiling. Areas of pasture where muds had been incorporated into the soil looked good and very little mud was identifiable within the soil profile.

17 February 2014

A site inspection was conducted in conjunction with groundwater sampling. No recent site activity had been undertaken. Oily waste still remained in the dedicated oily waste pit and a substantial amount of mud still remained in the adjacent pit. Barren patches of pasture were still observed in the former spreading area F1.

13 March 2014

Inspection was conducted in conjunction with groundwater and soil sampling. No recent activity was observed at the site. The oily waste pit and mud pit still contained waste.

15 April 2014

No objectionable odours or visible emissions were detected at the time of inspection. Both pits at the site were lined and contained drilling muds. Essentially no surface oils were present, plenty of freeboard was available and the liners appeared in good condition. Areas where muds were previously spread were inspected. The pasture had been cut and was being rolled during the inspection. No muds were visible at the surface, however test pits dug found that muds were clearly identifiable within the soil profile and in some cases were still in palm-sized clumps with slight hydrocarbon/mud odour noted. All material broke apart easily when handled.

Groundwater monitoring at the coastal boundary bore (GND2293) showed elevated levels of chlorides and total dissolved salts (TDS), as per samples obtained on 13 March 2014. The chlorides had risen to 3410 g/m³ and TDS had risen to 7087 g/m³. The TDS consent limit is 2500 g/m³. No hydrocarbon exceedances had been detected within this

groundwater bore. It was outlined to the consent holder that no muds were to be spread until TDS and chloride levels drop to compliant levels.

8 May 2014

Inspection of the site was conducted in conjunction with groundwater sampling. The oily waste pit was still full. Both the SBM/WBM pits were lined and full. A "contingency pit" had been established within the pit storage area. This pit was unlined and contained drilling muds.

13 May 2014

At the time of inspection Contract Resources were onsite unloading WBM into the contingency pit. The tanker driver indicated that the material was water based fluids from washing down the mud tanks on the Southern Cross Well site. The contingency pit was unlined and approximately half full. WRS were contacted (via phone) about the storage of this material, as the understanding was that the pit was supposed to be used for only short term purposes as an overflow contingency pit, not for continued stockpiling of muds. Findings were referred to Council management to determine if further action was required.

27 May 2014

Two lined pits at the site were nearly full of muds and rainwater. Liquid was being pumped from the first pit to the second pit. The first pit had had two concrete pads installed for vehicle access for unloading. Works were being undertaken on the first pit liner to raise the height of the walls, increasing capacity and improving bunds. Muds were being delivered into the first pit during the inspection; this operation appeared to be well managed. A third pit had been dug at the site, it was outlined that it was a contingency pit and was to be emptied as the first two pits were landfarmed in the near future. Plenty of space was available within the contingency pit, and the entry wall had a plastic liner installed to prevent scour. It was outlined that the pit was likely to be clay lined once it had been emptied. A bull dozer was onsite and had begun to strip back an area of topsoil southwest of the site in preparation for contouring works prior to receiving muds.

3 June 2014

An inspection was conducted in conjunction with additional groundwater sampling of bore GND2293, which had been shown to be in breach of the consent limit for dissolved solids. The site had been back to full operation, with all lined pits full of mud/waste. A new spreading area (seaward side of the site) had been established with topsoil removed in preparation for spreading activities.

11 June 2014

An inspecting officer visited the site and confirmed that no significant spills of material had occurred from a self-reported incident. On 10 June 2014 WRS advised the Council (via phone) of a safety incident at the Waikaikai landfarm site where a tractor towing a full 'honey cart' trailer of mud attempting to complete spreading activities had rolled while driving down the access track in poor weather conditions. No injuries were reported, however some equipment sustained damage. No material had been spilled and no environmental impacts were noted.



Photo 1 Crop growth within spreading area F1, looking north-east towards the pit storage area, on 28 January 2014

2.2 Results of discharge monitoring

There was a single disposal during the 2013-2014 monitoring period of approximately 1,200 m³ of predominantly water based cuttings and fluids from Southern Cross wellsite, Cheal-B (9) wellsite and Waihapa Production Station. The waste was spread at the 100 mm depth rate over an area of approximately 12,000 m² (Area A1, Figure 2). This disposal started in June 2014, and was completed in July 2014.

The consent holder is required to track and record all discharges under the resource consent and provide this data as part of their annual report for Council review.

Further details regarding discharges at the site are provided in the supplied report, attached in Appendix II.

2.3 Results of receiving environment monitoring

2.3.1 Council soil results

During the monitoring year, six composite soil samples were collected by sub-sampling along transects at 10 m intervals to a depth of 250mm in completed spreading area F1 (Figure 3) . The results are presented below in Table 2.

The Council soil sample results show compliance with application consent limits for the F1 area sampled. The initial results did not yet meet surrender limits for transect 1 for chloride, conductivity and total soluble salts (in bold). These limits apply only at the time of consent surrender or expiry, and not at time of application or during biodegradation. This transect was located in the area where the pits were previously located. Salinity parameters are expected to reduce relatively rapidly through leaching and dilution, and this process is already demonstrably occurring. Hydrocarbon concentrations were shown to be already low in all samples, as were sodium absorption ratios.

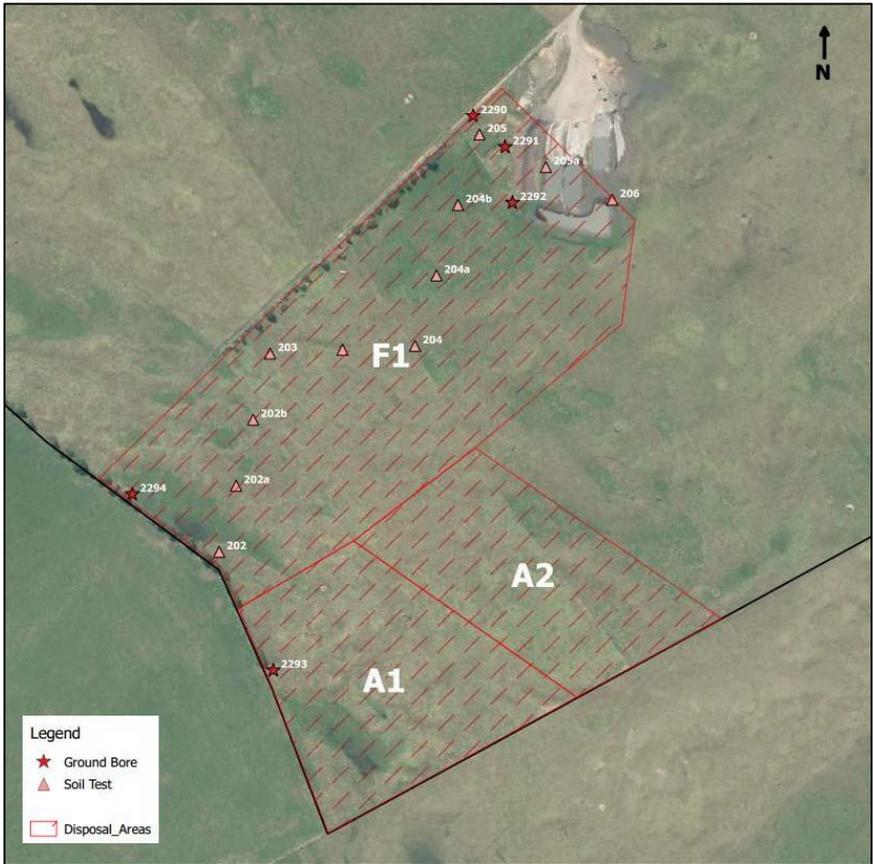


Figure 2 WRS supplied site map showing previously spread and completed area F1, future spreading area A2, and area A1 which was spread in the 2013-2014 monitoring period

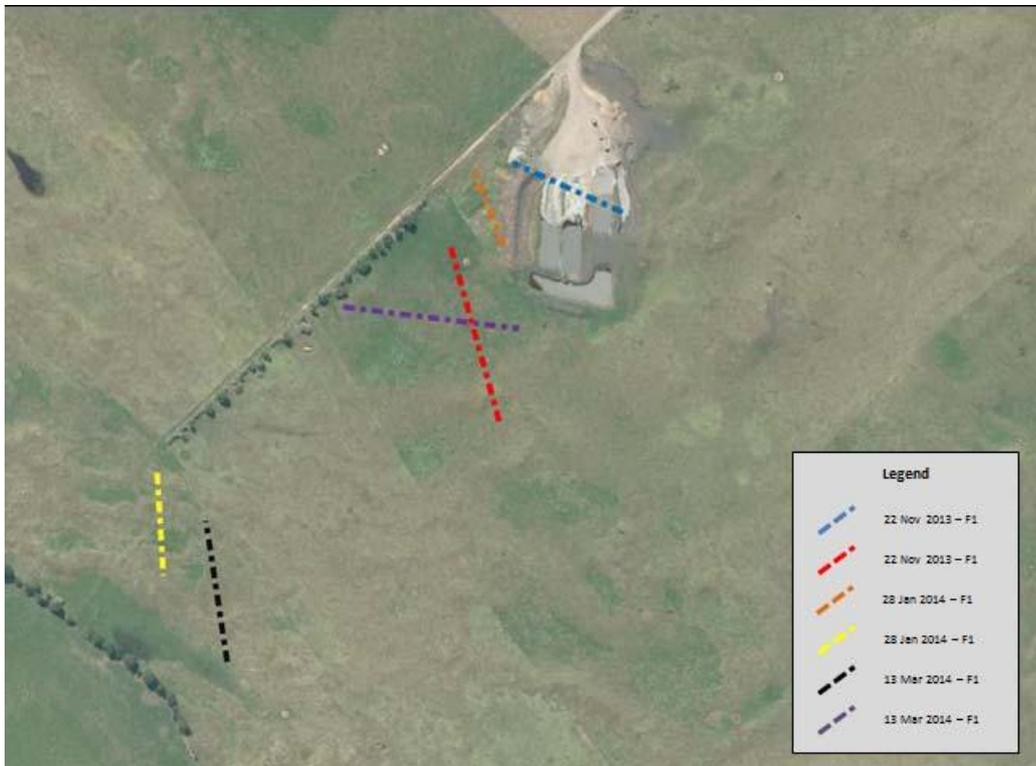


Figure 3 Council soil sampling transect locations at the Waikaikai Landfarm during the 2013-2014 monitoring period

Table 2 Council soil sample results obtained from Waikaikai Landfarm during the 2013-2014 monitoring period

Parameter	Unit	22 Nov 2013 <i>F1</i>	22 Nov 2013 <i>F1</i>	28 Jan 2014 <i>F1</i>	28 Jan 2014 <i>F1</i>	13 Mar 2014 <i>F1</i>	13 Mar 2014 <i>F1</i>
Calcium	mg/kg	277	219	121	236	105	221
Chloride	mg/kg DW	816	321	32.7	12.6	29.2	380
Conductivity	mS/m@20C	370	208	84.2	133	65.0	244
Hydrocarbons	mg/kg DW	100	320	40	68	27	120
Magnesium	mg/kg	34.4	28.2	18.2	28.7	15.7	23.8
Moisture factor	-	1.070	1.139	1.078	1.128	1.032	1.046
pH	pH	7.7	7.8	7.4	7.1	6.8	7.4
Sodium absorption ratio	-	1.84	1.09	0.31	0.29	0.34	1.35
Sodium	mg/kg	122	64.6	13.8	18.3	14.0	79.2
Total soluble salts	mg/kg	2895.6	1627.8	658.9	1040.9	508.7	1909.5

2.3.2 Council groundwater results

During the 2013-2014 monitoring period, quarterly groundwater sampling was conducted from five groundwater monitoring bores at the Waikaikai landfarm site, as shown in Figure 4. The results for each of the bores are presented in Tables 3 to 7.

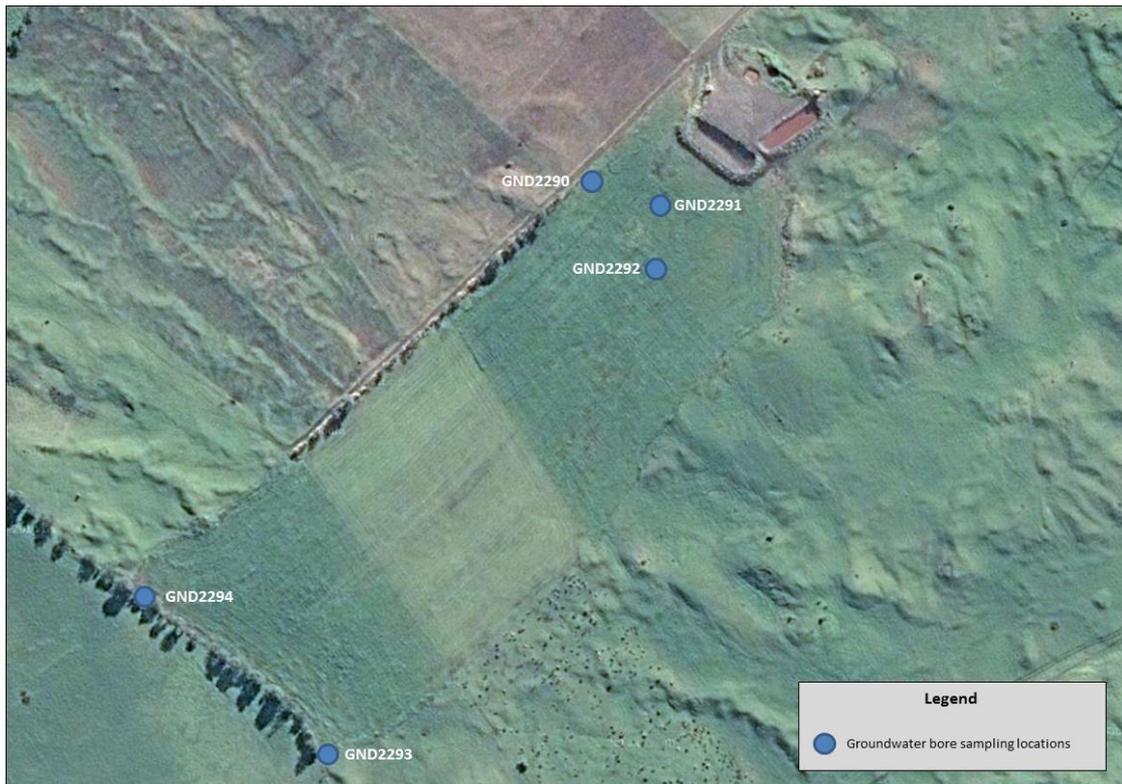


Figure 4 Groundwater monitoring bore sampling sites at Waikaikai Landfarm

Table 3 Groundwater monitoring results from bore GND2290, Waikaikai Landfarm during the 2013-2014 monitoring period

Parameter	Unit	28 Jan 2014	13 Mar 2014	08 May 2014
Benzene	g/m ³	<0.0010	<0.0010	<0.010
Toluene	g/m ³	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m ³	<0.0010	<0.0010	<0.0010
meta-Xylene	g/m ³	<0.002	<0.002	<0.002
ortho-Xylene	g/m ³	<0.0010	<0.0010	<0.0010
Hydrocarbons	g/m ³	<0.7	<0.7	<0.7
C7-C9	g/m ³	<0.10	<0.10	<0.10
C10-C14	g/m ³	<0.2	<0.2	<0.2
C15-C36	g/m ³	<0.4	<0.4	<0.4
Barium (acid soluble)	g/m ³	0.042	0.052	0.068
Barium (dissolved)	g/m ³	-	0.049	-
Chloride	g/m ³	72.4	75.4	77.9
Conductivity	mS/m@20C	43.3	47.5	48.3
pH	pH	6.8	7.0	6.7
Sodium	g/m ³	-	-	29.6
Static water level	m	4.350	3.591	3.288
Temperature	Deg.C	15.1	15.9	15.6
Total dissolved solids	g/m ³	335.0	367.5	373.7

Table 4 Groundwater monitoring results from bore GND2291, Waikaikai Landfarm during the 2013-2014 monitoring period

Parameter	Unit	28 Jan 2014	17 Feb 2014	13 Mar 2014	08 May 2014
Benzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Toluene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
meta-Xylene	g/m ³	<0.002	<0.002	<0.002	<0.002
ortho-Xylene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbons	g/m ³	<0.7	<0.7	<0.7	<0.7
C7-C9	g/m ³	<0.10	<0.10	<0.10	<0.10
C10-C14	g/m ³	<0.2	<0.2	<0.2	<0.2
C15-C36	g/m ³	<0.4	<0.4	<0.4	<0.4
Barium (acid soluble)	g/m ³	0.30	-	0.20	0.24
Barium (dissolved)	g/m ³	-	27.7	0.009	-
Chloride	g/m ³	49.8	5120	47.0	90.2
Conductivity	mS/m@20C	40.2	394	39.0	50.5
pH	pH	6.4	6.5	6.6	6.2
Sodium	g/m ³	-	-	-	39.4
Static water level	m	5.135	5.287	5.464	5.310
Temperature	Deg.C	15.2	16.8	15.7	15.4
Total dissolved solids	g/m ³	311.0	3048.4	301.7	390.7

Table 5 Groundwater monitoring results from bore GND2292, Waikaikai Landfarm during the 2013-2014 monitoring period

Parameter	Unit	28 Jan 2014	17 Feb 2014	13 Mar 2014	08 May 2014
Benzene	g/m ³	-	-	<0.0010	<0.0010
Toluene	g/m ³	-	-	<0.0010	<0.0010
Ethylbenzene	g/m ³	-	-	<0.0010	<0.0010
meta-Xylene	g/m ³	-	-	<0.002	<0.002
ortho-Xylene	g/m ³	-	-	<0.0010	<0.0010
Hydrocarbons	g/m ³	-	-	<0.7	<0.7
C7-C9	g/m ³	-	-	<0.10	<0.10
C10-C14	g/m ³	-	-	<0.2	<0.2
C15-C36	g/m ³	-	-	<0.4	<0.4
Barium (acid soluble)	g/m ³	-	-	0.63	0.67
Barium (dissolved)	g/m ³	-	-	0.11	-
Chloride	g/m ³	-	-	374	522
Conductivity	mS/m@20C	25.5	-	134	158
pH	pH	-	-	6.5	6.2
Sodium	g/m ³	-	-	-	108
Static water level	m	5.185	5.364	5.564	5.268
Temperature	Deg.C	-	-	15.7	15.6
Total dissolved solids	g/m ³	197.3	-	1036.8	1222.5

Table 6 Groundwater monitoring results from bore GND2293, Waikaikai Landfarm during the 2013-2014 monitoring period

Parameter	Unit	28 Jan 2014	17 Feb 2014	13 Mar 2014	15 May 2014	03 Jun 2014
Benzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Toluene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
meta-Xylene	g/m ³	<0.002	<0.002	<0.002	<0.002	<0.002
ortho-Xylene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbons	g/m ³	<0.7	<0.7	<0.7	<0.7	<0.7
C7-C9	g/m ³	<0.10	<0.10	<0.10	<0.10	<0.10
C10-C14	g/m ³	<0.2	<0.2	<0.2	<0.2	<0.2
C15-C36	g/m ³	<0.4	<0.4	<0.4	<0.4	<0.4
Barium (acid soluble)	g/m ³	0.92	-	1.2	0.50	0.73
Barium (dissolved)	g/m ³	-	1.5	1.2	-	0.38
Chloride	g/m ³	2920	3110	3410	3130	2560
Conductivity	mS/m@20C	718	847	916	839	748
pH	pH	6.4	6.5	6.6	6.3	6.3
Sodium	g/m ³	-	-	-	451	418
Static water level	m	1.915	2.056	2.207	1.880	1.926
Temperature	Deg.C	15.4	15.7	16.8	15.0	15.3
Total dissolved solids	g/m ³	5555.2	6553.3	7087.2	6491.4	5787.4

Table 7 Groundwater monitoring results from bore GND2294, Waikaikai Landfarm during the 2013-2014 monitoring period

Parameter	Unit	28 Jan 2014	17 Feb 2014	13 Mar 2014	08 May 2014	15 May 2014
Benzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010	-
Toluene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010	-
Ethylbenzene	g/m ³	<0.0010	<0.0010	<0.0010	<0.0010	-
meta-Xylene	g/m ³	<0.002	<0.002	<0.0010	<0.002	-
ortho-Xylene	g/m ³	<0.0010	<0.0010	<0.002	<0.0010	-
Hydrocarbons	g/m ³	<0.7	<0.7	<0.7	<0.7	-
C7-C9	g/m ³	<0.10	<0.10	<0.10	<0.10	-
C10-C14	g/m ³	<0.2	<0.2	<0.2	<0.2	-
C15-C36	g/m ³	<0.4	<0.4	<0.4	<0.4	-
Barium (acid soluble)	g/m ³	0.016	-	0.026	-	0.032
Barium (dissolved)	g/m ³	-	0.035	0.017	-	-
Chloride	g/m ³	41.4	42.0	42.0	-	41.6
Conductivity	mS/m@20C	29.4	30.1	30.0	-	29.3
pH	pH	7.2	7.2	7.3	-	7.0
Sodium	g/m ³	-	-	-	-	30.6
Static water level	m	2.460	2.575	2.672	2.395	2.43
Temperature	Deg.C	15.2	15.8	15.1	-	14.6
Total dissolved solids	g/m ³	227.5	232.9	232.1	-	226.7

No hydrocarbon contaminants have been detected in any of the samples. Bores GND2290 and GND2294 have shown no impacts from site activities. The February sample from Bore GND2291 gave anomalous (contradictory) results for dissolved barium, chloride, and conductivity. The results have been presented as provided, but should be interpreted only with caution, and it should be noted that subsequent sampling does not indicate any on-going effect in any case.

The groundwater sampling device got stuck in bore GND2292 in January 2014, preventing a sample from being collected and analysed in January and February 2014. Sampling of this bore resumed in March 2014

Bore 2292 will require ongoing close attention as the salinity parameters are starting to increase. TDS in this bore has increased from 197 g/m³ in January to 1,222 g/m³ in May, which remains compliant with the consent limit (2,500 g/m³), but will need to be monitored closely in the 2014-2015 monitoring period. Bore GND2293 has clearly shown the impacts of the 2012 landfarming of spreading area F1, with a noticeable increase in salinity parameters with chloride concentrations significantly above background levels, and TDS more than double the consented limit for that parameter.

The TDS concentration appears to have peaked and be reducing in the later samples; this will need to be closely monitored in the 2014-2015 monitoring period.

2.4 Review of analytical results

Waste Remediation Services Limited (WRS) supplied receiving environment soil results during the monitoring year. WRS collected 2 composite samples from spreading area F1. Their results are compliant with all application and surrender limits for all

parameters, and generally, contaminant concentrations are very low. At the time of reporting, the area 'A' had just been completed and sample results were not available.

Their results are included in the supplied report in Appendix II.

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 courses of non-compliance or failure to maintain good practices. A pro-active approach that in the first instance avoids issues occurring is favoured.

The Taranaki Regional Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The Unauthorised Incident Register (UIR) includes events where the company concerned has itself notified the Council. The register contains details of any investigation and corrective action taken.

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

In the 2013-2014 period, one incident was recorded against the site and abatement notice EAC-20298 was issued.

In April 2014, shortly after stockpiling activities resumed at the site, WRS contacted the Council via telephone to advise that due to a combination of the delivery of excess mud (relative to original estimates) and heavy rainfall events, storage capacity had been reached in lined pits 1 and 2. The Company proposed to construct a temporary unlined overflow pit as a contingency measure to deal with increasing fluid (mud and rainwater) volumes, to be followed by reconstruction of the lined pit (to increase capacity) and eventually landfarming of the stored wastes once weather conditions allowed. The Company were advised that the preference was to pump off and irrigate rain water from the pits to lower the level, but if there was a danger of pit overflow, a contingency pit could be used temporarily until further action could be undertaken by the Company.

WRS constructed pit 3 and used this to hold some water based muds and rainwater during the period of delivery of muds to the site. The Company informed the Council that further material would not be stockpiled in this pit.

During a site inspection conducted on 13 May 2014, Council staff observed a transport contractor unloading additional muds and water into pit 3, which was not in line with the information that had been received from the site operator.

This inspection record was passed on to the Council's Inspectorate Section and an incident was recorded against the site. A 14 day 'please explain' letter was issued to the

consent holder, who provided a reasonable explanation, detailing the circumstances that led to the incident. However, the site operator was well aware of pit lining requirements, and a follow-up inspection indicated the pit was receiving mud and washings after the period of drilling the operator had specified in their notification to Council.

An abatement notice was issued to the consent holder instructing the operators to remove all material from pit 3 and clean the pit out. It was communicated to the operator that this pit would need to either be reinstated or, if the intention was to use this pit again in the future, it would require lining prior to receiving waste. Re-inspection of the site confirmed that the material had been removed from the pit and spread in area A, but the pit remains on site and is collecting rainwater. It is recommended that in the following monitoring year that the operator either reinstates or lines the pit to make it fit for purpose. A recommendation to this effect is given in Section 4.



Photo 2 Discharge of mud tank washings into pit 3, Waikaikai landfarm

3. Discussion

3.1 Discussion of site performance

During the previous monitoring period the Council had been required to intervene in site operations following non compliances by the previous site operator Redback Contracting. Redback Contracting was removed as the site operator, and the consent holder was informed (as recorded in the previous annual report) that he would have to engage a competent site operator prior to resumption of stockpiling/landfarming activities at the site. The site therefore remained in a state of inactivity until April 2014 when WRS were employed to run the site on behalf of the consent holder. Since this time there has been one incident, which resulted in the issuing of an abatement notice. This incident was more operational than environmental in nature, but could have easily led to adverse impacts on site groundwater and should have been avoided, especially in light of the previous site operator's practices for which enforcement action was undertaken in the previous monitoring period. The operator has made some site improvements to sight signage, safety and housekeeping. However, further improvement is required in the reporting formatting and in general site management.

The reporting format used for the supply of information requires improvement. This has been communicated to the site operator and a recommendation to this effect is given in Section 4.

3.2 Environmental effects of exercise of consents

Monitoring indicates that there appears to be less than minor adverse environmental effects on soils due to activities at the site. Levels of contaminants in the surface soil are compliant with the limits given in the consent. Heavy metals and hydrocarbons are well within guideline values set for agricultural land use, and salinity related parameters are returning to normal levels after some initial high salt levels detected in the previous monitoring period.

Groundwater in one of the bores has shown minor impacts and remains non-compliant, with a significantly high level in salinity parameters, likely related to the spreading that took place in October 2012. These concentrations appear to be reducing, which will be confirmed by ongoing groundwater monitoring. No hydrocarbon contaminants have been detected in any of the groundwater samples to date.

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 8.

During the period under review, there was one incident recorded against the site and subsequently one abatement notice issued to the consent holder, in respect of deficiencies in notification and non-conformity with information provided. The site operator made some improvements to site operations, but several improvements will need to be made in the next monitoring year around reporting and sampling.

Table 8 Summary of performance for Consent 5956-1 to discharge drilling wastes from hydrocarbon exploration and production activities, and oily wastes from wellsites, onto and into land via landfarming

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Definitions of material, stockpiling and landfarming	N/A	N/A
2. Exercise in accordance with application documentation	Inspection, sampling and liaison with consent holder	Yes
3. Adoption of best practicable option	Inspection, sampling and liaison with consent holder	No
4. Notify TRC 48 hours prior to transfer of waste to disposal site	Notifications received	Yes
5. Notify TRC 48 hours prior to landfarming wastes	Notifications received	Yes
6. The consent holder shall sample for the following: a) Total Petroleum Hydrocarbons b) Benzene, toluene, ethylbenzene, xylenes c) Polycyclic aromatic hydrocarbons d) Chloride, nitrogen, pH, potassium, sodium	Sampling	Yes
7. Keep records relating to wastes, areas, compositions, volumes, dates, treatments and monitoring	Company records	Yes
8. Report on records in condition 7 to Council by 31 August each year	2013-2014 report received 1 September 2014	Yes (1 day late)
9. No discharge within 25m of surface water	Inspection	Yes
10. Discharge of hydraulic fracturing fluids is prohibited	Inspection, sampling, records	Yes
11. Oily wastes to be stored in a tank or lined pit or mixed with WBM	Inspection	Yes
12. All wastes must be landfarmed within 12 months of arrival onsite	Company records and inspection	No
13. Maximum application thickness for solid wastes: a) 100 mm TPH <5% b) 50mm TPH >5%	Company records and sampling	Yes
14. Liquid wastes to be applied in a manner that prevents overland flow and ponding	Inspection	Yes
15. Incorporation into soil as soon as practicable to a depth of at least 250mm	Inspection and sampling	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
16. Hydrocarbon concentration to not exceed 50,000 mg/kg following application	Sampling	Yes
17. Any area of land used for the landfarming of wastes shall not be used for any subsequent discharges of waste	Company records and inspections	Yes
18. Re-vegetate landfarmed areas as soon as practicable	Company records and inspections	Yes
19. Total dissolved salts in any fresh water body shall not exceed 2500g/m ³	Sampling	No
20. Consent shall not lead or be liable to lead to contaminants entering a surface water body.	Inspections and sampling	Yes
21. Activities shall not result in any adverse impacts on groundwater or surface water	Inspections and sampling	No
22. Conductivity must be less than 400 mSm ⁻¹ . If background soil has a conductivity greater than 400 mSm ⁻¹ , then conductivity after disposal shall not exceed original conductivity by more than 100 mSm ⁻¹	Sampling	Yes
23. Sodium absorption ratio [SAR] must be less than 18.0, if background SAR exceeds 18.0 then increase shall not exceed 1.0	Sampling	Yes
24. Concentrations of heavy metals in the soil shall at all times comply with MfE guidelines	Sampling	Yes
25. Prior to expiry/cancellation of consent these levels must not be exceeded: a) conductivity, 290 mSm ⁻¹ b) chloride, 700 g/m ³ c) dissolved salts, 2500 g/m ³ d) sodium, 460 g/m ³	Not applicable – sampling prior to surrender of consent	N/A
26. Consent cannot be surrendered until standards in condition 25 have been met	Not applicable	N/A
27. Notification of discovery of archaeological remains	Not applicable – none found	N/A
Overall assessment of environmental performance in respect of this consent Overall assessment of administrative compliance in respect of this consent	Improvement required Improvement required	

Ongoing effects on groundwater have been detected in at least one of the bores; while this can likely be attributed to poor stockpiling and spreading practices in the previous monitoring period, the effects of it have remained apparent throughout the current monitoring period.

Overall, the consent holder demonstrated an 'improvement required' level of environmental performance and an 'improvement required' level of consent compliance. The incident that occurred in respect of resource consent 5956-1 has been discussed in section 2.5.

3.4 Recommendations from the 2011-2013 Biennial Report

In the 2011-2013 Biennial Report, it was recommended:

1. THAT the monitoring programme for the Waikaikai Farms Limited site in the 2013-2014 year, remain unchanged from that for 2011-2013 monitoring period.
2. THAT prior to the resumption of any further activity at this site, the Company engages a competent site management team.
3. THAT the Company reviews their recording and reporting procedures to ensure accuracy in reporting as per the conditions of their consent.

Recommendations 1 and 2 were implemented, but the report received from the operator for the 2013-14 year requires improvement, which has been communicated to the site operator.

3.5 Alterations to monitoring programmes for 2014-2015

In designing and implementing the monitoring programmes for air/water discharges in the region, the Taranaki Regional Council has taken into account the extent of information made available by previous authorities, its relevance under the RMA the obligations of the Act in terms of monitoring emissions/ discharges and effects, and subsequently 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 emitting to the atmosphere/ discharging to the environment.

It is proposed that for 2014-2015 the monitoring programme for the Waikaikai Farms Limited site remains unchanged from that for the 2013-2014 monitoring period. A recommendation to this effect is attached to this report

4. Recommendations

1. THAT the monitoring programme for the Waikaikai Farms Limited site in the 2014-2015 year, remains unchanged from that for 2013-2014 monitoring period.
2. THAT the consent holder reviews the reporting format for supply of annual data.
3. THAT the consent holder lines or reinstates pit 3.
4. THAT the consent holder disposes of or removes the oily waste stockpiled for over 12 months, as per condition 12 of the resource consent, now that the site is again actively receiving muds for disposal.

Glossary of common terms and abbreviations

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

Al*	Aluminium.
As*	Arsenic.
Biomonitoring	Assessing the health of the environment using aquatic organisms.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODF	Biochemical oxygen demand of a filtered sample.
Bund	A wall around a tank to contain its contents in the case of a leak.
CBOD	Carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate.
cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
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.
E.coli	Escherichia coli, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Ent	Enterococci, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre of sample.
F	Fluoride.
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
g/m ³	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
l/s	Litres per second.

MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
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.
PM ₁₀	Relatively fine airborne particles (less than 10 micrometre diameter).
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	<i>Resource Management Act</i> 1991 and including all subsequent amendments.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.
UIR	Unauthorised Incident Register – contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
Zn*	Zinc.

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

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

Bibliography and references

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

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

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

Taranaki Regional Council (2014): Waikaikai Farms Ltd Drilling Waste Disposal Monitoring Programme Annual Report 2012-2013. Technical Report 2013-68.

Appendix I

Resource consent held by Waikaikai Farms Limited

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

Name of
Consent Holder: Waikaikai Farms Limited
 [Peter Frank & Karen Mary Wards]
 78 Lower Manutahi Road
 R D 2
 PATEA 4598

Decision Date 13 October 2011
[Change]:

Commencement 13 October 2011 [Granted: 22 March 2002]
Date [Change]:

Conditions of Consent

Consent Granted: To discharge drilling wastes from hydrocarbon exploration
 and production activities, and oily wastes from wellsites,
 onto and into land via landfarming at or about (NZTM)
 1719720E-5605515N

Expiry Date: 1 June 2016

Site Location: Lower Manutahi Road, Manutahi

Legal Description: Lots 1, 2 & 4 DP 7139 Lots 2 & 12 DP 14551 Sec 742
 Patea Dist Blk I Carlyle SD [Discharge site]

Catchment: Mangaroa

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

General conditions

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

Special conditions

1. 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 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) 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.
 - d) 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. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of applications 1706, 2213, 3980 and 6894. In the case of any contradiction between the documentation submitted in support of applications 1706, 2213, 3980 and 6894, and the conditions of this resource consent, the conditions of this resource consent shall prevail.
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.

Notifications, monitoring and reporting

4. 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.

5. The consent holder shall notify the Chief Executive, Taranaki Regional Council, [by emailing worknotification@trc.govt.nz.] at least 48 hours prior to landfarming wastes. 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 landfarmed;
 - d) the volume of the waste to be landfarmed;
 - e) the concentration of hydrocarbons in the waste; and
 - f) the specific location and area over which the waste will be landfarmed.

6. 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; and
 - d) chloride, nitrogen, pH, potassium, and sodium.

7. The consent holder shall keep records of the following:
 - a) composition of wastes;
 - b) storage area[s];
 - c) volumes of material stored;
 - d) landfarming area[s], including a map showing individual disposal areas with GPS co-ordinates;
 - e) volumes and weights of wastes landfarmed;
 - f) dates of commencement and completion of storage and landfarming events;
 - g) dates of sowing landfarmed areas;
 - h) photographic evidence of pasture establishment;
 - i) treatments applied;
 - j) details of monitoring, including sampling locations, sampling methods and the results of analysis;

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

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

Waste types and waste storage

9. No discharge shall take place within 25 metres of surface water or property boundaries.
10. The discharge of hydraulic fracturing fluids is prohibited.
11. Liquid oily wastes shall be either:
 - a) stored in a tank, or in a pit with an impermeable synthetic liner; or
 - b) mixed directly into a pit containing a suitable volume of water based mud waste, in a manner that prevents the liquid oily wastes entering the ground.
12. All wastes must be landfarmed as soon as practicable, but no later than twelve months after being brought onto the site.

Discharge limits

13. 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.
14. 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.
15. As soon as practicable following the application of solid wastes to land, the consent holder shall incorporate the wastes into the soil to a depth of at least 250 mm.
16. The hydrocarbon concentration in the soil over the landfarming area shall not exceed 50,000 mg/kg dry weight at any point where:
 - a) liquid waste has been discharged; or
 - b) solid waste has been discharged and incorporated into the soil.
17. Any areas of land used for the landfarming of wastes in accordance with conditions 13-15 of this consent, shall not be used for any subsequent discharges of waste
18. As soon as practicable following landfarming, areas shall be sown into pasture [or into crop]. The consent holder shall monitor revegetation and if adequate establishment is not achieved within two months of sowing, shall undertake appropriate land stabilisation measures to minimise wind and stormwater erosion.

Receiving environment limits - water

- 19. The exercise of this consent shall not result in a level of total dissolved salts within any surface or groundwater of more than 2500 gm⁻³.
- 20. 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.
- 21. 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 environment limits - soil

- 22. The conductivity of the soil/waste layer after application shall be less than 400 mSm⁻¹, or alternatively, if the background soil conductivity exceeds 400 mSm⁻¹, the landfarming of waste shall not increase the soil conductivity by more than 100 mSm⁻¹.
- 23. The sodium absorption ratio [SAR] of the soil/waste layer after landfarming shall be less than 18.0, or alternatively if the background soil SAR exceeds 18.0, the landfarming of waste shall not increase the SAR by more than 1.0.
- 24. The concentration of metals in the soil shall at all times comply with the guidelines for heavy metals in soil set out in Table 7.1, Section 7 of the Ministry for the Environment and New Zealand Water & Wastes Association’s Guidelines for the safe application of biosolids to land in New Zealand [2003].
- 25. From 1 March 2016 [three months prior to the consent expiry date], constituents in the soil shall not exceed the standards shown in the following table:

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

MAHs - benzene, toluene, ethylbenzene, xylenes
 PAHs - naphthalene, non-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 2016, the consent holder applies for a new consent to replace this consent when it expires, and that application is not subsequently withdrawn.

26. This consent may not be surrendered at any time until the standards in condition 25 have been met.

Archaeological remains

27. 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.

Signed at Stratford on 13 October 2011

For and on behalf of
Taranaki Regional Council

Director-Resource Management

Appendix II

Supplied annual report

26th August 2014

Consents Manager
Taranaki Regional Council
Private Bag 713
47 Cloten Road
Stratford

Attention Colin McLellan

RE: Resource Consent 5956-1
Waikaikai (Wards)
78 Lower Manutahi Road
RD 2, Patea

Dear Colin

As required under special condition 8 of resource consent 5956-1, please find all information that WRS, as the new operator of the site, have been able to obtain related to disposal activities undertaken from the 1 July 2013 to the 30th July 2014. Although the consent remains in the name of the property owners Waikaikai Farms Ltd, WRS took over operation of the site from approx late April 2014. At that time all three pits were approx 80% full with drilling mud and cuttings that had been placed in storage over the previous 12 months from a variety of sources. Since late April WRS has records of mud, drilling and production station wastes being placed into storage in the three lined pits (two of approx 500m³ each and a small oily waste pit of some 20m³). At the close of the reporting period on 31 July all three pits were in the process of being emptied and wastes spread.

Earlier in the year with land farming available acreage in the province severely limited by legal action at one site and contractual matters at some of the other sites, WRS took a decision to construct a clay lined contingency pit that could, if necessary, be used for temporary storage if capacity became limited.. In May drilling wastes volumes peaked and it was necessary for WRS to use the contingency pit for a few weeks until contractors became available, acreage could be prepared for spreading and the pond emptied. Apart from the accumulation of rainwater the pit has been decommissioned pending longer term decisions on its fate.

Information pertaining to resource consent 5956-1 will be provided under the following heading

1) Spread Areas during 2014 –attachment A

Site map showing Area A spread between 02/06-31/07/2014.

2) Delivery Record -attachment B

Copy of the field record of deliveries

3) Field Photographs

As Spread Area A had not been reinstated at the end of June 2104 – no records of pasture development are available.

E) Composition of Wastes/Pre Disposal Analysis - attachment C

Analytical results from RJ Hill Laboratories Ltd of all sampling undertaken during the period.

F) TRC Inspection Notices –

The consent holder has copies of the following inspections (it is not known if this is all the inspections undertaken)

8 July 2013 # B311038718
10 Feb 2014 # B332743210
15 Apr 2014 # B339151945
27 May 2014 # B343353078
3 July 2014 # B348242105

G) Enforcement Action

The consent holder was issued with an abatement notice on 16 June 2014 Doc # 1361659.. This was responded to by the consent holder on 25 June 2014.

H) Operations Management Plan –attachment D

Operations at the Waikaikai land farm are all undertaken generally in accordance with the Waikaikai (Wards) Landfarm Management Plan. The document is a live document and is constantly reviewed and updated as necessary to reflect operational requirements and practices

To summarise

All material stockpiled on the site is sampled prior to arrival on site as once wastes are mixed with other material in the storage pits individual consignments can no longer be characterised if required.

When a sufficient volume of material has been stockpiled requiring spreading to land, an assessment is made of all predisposal results to determine whether a composite sample needs to be taken. If hydrocarbon levels can be estimated without the need for a composite sample, the spread area is designated and landfarming commences.

Monitoring of the landfarm area begins within one month of topsoil being re-applied and pasture planted. As no spreading was completed in the reporting period no post disposal/spreading sampling was undertaken

Specific landfarmed and sampling locations areas are set out and surveyed in by fixed station or hand held GPS methods. These co-ordinates are contained within the Waikaikai (Wards) site records which are updated as spreading and any other works are undertaken.

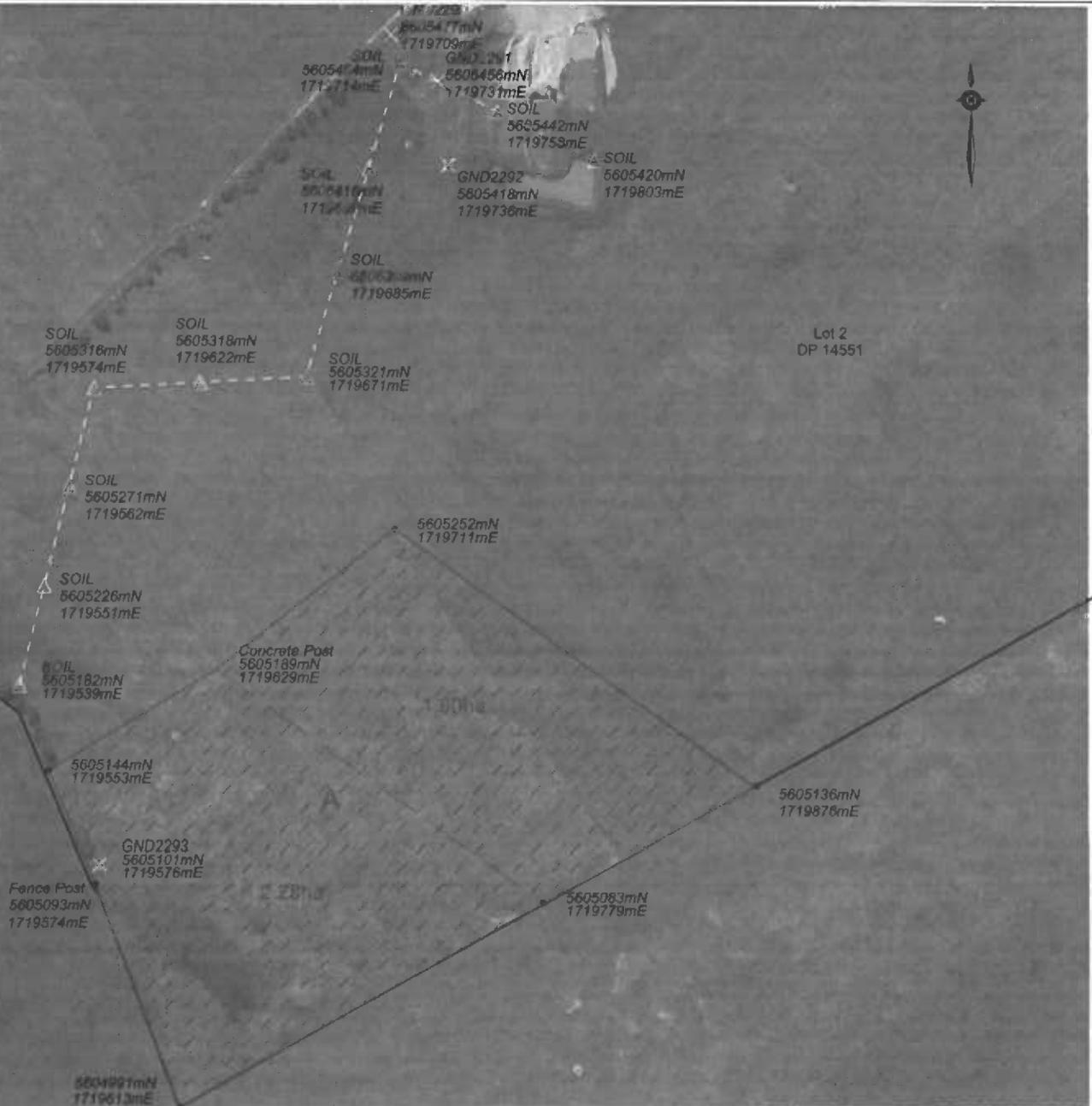
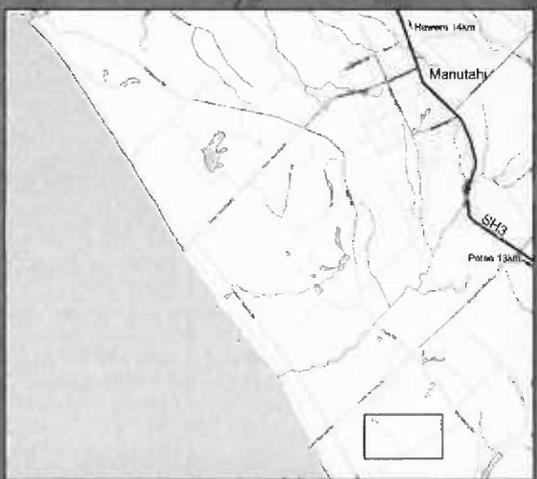
Methods:

All sampling is undertaken as per standard Hill Laboratories sampling protocols. Representative samples are collected from a number of surveyed points and these are aggregated to produce the representative sample that is sent to the laboratory for analysis. Typically samples are retrieved from approximately 250mm depth but this can vary depending on the location of the waste layer and the depth of waste disposal.

Yours truly

Keith Brodie

Waste Remediation Services (WRS) Ltd
PO Box 7150,
New Plymouth



ID	Area (ha)	Case
A	4.18	C14551/14-10/08/14

LEGEND

- Ground Water Monitoring Bores
- Soil Sample Locations

Date	Revision	By	Ver.	App.



GeoSync
Land Surveying & Spatial Solutions

23 Hobson St | New Plymouth 4312
t 08 281 1714 | w geosync.co.nz | e info@geosync.co.nz

Title:	NZTM 2000 coordinates
Notes:	Aerial photography source TRC 2012

Project: Waikaikai (Wards)

Drawn	Signed	Date



WRS
Surveyors

Project No:	14037
Scale:	1 : 2000 (A3)
Drawing No:	14037_01
Rev:	D



ANALYSIS REPORT Page 1 of 1

Client:	Waste Remedation Services Ltd (WRS)	Lab No:	1300854	SPV1
Contact:	Keith Brodie PO Box 77 OAKURA 4345 TARANAKI	Date Registered:	19-Jul-2014	
		Date Reported:	23-Jul-2014	
		Quote No:		
		Order No:		
		Client Reference:		
		Submitted By:	Keith Brodie	

Sample Type: Aqueous					
Sample Name:	Waikakai Pre Disp 31	Manawapou Pre Disp 1	Manawapou Pre Disp 2		
	17-Jul-2014 4:30 pm	17-Jul-2014 5:00 pm	17-Jul-2014 5:05 pm		
Lab Number:	1300854.1	1300854.2	1300854.3		
Total Petroleum Hydrocarbons in Water					
C7 - C9	g/m ³	< 0.15	4.4	< 0.15	-
C10 - C14	g/m ³	< 0.4	16.1	< 0.4	-
C15 - C36	g/m ³	< 0.8	8	< 0.8	-
Total hydrocarbons (C7 - C36)	g/m ³	< 1.4	28	< 1.4	-

Analyst's Comments
Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

SUMMARY OF METHODS

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

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines [KBIs:2803,10734]	0.10 - 0.7 g/m ³	1-3

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.

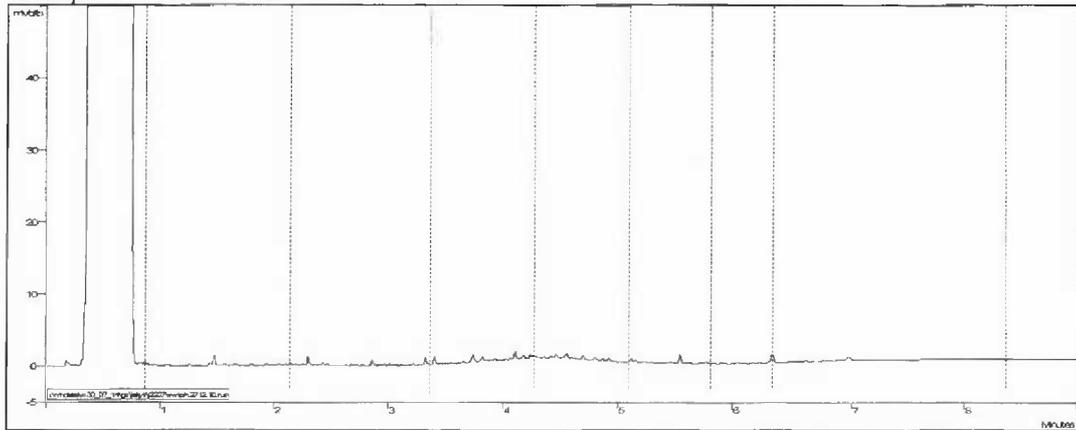
This report must not be reproduced, except in full, without the written consent of the signatory.

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

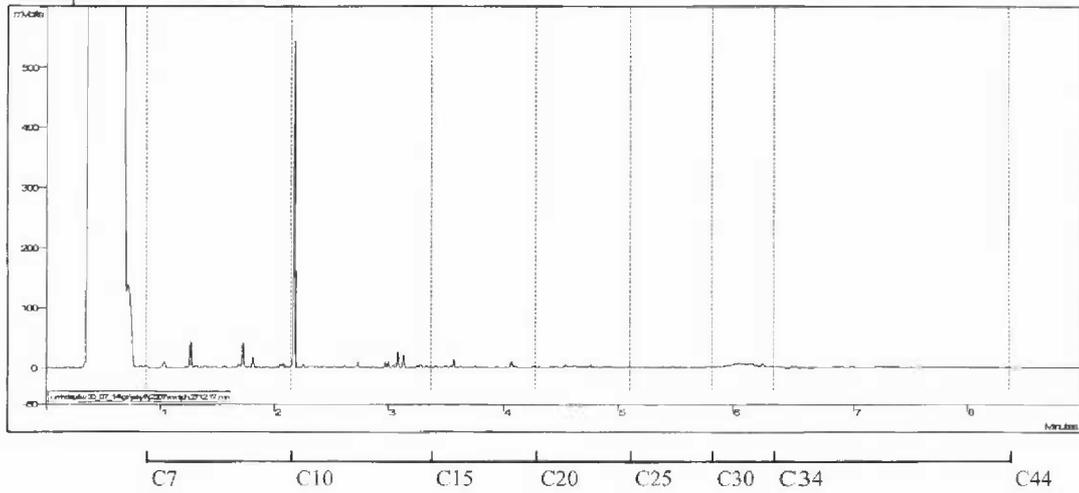


This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised. The tests reported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

Sample : 1300854.1



Sample : 1300854.2





ANALYSIS REPORT

Client: Waste Remediation Services Ltd (WRS)	Lab No: 1286542	SPv2
Contact: Keith Brodie PO Box 77 OAKURA 4345 TARANAKI	Date Registered: 12-Jun-2014	
	Date Reported: 03-Jul-2014	
	Quote No: 61753	
	Order No: WRS - NZEC	
	Client Reference: Pre-disposal Testing (Oily Sl)	
	Submitted By: Keith Brodie	

Sample Type: Sludge		Sample Name:	Waihapa NZEC Sludge Pre-disposal Oily Sludge 10-Jun-2014 3:30 pm	Lab Number:	1286542.1
Individual Tests					
Dry Matter	g/100g as rcvd	100	-	-	-
Total Arsenic*	mg/kg as rcvd	2.9	-	-	-
Total Barium*	mg/kg as rcvd	149	-	-	-
Total Boron*	mg/kg as rcvd	< 30	-	-	-
Total Cadmium*	mg/kg as rcvd	0.22	-	-	-
Total Calcium*	mg/kg as rcvd	31,000	-	-	-
Total Chromium*	mg/kg as rcvd	24	-	-	-
Total Copper*	mg/kg as rcvd	81	-	-	-
Total Lead*	mg/kg as rcvd	54	-	-	-
Total Mercury*	µg/kg as rcvd	1,000	-	-	-
Total Nickel*	mg/kg as rcvd	17.8	-	-	-
Total Potassium*	mg/kg as rcvd	270	-	-	-
Total Sodium*	mg/kg as rcvd	1,700	-	-	-
Total Vanadium*	mg/kg as rcvd	< 50	-	-	-
Total Zinc*	mg/kg as rcvd	310	-	-	-
Chloride*	mg/kg dry wt	890	-	-	-
Chloride*	mg/kg as rcvd	4,100	-	-	-
Total Nitrogen*	g/100g as rcvd	0.15 #1	-	-	-
BTEX in Soil by Headspace GC-MS					
Benzene	mg/kg dry wt	181	-	-	-
Toluene	mg/kg dry wt	620	-	-	-
Ethylbenzene	mg/kg dry wt	90	-	-	-
m&p-Xylene	mg/kg dry wt	670	-	-	-
o-Xylene	mg/kg dry wt	196	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil					
Acenaphthene	mg/kg dry wt	8	-	-	-
Acenaphthylene	mg/kg dry wt	< 3	-	-	-
Anthracene	mg/kg dry wt	< 3	-	-	-
Benzo[a]anthracene	mg/kg dry wt	2	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	3	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	7	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	3	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 3	-	-	-
Chrysene	mg/kg dry wt	4	-	-	-



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

Sample Type: Sludge				
Sample Name:		Wahapa NZEC Sludge Pre-disposal Oily Sludge 10-Jun-2014 3:30 pm		
Lab Number:		1286542.1		
Polycyclic Aromatic Hydrocarbons Screening in Soil				
Dibenzo[a,h]anthracene	mg/kg dry wt	< 3	-	-
Fluoranthene	mg/kg dry wt	8	-	-
Fluorene	mg/kg dry wt	30	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 3	-	-
Naphthalene	mg/kg dry wt	440	-	-
Phenanthrene	mg/kg dry wt	58	-	-
Pyrene	mg/kg dry wt	20	-	-
Total Petroleum Hydrocarbons in Soil As Received				
C7 - C9	mg/kg as rcvd	26,000	-	-
C10 - C14	mg/kg as rcvd	41,000	-	-
C15 - C36	mg/kg as rcvd	195,000	-	-
Total hydrocarbons (C7 - C36)	mg/kg as rcvd	260,000	-	-
Analyst's Comments				
<p>This sample is an oily sludge, so we are unable to report a Total Solids content as there is a loss of hydrocarbons as well as water when the sample is placed in an oven at 105C. The dry matter has thus been set to 100% and results are reported as mg/kg 'as received' rather than mg/kg dry weight as shown in the table.</p> <p>#1 It should be noted that the replicate analyses performed on this sample as part of our in-house Quality Assurance procedures showed greater variation than would normally be expected. This may reflect the heterogeneity of the sample. The average of the results of the replicate analyses has been reported.</p> <p>Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms</p> <p>Appendix No.2 - IPL Laboratory Report</p>				

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
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]	0.010 - 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]	-	1
Total Petroleum Hydrocarbons in Soil As Received	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 as rcvd	1
TPH + PAH + BTEX profile	Sonication extraction, SPE cleanup, GC & GC-MS analysis	0.010 - 0.10 mg/kg dry wt	1
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry, US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1
esiCextn*	(1:5) ratio of sample (g):0.02M potassium dihydrogen ortho-phosphate extractant (mL), analysis by Ion Chromatography. In House.	-	1
Ashing and Aqua Regia digest	Ashing in Muffle furnace, Aqua Regia (HNO ₃ /HCl) digestion .	-	1
Total Arsenic*	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	1
Total Barium*	Aqua Regia Digestion, ICP-MS.	0.2 mg/kg as rcvd	1

Sample Type: Sludge			
Test	Method Description	Default Detection Limit	Sample No
Total Boron*	Aqua Regia Digestion, ICP-MS.	10 mg/kg as rcvd	1
Total Cadmium*	Aqua Regia Digestion, ICP-MS.	0.05 mg/kg as rcvd	1
Total Calcium*	Aqua Regia Digestion, ICP-MS.	50 mg/kg as rcvd	1
Total Chromium*	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	1
Total Copper*	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	1
Total Lead*	Aqua Regia Digestion, ICP-MS.	0.2 mg/kg as rcvd	1
Total Mercury*	Aqua Regia Digestion, reduction with Tin Chloride, analysis by Atomic Fluorescence (PSA Millenium Merlin). Subcontracted to IPL Ltd. ANC 010 - Method for the Determination of Ultra Trace Mercury in Hydrocarbon by Millenium Merlin.	20 µg/kg as rcvd	1
Total Nickel*	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	1
Total Potassium*	Aqua Regia Digestion, ICP-MS.	50 mg/kg as rcvd	1
Total Sodium*	Aqua Regia Digestion, ICP-MS.	20 mg/kg as rcvd	1
Total Vanadium*	Aqua Regia Digestion, ICP-MS.	50 mg/kg as rcvd	1
Total Zinc*	Aqua Regia Digestion, ICP-MS.	2 mg/kg as rcvd	1
Chloride*	Ion Chromatography determination of es potassium phosphate extraction.	3 mg/kg dry wt	1
Total Chloride in Oil*	Determination using Titraclor-c, used oil quantification kit.	50 mg/kg as rcvd	1
Total Nitrogen*	Catalytic Combustion (900°C, O ₂), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g as rcvd	1

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

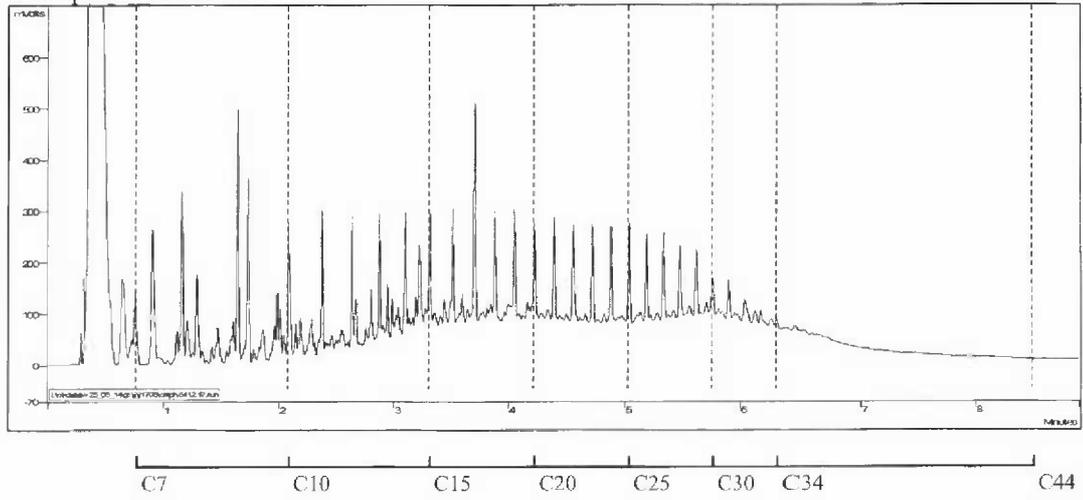
Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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Martin Cowell - BSc
Client Services Manager - Environmental Division

Sample : 1286542.1





Laboratory Test Report 140620

Customer: Graham Corban

Copy to:

Address: Hill Laboratories
1 Clyde Street
Private Bag 3205
Hamilton East Hamilton

Purchase Order: 138855

Customer Ref: 1286542/1

E-Mail: EnvJobEnquiry@hill-lab.co.nz

Product: Black Sludge

Test Required: Total Mercury

SAMPLES RECEIVED / WORK COMPLETED

One vial of black sludge was received on 18th of June 2014, in a container supplied by Hill Labs.

The sample was sub-contracted for total mercury.

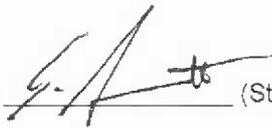
The sample was homogenised and an aliquot digested by closed vial aqua regia digestion (ANC-010) on 19th of June followed by combustion and quantification by hollow cathode absorption spectroscopic analysis (ANC-011).

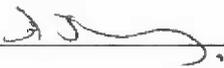
The sample was digested & analysed in duplicate and the averaged result is quoted below.

Estimated limit of quantification for this sample is 3 ppb w/w.

RESULTS

Customer Reference	1286542/1
IPL Sequence No	461876
Mercury Content	1.0 mg/kg (ppm w/w)

Work completed and Reported by:  (Steven Fawcett, *Analytical Technician*) Date: 20/06/2014

Checked by:  (Tony Hockings, *Development Manager*) Date: 20/06/2014

This report relates specifically to the samples as received.
The latest issue of the relevant test methods was used unless otherwise stated.
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K:\Operations\Environmental\Reports\Reports 2014\Mercury\Hills Lab\Hills Hg 140620.docx

Page 1 of 1

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Port Marsden Highway, PO Box 3, Ruakaka 0171, Northland, New Zealand

Phone: +64 9 432 8567 • Fax: +64 9 432 6326 • Email: laboratory@ipl.co.nz • Web: www.ipl.co.nz



ANALYSIS REPORT

Page 1 of 3

Client:	Waste Remedation Services Ltd (WRS)	Lab No:	1286435	shpv1
Address:	PO Box 7150 NEW PLYMOUTH 4341	Date Registered:	11-Jun-2014	
		Date Reported:	19-Jun-2014	
		Quote No:	61678	
		Order No:		
		Client Reference:		
Phone:	06 751 9221	Submitted By:	Keith Brodie	

Analysis		Level Found	Medium Range	Low	Medium	High
pH	pH Units	7.0	5.8 - 6.2			
Olsen Phosphorus	mg/L	27	15 - 25			
Potassium	me/100g	0.87	0.40 - 0.60			
Calcium	me/100g	9.6	4.0 - 10.0			
Magnesium	me/100g	0.67	0.80 - 1.60			
Sodium	me/100g	0.07	0.20 - 0.50			
CEC	me/100g	11	12 - 25			
Total Base Saturation	%	100	50 - 85			
Volume Weight	g/mL	1.47	0.60 - 1.00			
Sulphate Sulphur	mg/kg	24	10 - 12			
Calcium (Sat Paste)*	mg/L	171				
Magnesium (Sat Paste)*	mg/L	24				
Sodium (Sat Paste)*	mg/L	26				
Sodium Absorption Ratio*		0.5				
Base Saturation %		K 7.8 Ca 86 Mg 6.0 Na 0.6				
MAF Units		K 26 Ca 18 Mg 22 Na 5				

The above nutrient graph compares the levels found with reference interpretation levels. NOTE: It is important that the correct sample type be assigned, and that the recommended sampling procedure has been followed. R J Hill Laboratories Limited does not accept any responsibility for the resulting use of this information. IANZ Accreditation does not apply to comments and interpretations, i.e. the 'Range Levels' and subsequent graphs.



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



ANALYSIS REPORT

Page 2 of 3

Client:	Waste Remedation Services Ltd (WRS)	Lab No:	1286435	shpv1
Address:	PO Box 7150 NEW PLYMOUTH 4341	Date Registered:	11-Jun-2014	
		Date Reported:	19-Jun-2014	
		Quote No:	61678	
		Order No:		
		Client Reference:		
Phone:	06 751 9221	Submitted By:	Keith Brodie	

Analyst's Comments

Sample 1 Comment:

The medium range guidelines shown in the histogram report relate to sampling protocols as per Hill Laboratories' crop guides and are based on reference values where these are published. Results for samples collected to different depths than those described in the crop guide should be interpreted with caution.

For pastoral soils, the medium ranges are specific for a 75mm sample depth, but if a 150mm sampling depth is used the nutrient levels measured may appear low against these ranges, as nutrients are typically more concentrated in the top of the soil profile. These soil profile differences are altered upon cultivation or contouring.

Sample 1 Comment:

The low CEC level found in this soil indicates that it can only retain cation nutrients (potassium, calcium, magnesium and sodium) at low levels. The normal ranges and the derived histograms are based on a typical soil with a CEC level between 12 and 25 me/100g. The % base saturation data for each element provides an alternative presentation that may be more appropriate for soils with atypical CEC values. Normal %BS levels, as a general guide, are: K 2%-5%, Ca 50%-75%, Mg 5%-15%, Na 1%-2%.

Sample 1 Comment:

While soil Mg MAF levels of 8-10 are sufficient for pasture production, soil levels of 25-30 are required to ensure adequate Mg content in pasture for animal health (greater than 0.22%).

SUMMARY OF METHODS

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

Sample Type: Soil			
Test	Method Description	Default Detection Limit	Sample No
Sample Registration*	Samples were registered according to instructions received.	-	1
Soil Prep (Dry & Grind)*	Air dried at 35 - 40°C overnight (residual moisture typically 4%) and crushed to pass through a 2mm screen.	-	1
pH	1:2 (v/v) soil:water slurry followed by potentiometric determination of pH.	0.1 pH Units	1
Olsen Phosphorus	Olsen extraction followed by Molybdenum Blue colorimetry.	1 mg/L	1
Sulphate Sulphur	0.02M Potassium phosphate extraction followed by Ion Chromatography.	1 mg/kg	1
Potassium (MAF)	1M Neutral ammonium acetate extraction followed by ICP-OES.	1 MAF units	1
Calcium (MAF)	1M Neutral ammonium acetate extraction followed by ICP-OES.	1 MAF units	1
Magnesium (MAF)	1M Neutral ammonium acetate extraction followed by ICP-OES.	1 MAF units	1
Sodium (MAF)	1M Neutral ammonium acetate extraction followed by ICP-OES.	2 MAF units	1
Calcium (Sat Paste)*	Saturated Paste extraction followed by ICP-OES.	1 mg/L	1
Magnesium (Sat Paste)*	Saturated Paste extraction followed by ICP-OES.	1 mg/L	1
Sodium (Sat Paste)*	Saturated Paste extraction followed by ICP-OES.	1 mg/L	1
Sodium Absorption Ratio (SAR)*	Calculation from the sodium, calcium and magnesium determined on a Saturated Paste extract.	0.2	1
Potassium	1M Neutral ammonium acetate extraction followed by ICP-OES.	0.01 me/100g	1
Calcium	1M Neutral ammonium acetate extraction followed by ICP-OES.	0.5 me/100g	1
Magnesium	1M Neutral ammonium acetate extraction followed by ICP-OES.	0.04 me/100g	1
Sodium	1M Neutral ammonium acetate extraction followed by ICP-OES.	0.05 me/100g	1



ANALYSIS REPORT

Page 3 of 3

Client:	Waste Remedation Services Ltd (WRS)	Lab No:	1286435	shp:1
Address:	PO Box 7150 NEW PLYMOUTH 4341	Date Registered:	11-Jun-2014	
		Date Reported:	19-Jun-2014	
		Quote No:	61678	
		Order No:		
		Client Reference:		
Phone:	06 751 9221	Submitted By:	Keith Brodie	

Sample Type: Soil			
Test	Method Description	Default Detection Limit	Sample No
Potassium (Sat)	1M Neutral ammonium acetate extraction followed by ICP-OES.	0.1 %BS	1
Calcium (Sat)	1M Neutral ammonium acetate extraction followed by ICP-OES.	1 %BS	1
Magnesium (Sat)	1M Neutral ammonium acetate extraction followed by ICP-OES.	0.2 %BS	1
Sodium (Sat)	1M Neutral ammonium acetate extraction followed by ICP-OES.	0.1 %BS	1
CEC	Summation of extractable cations (K, Ca, Mg, Na) and extractable acidity. May be overestimated if soil contains high levels of soluble salts or carbonates.	2 me/100g	1
Total Base Saturation	Calculated from Extractable Cations and Cation Exchange Capacity.	5 %	1
Volume Weight	The weight/volume ratio of dried, ground soil.	0.01 g/mL	1

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Shelley Edhouse
Quality Assurance Officer - Agriculture Division



ANALYSIS REPORT

Page 1 of 2

Client:	Waste Remediation Services Ltd (WRS)	Lab No:	1284735	SPv1
Contact:	Keith Brodie PO Box 77 OAKURA 4345 TARANAKI	Date Registered:	06-Jun-2014	
		Date Reported:	18-Jun-2014	
		Quote No:	61678	
		Order No:		
		Client Reference:	WAI Soil 1 (1284735)	
		Submitted By:	Keith Brodie	

Sample Type: Soil

Sample Name:	WAI Soil 1 06-Jun-2014 12:00 pm				
Lab Number:	1284735.1				
Individual Tests					
Dry Matter	g/100g as rcvd	88	-	-	-
Total Recoverable Barium	mg/kg dry wt	127	-	-	-
Total Recoverable Potassium*	mg/kg dry wt	500	-	-	-
Chloride*	mg/kg dry wt	10	-	-	-
Total Nitrogen*	g/100g dry wt	0.12	-	-	-
Total Organic Carbon*	g/100g dry wt	1.36	-	-	-
Carbon:Nitrogen Ratio		11.5	-	-	-
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn					
Total Recoverable Arsenic	mg/kg dry wt	< 2	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	-	-	-
Total Recoverable Chromium	mg/kg dry wt	11	-	-	-
Total Recoverable Copper	mg/kg dry wt	11	-	-	-
Total Recoverable Lead	mg/kg dry wt	2.4	-	-	-
Total Recoverable Nickel	mg/kg dry wt	8	-	-	-
Total Recoverable Zinc	mg/kg dry wt	55	-	-	-
Total Petroleum Hydrocarbons in Soil					
C7 - C9	mg/kg dry wt	< 8	-	-	-
C10 - C14	mg/kg dry wt	< 20	-	-	-
C15 - C36	mg/kg dry wt	< 40	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	-	-	-

SUMMARY OF METHODS

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

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 metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	0.10 - 4 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
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry), gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1



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Sample Type: Soil			
Test	Method Description	Default Detection Limit	Sample No
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
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1
Total Recoverable Potassium*	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Chloride*	Ion Chromatography determination of es potassium phosphate extraction.	3 mg/kg dry wt	1
Total Nitrogen*	Catalytic Combustion, separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1
Total Organic Carbon*	Acid pretreatment to remove carbonates if present, neutralisation, Elementar Combustion Analyser.	0.05 g/100g dry wt	1
Carbon:Nitrogen ratio in environmental solids	Calculation: from Total Organic Carbon and Total Nitrogen.	0.10	1

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



ANALYSIS REPORT

Page 1 of 4

Client:	Keith Brodie	Lab No:	1280210	SPV3
Contact:	Keith Brodie PO Box 77 OAKURA 4345 TARANAKI	Date Registered:	27-May-2014	
		Date Reported:	12-Jun-2014	
		Quote No:	61228	
		Order No:		
		Client Reference:	Pre-disposal soils	
		Submitted By:	Keith Brodie	

Sample Type: Sediment				
Sample Name:		Waikakau 1 26-May-2014 1:45 pm		
Lab Number:		1280210.1		
Individual Tests				
Dry Matter	g/100g as rcvd	74	-	-
Total Recoverable Potassium*	mg/kg dry wt	8,600	-	-
Total Recoverable Sodium	mg/kg dry wt	610	-	-
pH*	pH Units	10.4	-	-
Total Nitrogen*	g/100g dry wt	0.07	-	-
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn				
Total Recoverable Arsenic	mg/kg dry wt	5	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	-	-
Total Recoverable Chromium	mg/kg dry wt	27	-	-
Total Recoverable Copper	mg/kg dry wt	14	-	-
Total Recoverable Lead	mg/kg dry wt	10.5	-	-
Total Recoverable Nickel	mg/kg dry wt	21	-	-
Total Recoverable Zinc	mg/kg dry wt	58	-	-
BTEX in Soil by Headspace GC-MS				
Benzene	mg/kg dry wt	< 0.06	-	-
Toluene	mg/kg dry wt	< 0.06	-	-
Ethylbenzene	mg/kg dry wt	< 0.06	-	-
m&p-Xylene	mg/kg dry wt	< 0.12	-	-
o-Xylene	mg/kg dry wt	< 0.06	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil				
Acenaphthene	mg/kg dry wt	< 0.03	-	-
Acenaphthylene	mg/kg dry wt	< 0.03	-	-
Anthracene	mg/kg dry wt	< 0.03	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.03	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.03	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.03	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.03	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.03	-	-
Chrysene	mg/kg dry wt	< 0.03	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.03	-	-
Fluoranthene	mg/kg dry wt	< 0.03	-	-
Fluorene	mg/kg dry wt	< 0.03	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.03	-	-
Naphthalene	mg/kg dry wt	< 0.15	-	-
Phenanthrene	mg/kg dry wt	< 0.03	-	-
Pyrene	mg/kg dry wt	< 0.03	-	-



Sample Type: Sediment					
Sample Name:		Waikaikau 1 26-May-2014 1:45 pm			
Lab Number:		1280210.1			
Total Petroleum Hydrocarbons in Soil					
C7 - C9	mg/kg dry wt	< 9	-	-	-
C10 - C14	mg/kg dry wt	< 20	-	-	-
C15 - C36	mg/kg dry wt	580	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	580	-	-	-
Sample Type: Aqueous					
Sample Name:		Waikaikau 2 26-May-2014 1:40 pm			
Lab Number:		1280210.2			
Individual Tests					
pH	pH Units	10.5	-	-	-
Total Potassium	g/m ³	7,200	-	-	-
Total Sodium	g/m ³	450	-	-	-
Total Nitrogen	g/m ³	330	-	-	-
Nitrate-N + Nitrite-N	g/m ³	1.20	-	-	-
Total Kjeldahl Nitrogen (TKN)	g/m ³	330	-	-	-
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn					
Total Arsenic	g/m ³	0.21	-	-	-
Total Cadmium	g/m ³	0.0075	-	-	-
Total Chromium	g/m ³	0.53	-	-	-
Total Copper	g/m ³	0.58	-	-	-
Total Lead	g/m ³	0.29	-	-	-
Total Nickel	g/m ³	0.39	-	-	-
Total Zinc	g/m ³	1.12	-	-	-
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	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq					
Acenaphthene	g/m ³	< 0.0007	-	-	-
Acenaphthylene	g/m ³	< 0.0007	-	-	-
Anthracene	g/m ³	< 0.0007	-	-	-
Benzo[a]anthracene	g/m ³	< 0.0007	-	-	-
Benzo[a]pyrene (BAP)	g/m ³	< 0.0007	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m ³	< 0.0007	-	-	-
Benzo[g,h,i]perylene	g/m ³	< 0.0007	-	-	-
Benzo[k]fluoranthene	g/m ³	< 0.0007	-	-	-
Chrysene	g/m ³	< 0.0007	-	-	-
Dibenzo[a,h]anthracene	g/m ³	< 0.0007	-	-	-
Fluoranthene	g/m ³	< 0.0007	-	-	-
Fluorene	g/m ³	< 0.0007	-	-	-
indeno(1,2,3-c,d)pyrene	g/m ³	< 0.0007	-	-	-
Naphthalene	g/m ³	< 0.004	-	-	-
Phenanthrene	g/m ³	< 0.0007	-	-	-
Pyrene	g/m ³	< 0.0007	-	-	-
Total Petroleum Hydrocarbons in Water					
C7 - C9	g/m ³	< 0.4	-	-	-
C10 - C14	g/m ³	9.0	-	-	-
C15 - C36	g/m ³	19	-	-	-
Total hydrocarbons (C7 - C36)	g/m ³	28	-	-	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

Appendix No.2 - Total Petroleum Hydrocarbon Chromatograms

SUMMARY OF METHODS

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

Sample Type: Sediment			
Test	Method Description	Default Detection Limit	Sample No
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	1
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn	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]	0.010 - 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	0.010 - 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. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvcd	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	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
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH.	0.1 pH Units	1
Total Nitrogen*	Catalytic Combustion, separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1

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	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
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq	Liquid / liquid extraction, SPE (if required), GC-MS SIM analysis [KBIs:4736,2695]	0.00010 - 0.0005 g/m ³	2
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines [KBIs:2803,10734]	0.10 - 0.7 g/m ³	2
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	2
Total Digestion	Boiling nitric acid digestion. APHA 3030 E 22 nd ed. 2012 (modified).	-	2
Total Kjeldahl Digestion	Sulphuric acid digestion with copper sulphate catalyst.	-	2
pH	pH meter. APHA 4500-H ⁺ B 22 nd ed. 2012.	0.1 pH Units	2
Total Potassium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22 nd ed. 2012.	1.1 g/m ³	2
Total Sodium	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22 nd ed. 2012.	0.42 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

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO ₃ ⁻ I 22 nd ed. 2012.	0.002 g/m ³	2
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion. phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N _{org} D. (modified) 4500 NH ₃ F (modified) 22 nd ed. 2012.	0.10 g/m ³	2

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

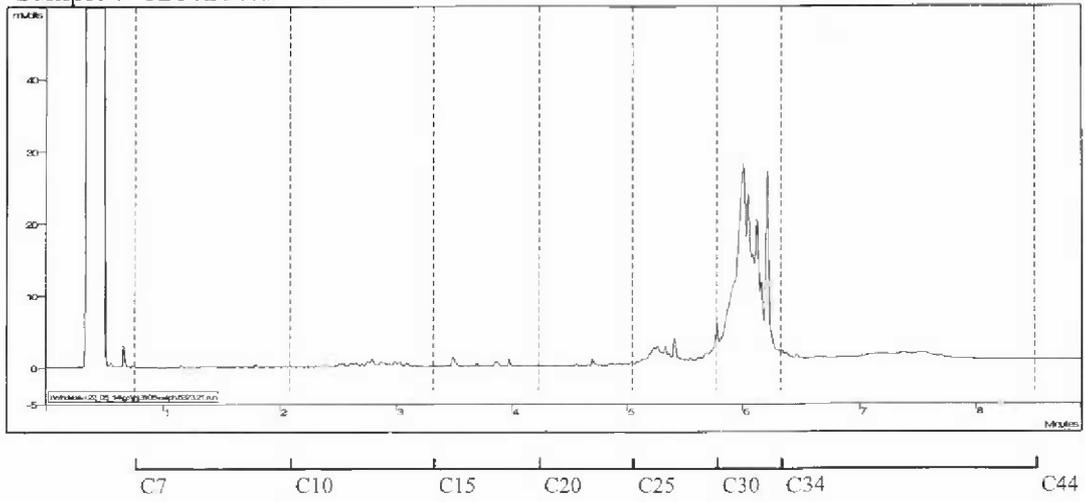
Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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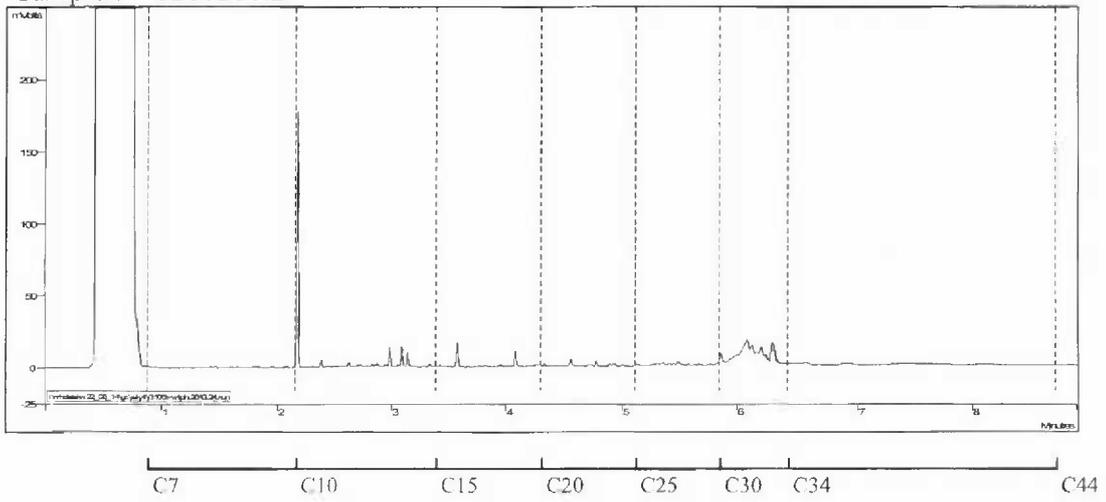


Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental Division

Sample : 1280210.1



Sample : 1280210.2





ANALYSIS REPORT

Client:	Waste Remediation Services Ltd (WRS)	Lab No:	1302190	SPV1
Contact:	Keith Brodie PO Box 77 OAKURA 4345 TARANAKI	Date Registered:	23-Jul-2014	
		Date Reported:	25-Jul-2014	
		Quote No:		
		Order No:		
		Client Reference:		
		Submitted By:	Keith Brodie	

Sample Type: Soil				
Sample Name:	WAI Soil #2 [1298333.1]			
Lab Number:	1302190.1			
Total Petroleum Hydrocarbons in Soil				
C7 - C9	mg/kg dry wt	< 8	-	-
C10 - C14	mg/kg dry wt	< 20	-	-
C15 - C36	mg/kg dry wt	< 40	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	-	-

Analyst's Comments
It should be noted that the TPH analysis was carried out on the dried and sieved sample at the request of the client.

SUMMARY OF METHODS

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

Sample Type: Soil			
Test	Method Description	Default Detection Limit	Sample No
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

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

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

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

Waste Remediation Services Ltd (WRS)

Waikaikai (Wards)

Landfarm Management Plan

Rev	Date	Reason for Issue	Prepared	Checked	Approved
A	May 2014	Issued for review	KMB		

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This landfarm Operations Management Plan describes the process and procedures/requirements for disposal by land farming of drilling muds and cuttings in accordance with the Taranaki Regional (TRC) and South Taranaki District Councils (STDC) resource and landuse consent conditions and relevant New Zealand guidelines.

1. Safety

Waste Remediation Services Ltd will comply with all current Occupational Safety and Health legislation in operating the land farm site at Waikaikai. The company has the services of an in-house dedicated Safety Supervisor who will provide regular input and advice on all site and operational safety matters to identify risks, record and manage these through site visits and conduct regular safety meetings with site personnel and staff.

2. Scope

This Landfarm Operations Management Plan sets out the location, parties involved, safety practices and methodologies adopted by the operator to meet all legal requirements, and to minimise the risks and effects of the disposal of oil exploration and production drilling and workover wastes to land.

Management of the landfarm sites involves continual liaison by the Waste Remediation Services Ltd (the Operator) with the landowner (P and K Ward), the Taranaki Regional Council and South Taranaki District Councils (as the consenting authorities), offsite service providers and agents (laboratories, couriers..), the exploration/drilling company supplying the wastes, and contractors involved with delivery and landfarming of the wastes from time to time.

This liaison particularly with the TRC along with regular site and operations supervision and the keeping of comprehensive and timely records are key components of site management.

The land farm and each delivery of waste through to disposal needs to be managed to ensure compliance with resource consent conditions and guidelines viz the New Zealand guidelines for the safe application of biosolids to land (NZWWA, 2003), guidelines for assessing and managing petroleum hydrocarbon contaminated sites in New Zealand (MfE, 1999) and the TRC's guidelines for disposal of oilfield wastes by land farming.

3. Consents

The site is authorised and operated under the following consents;

1. TRC : Consent number 5956-1 - Issued 13 October 2011, Expiry 1 June 2016.
2. STDC : Landuse Consent RM 010155 Issued 9 January 2002.

4. Abbreviations

WBM	Water based drilling mud
SBM	Synthetic based drilling mud
TRC	Taranaki Regional Council
MFE	Ministry for the Environment
NZWWA	New Zealand Water and Wastes Association

5. Overview of the Landfarming Process

Landfarming is the practice of disposing of drilling wastes to land. It comprises collection and delivery to site, storage to allow natural degradation to occur. This is followed by the spreading of waste onto land, incorporating this waste into the soil by tilling (dilution), and then cultivating and resowing the area to pasture or crop to facilitate natural soil processes to effectively biodegrade, transform and assimilate the waste. This process results in improved soil properties particularly on light, free draining sandy soils resulting in dry matter pasture yields to be multiplied several fold.

The process involves the following broad steps:

1. Notification prior to removal from the wellsite of disposal consent number, well site name and well number, waste source, type and volumes, sampling (for hydrocarbon characterization) and assessment of the wastes to be disposed of.
2. Collection of fluids and cuttings from the wellsite and transport to the disposal site in purpose built, sealed units. Fluids are pumped into tankers, and solids are transported by sealed well-side trucks using an excavator to transfer the material from wellsite in ground sumps/mud tanks.
3. Discharge of water based muds (WBM) cuttings and fluids, synthetic based mud (SBM) cuttings and fluids, and oily wastes, from transport vehicles into lined storage pits to allow natural atmospheric degradation and dilution until volumes are sufficient to allow campaigned spreading.
4. Preparation of spreading areas by removal and stockpiling of topsoil (A soil horizon), re-contouring and levelling the spreading area to improve uniformity and control of waste application rates and establishment of spread area margin bunding if required.
5. Spreading of the cuttings and fluids materials over land at the consented rates using a bulldozer, motor scraper or sprinkler system (depending on the fluid content of the mud). Fluids are usually distributed onto the disposal area using a tractor drawn spray irrigation system.
6. Allowing the cuttings and fluid to dry and degrade sufficiently to enable effective working into the sub-soils (B horizon) and surface soils (A horizon) to required depths.
7. Levelling the soil surface with a levelling bar or similar to provide an established workable field surface.

8. Replacement of the stockpiled A horizon clay/topsoil to aid stability and assist in grass establishment.
9. Fertilising and sowing either in crop or pasture in consultation with the landowner.

6. Wastes Consented for Landfarming

There are only three types of waste able to be disposed of at the Waikaikai Landfarm:

1. Water Based Mud (WBM) drill cuttings and fluids,
2. Synthetic Based Mud (SBM) drill cuttings and fluids
3. Oily Wastes from wellsites.

7. Landfarm Management Process

This management plan includes, as a minimum:

1. Procedures for notification to TRC of disposal activities;
2. Procedures for the receipt and stockpiling of drilling wastes onto the site;
3. Methods used for the mixing and testing of different waste types;
4. Procedures for the stripping and recontouring/levelling of area to be land farmed;
5. Procedures for landfarming drilling wastes (including methods of transfer from stockpiling area, methods of spreading, and incorporation into the soil);
6. Procedures for sowing landfarmed areas;
7. Contingency procedures;
8. Sampling regime and methodology;
9. Post-landfarming management, monitoring and site reinstatement;
10. Record keeping; and
11. Control of site access.

8. Landfarm Management Process

The following table provides a step-by-step process of landfarm site management.

Table 1 Overview of site management process

Step	What	Who
1.	<ul style="list-style-type: none"> Identify wastes types, characterisation and volumes for disposal, there are three possible types of waste: Water based muds; Synthetic based muds. Oily wastes 	Production supervisors/ drilling supervisors/ well services supervisors
2.	<p>Contact WRS Operations Manager to discuss waste type/volume/sampling/timing of disposal</p> <ul style="list-style-type: none"> Fill out Notification of Disposal of Waste to Landfarm form and return to WRS Operations Manager <p>Receive request for delivery/disposal of material:</p>	Production supervisors/ drilling supervisors/ well services supervisors
3.	<p>Receive notification in regard to waste for disposal;</p> <ul style="list-style-type: none"> Receive notification of well exploration activities and programme for collection and delivery of waste to land farm site Ensure forms are filled out completely; Identify mud types, approximate volumes, confirm sample collected and advise delivery Record all collection details on WRS Waste Tracking Record. Assign each 'parcel' of waste a number to ensure source, transport and storage location are recorded ;and disposal and monitoring can be tracked; Collect and submit pre-disposal sample for analysis . 	WRS Operations Manager
4.	<p>Notify TRC (delivery for storage):</p> <ul style="list-style-type: none"> 48 hours prior to delivery for stockpiling on site; and Advise: tracking number, consent number, name of well/site, type of waste, volume of waste. <p>Planning for delivery/stockpiling:</p> <ul style="list-style-type: none"> Arrange and assign storage pit into which the waste consignment is to be discharged taking into account mud type, characteristics and storage volumes available Ensure delivery driver completes delivery details into WRS/TRC Site Disposal Log located in hut at the disposal site shack 	WRS Operations Manager WRS Operations Manager
5.	<p>Delivery:</p> <ul style="list-style-type: none"> Once location for stockpiling at landfarm has been arranged organize with a contractor for delivery; and Notify WRS of all deliveries to site, providing as much notice as practicable. 	Production supervisors/drilling supervisors/well services supervisors

Step	What	Who
6.	<p>Managing Stockpiles:</p> <ul style="list-style-type: none"> • Maintain a record of volumes of wastes in storage pits and ensure freeboard and storage capacities are commensurate with drilling waste volumes as far as is practicable. If heavy rainfall reduces pit capacity and freeboard notify TRC of need to use contingency storage and removal of excess rainwater by irrigation to suitable land farming areas until land spreading of mud and solids is practicable • Ensure material is not stockpiled at site for longer than 12 months. 	WRS Operations Manager
7.	<p>Planning for spreading:</p> <ul style="list-style-type: none"> • Identify volumes delivered and sample results; • Consider mixing similar waste to provide the appropriate soil improvement properties sought by the landowner 	WRS Operations Manager
8.	<p>Resample for pre-disposal results</p> <ul style="list-style-type: none"> • Calculate loading according to the consent for area and spreading rate calculations; and • Identify location for disposal site based on area required for appropriate loading and separation distances (at least 25 metres away from waterways and un-consented property boundaries, 6m from existing gas pipelines, and 2m from other disposal sites). 	WRS Operations Manager
9.	<p>Notify TRC (spreading):</p> <p>48 hours prior to spreading advise TRC of date; consent number; well/site; type of waste; volume; weight; concentrations of chloride, nitrogen and TPH; and location/area it will be spread upon</p>	WRS Operations Manager

9. Pre-disposal Testing of Wastes

Pre-disposal testing requirements and species limits are outlined in the following table.

Table 2 Pre-disposal testing requirements

Parameter	Consent Limit (mg/kg unless otherwise stated)	Minimum pre-disposal analysis required
Conductivity	290mS/m (guideline)	
Chloride	700 mg/kg (guideline)	
Sodium	460 (guideline)	
Total Soluble Salts	2500mg/kg	
BTEX Benzene Toluene Ethylbenzene Xylenes	Not Stated Submit results to TRC	i (for SBM only)
PAH (Polycyclic Aromatic Hydrocarbons) Naphthalene Pyrene Benzo(a)pyrene	Not Stated Submit results to TRC((for SBM / OW only)
TPH (Total Petroleum Hydrocarbons) C6-C9 C10-C14 C15-C36	Not Stated Submit results to TRC	

10. Mixing Waste

Predisposal testing of waste will be carried out for each storage pit prior to any decision to mix wastes. Both the combined product volumes and species concentrations of the resultant aggregated waste will be calculated to guide and provide a check on the actual composite sample results, prior to disposal occurring.

11. Calculating spreading areas and depth requirements from pre-disposal sample results

The pre-disposal sample results are used for pre-planning of each waste disposal. The consents restrict the depth that waste can be spread as follows:

- 100mm for wastes with hydrocarbon content less than 50,000mg/kg dry wgt;
- 50mm for wastes with hydrocarbon content greater than 50,000mg/kg dry wgt

Application must be at a rate such that there is no overland flow of liquids; and at a rate such that no ponded liquids remain after one hour, after application

To ensure these limits can be met, the following calculations are required, using information from the pre-disposal sample.

To obtain the minimum area for spreading the calculation is:

a) for TPH < 50,000mg/kg
volume (m³) / depth allowed (0.10m) = area m²

b) for TPH > 50,000 mg/kg
volume (m³) / depth allowed (0.05m) = area m²

e.g. Volume to be spread is 200cu.m

Spread Area= 200/0.05 = 4,000 sq.m = 0.4Ha

12. Monitoring

12.1. Site Inspections

Regular monitoring inspections of the landfarm sites will be undertaken (monthly at a minimum) to check for:

- Housekeeping of site (rubbish, access tracks, site layout, safety, security, hazards)
- Status of storage pits (volume, contamination, stability, wastes) and signage (wellsite and waste type)
- Landfarming (progress, application, depth/area, slopes, separation, reinstatement), and
- Environmental (boundary distances, discharges/spills, water bodies).

12.2. Soil Sampling

TRC has developed a set of guidelines for the disposal of drilling wastes onto and into land that are reflected in the conditions of resource consents.

These guidelines, along with MFE and NZWWA guidelines, set the maximum concentrations of metals, hydrocarbons and other elements at surrender. These levels form the basis for the monitoring that must be undertaken at the site. It is these analytes that are monitored through periodic sampling of the landfarm spreading areas.

The sampling requirements and reasons are:

- A representative sample of the wastes taken prior to spreading. This is used to ascertain levels of hydrocarbons to calculate loadings and rates
- Composite soil samples of each disposal area following spreading at approx. one month after spreading, thereafter at six months and 12 months, and then annually until consent levels are achieved; and
- Full testing undertaken on all disposal areas prior to lodging an application to surrender and close the site.

Analyses are normally conducted on a composite sample fraction. The composite is collected from a surveyed transect across the disposal area. Three or four soil samples are taken at various depths from 100mm to 400mm and from this bulk sample a representative fraction is submitted for analysis. This composite provides material from the depth to which the material was applied and allows for an additional margin to the depth tilling may have occurred to.

All analysis will be provided by R J Hill Laboratories in Hamilton and copies of these analysis results are provided to the TRC annually or as requested.

Not all parameters are tested at every sample due to cost and practicality – generally a surrogate analytical suite is established in consultation with R J Hills Labs and agreed with the TRC.

Before any consent can be surrendered all parameters will be analysed. The consent can not be surrendered and the site closed until all species meet the consent surrender criteria as below

Table 3 Sampling requirements and consent limits

Parameter	Consent Limit (mg/kg unless otherwise stated)	Sampling requirements for WBM/SBM/Oily Wastes		
		1 month after*	6 months after*	Annual *
Chloride	700 mg/kg (expiry)	/	/	
Sodium (Na)	460 (expiry)			

Parameter	Consent Limit (mg/kg unless otherwise stated)	Sampling requirements for WBM/SBM/Oily Wastes		
Conductivity	290 mSm (expiry)			
Sodium Absorption Ratio	18 (post-app)			
Total soluble salts (g/100g)	2500 (expiry)			i
BTEX Benzene Toluene Ethylbenzene Xylenes	Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in [New Zealand MfE 1999]. Tables 4.12 and 4.15, for soil type sand.	/	/	/
PAH Naphthalene Pyrene Benzo(a)pyrene				
TPH C6-C9 C10-C14 C15-C36				

12.3. Pasture/Vegetation Monitoring

Pasture/vegetation monitoring will be carried out on a monthly basis in consultation with the landowner/farmer.

Any remedial action will be by agreement with the operator /landowner to enable return to the desired use as soon as practical.

12.4. Photographic Records

Representative photos of the site will be taken before spreading, immediately after spreading and then at 2 months and 12 months post spreading. These will be held by the operator for 5 years and made available to the landowner and TRC upon request.

13. Contingency Procedures _ Transport Spills

The primary transport contractor maintains a spill plan that will be implemented should a spill occur during transport of wastes from the rig to the land farm site. A request for a copy of this plan should be made directly to the transporting company.

14. Site Reinstatement and Closure

When the area consented for landfarming at a particular site has been completed, stockpiling of material on the site will cease and the storage pits and discharge platform area will be reinstated to a standard and conformation compatible with the adjacent land farmed areas.

Monitoring of the site will continue until all spread areas within the site have met consent surrender conditions and guidelines. A final campaign of compliance sampling results are required before consents can be surrendered. The final round of sampling will be taken at 100m intervals along parallel transect lines (100m apart) crossing the entire site. This method will treat the site as a whole and provide an overview of waste remediation spatially across the landfarm. This method mirrors the process that the TRC uses to monitor the site on an annual basis.

15. Record Keeping

Records are kept of the following, and provided to the Taranaki Regional Council as required by consent conditions:

- Notifications to TRC for disposal delivery and landfarming; trucking contractor and delivery volumes;
- Wastes from each individual well, including records of all additives used at the wellsite during the drilling process;
- Source (date collected, waste description, volume, any peculiarities in wastes for example: waxy, high percentage water, stony/sandy etc.);
- Stockpiling (area, volumes stockpiled, dates and times of commencement and completion);
- Disposal (area (including a map and GPS co-ordinates), volumes, dates and times of commencement and completion);
- Composition of material (including conductivity, concentrations of , chloride, sodium, total soluble salts and total hydrocarbons, and C6-C9, C10-C14 and C15-C36 fractions);
- Treatments applied (e.g. fertilisers);
- Site Inspections; and
- Sampling, analysis, and results of monitoring.

Records that are to be kept for 5 years from the date of closure include copies of the TRC monitoring programmes, inspection notices, sample forms, sample results and notifications. These will be held on disc and/or in hard copy, all of which are managed by Waste Remediation Services Ltd's Operations Manager.

16. Accountabilities/Responsibilities

These personnel are responsible for the following activities:

Operations Manager	Implementation of this plan, maintaining records of all wastes approved for disposal via land farming, manage landfarm sites, provide notifications and reports to TRC as required by resource consent conditions.
Operations Manager	Liaison with landowners for all land farming matters
Client production supervisors, drilling supervisors, well services supervisors	Provide notification and information on source, nature and volume of wastes to WRS's Operations Manager Organise transport to the landfarm site.

Civil/Earthworks/Spreading Contractor	Undertake spreading of wastes as instructed by WRS's Operations Mianager, and in accordance with TRC consent conditions.
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17. Reference Documents

Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand, Ministry for the Environment, 1999.

Disposal of Hydrocarbon Drilling Wastes near Geary Road, Taranaki Regional Council Report, June 2000.

Public Health Guidelines for the safe use of Sewage Effluent and Sewage Sludge on Land, Department of Health.

Guidelines for the control of disposal of drilling wastes onto and into land, Taranaki Regional Council, July 2003,2005 and 2013.

Review of typical TRC consent conditions to discharge drilling wastes and oily wastes via landfarming

Alberta Energy Et Utilities Board Guide 50: Drilling Waste Management, October 1996

Resource Consents

Consent Monitoring and Compliance Programmes

New Zealand Water and Wastes Association (2003): New Zealand guidelines such as Guidelines for the safe application of biosolids to land.