

Waste Remediation Services Limited  
Waikaikai Landfarm  
Monitoring Programme  
Annual Report  
2014-2015

Technical Report 2015-95

ISSN: 1178-1467 (Online)  
Document: 1610696 (Word)  
Document: 1644777 (Pdf)

Taranaki Regional Council  
Private Bag 713  
STRATFORD

May 2016



## Executive summary

Waste Remediation Services Limited (hereafter the Company) holds consent to manage and operate a drilling waste landfarm located off Lower Manutahi Road at Manutahi. During this period the Company sequestered close to 4000 m<sup>3</sup> of drilling mud and associated contaminated soil, the majority of which originated from Shell Todd Oil Services' operation and clean up of their Kapuni impacted soils. This report is for the period July 2014 to June 2015 and it describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess the Company's environmental performance during the period under review, and the results and environmental effects of the Company's activities.

The Company holds one resource consent, which includes a total of 31 conditions setting out the requirements that the Company must satisfy. The Company holds consent to allow it to discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsites and contaminated soil onto and into land via landfarming.

**During the monitoring period, the Company demonstrated an overall Good level of environmental performance.**

The Council's monitoring programme for the year under review included 16 inspections, 20 groundwater samples and six composite soil samples collected for physicochemical analysis.

During the year, the Company demonstrated a Good level of environmental and a Good level of administrative performance with the resource consent. There are a number of factors that contributed to this performance rating.

To prove compliance with the consent the Company would need to provide analytical sample results of all areas utilised with the analysis including the complete zone of application. During the monitoring period, the Company did not supply adequate evidence that they had met these requirements as only one soil sample from the top 75mm was supplied.

The Company's consent requires that all cells which are utilised for the storage of drilling waste should be lined with a fit for purpose liner. The 'contingency' cell remained unlined and was observed to contain drilling mud during this monitoring period. An investigation is ongoing into whether this cell is fit for purpose.

The consent also stipulates that the discharge shall not result in a concentration of total dissolved salts within the groundwater of more than 2,500 g/m<sup>3</sup>. Sampling from one well returned analytical results above this limit.

For reference, in the 2014-2015 year, 75% 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 22% demonstrated a good level of environmental performance and compliance with their consents.

This report includes recommendations for the 2015-2016 year.



## Table of contents

	Page
1. Introduction	1
1.1 Compliance monitoring programme reports and the Resource Management Act 1991	1
1.1.1 Introduction	1
1.1.2 Structure of this report	2
1.1.3 The Resource Management Act 1991 and monitoring	2
1.1.4 Evaluation of environmental and administrative performance	3
1.2 Process description	4
1.3 Site location and description	6
1.4 Resource consents	7
1.4.1 Discharges of wastes to land	7
1.5 Monitoring programme	8
1.5.1 Introduction	8
1.5.2 Programme liaison and management	8
1.5.3 Site inspections	8
1.5.4 Chemical sampling	9
1.5.5 Review of analytical data	9
2. Results	10
2.1 Inspections	10
2.2 Results of abstraction and discharge monitoring	14
2.2.1 Provision of company data	14
2.2.2 Results of receiving environment monitoring	14
2.3 Investigations, interventions, and incidents	21
3. Discussion	23
3.1 Discussion of site performance	23
3.2 Environmental effects of exercise of consents	24
3.3 Evaluation of performance	25
3.4 Recommendations from the 2013-2014 Annual Report	28
3.5 Alterations to monitoring programmes for 2015-2016	28
3.6 Exercise of optional review of consent	28
4. Recommendations	29
Glossary of common terms and abbreviations	30
Bibliography and references	32
Appendix I Resource consent held by Waste Remediation Services Limited (For a copy of the signed resource consent please contact the TRC Consent Department)	
Appendix II Company supplied annual report	

## List of tables

<b>Table 1</b>	Material delivery register	14
<b>Table 2</b>	Council soil sample results Waikaikai Landfarm 2014-15	14
<b>Table 3</b>	Company supplied soil sample results	16
<b>Table 4</b>	Annual groundwater monitoring results for GND 2290	17
<b>Table 5</b>	Annual groundwater monitoring results for GND 2291	18
<b>Table 6</b>	Annual groundwater monitoring results for GND 2292	18
<b>Table 7</b>	Annual groundwater monitoring well results for GND 2293	19
<b>Table 8</b>	Annual groundwater monitoring well results for GND 2294	20
<b>Table 9</b>	Summary of performance for consent 5956-1.7	25

## List of figures

<b>Figure 1</b>	Site location and regional inset	7
<b>Figure 2</b>	Council soil sample transects	15
<b>Figure 3</b>	Groundwater monitoring well locations with respect to the site	17
<b>Figure 4</b>	Long term TDS concentrations at the Waikaikai Landfarm	21
<b>Figure 5</b>	Disposal area map provided by the Company	23

# **1. Introduction**

## **1.1 Compliance monitoring programme reports and the Resource Management Act 1991**

### **1.1.1 Introduction**

This annual report is for the period July 2014 to June 2015 by the Taranaki Regional Council (the Council). It describes the monitoring programme associated with resource consent 5956-1.7 held by Waste Remediation Services Limited (hereafter the Company), whom operate the landfarm situated on Lower Manutahi Road at Manutahi (Waikaikai Landfarm).

The Company holds one resource consent. This was initially held by Swift Energy Ltd. The original consent was granted on 22 March 2002, permitting the disposal 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 Waikaikai Farms Limited, 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 Waikaikai Farms Limited. 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 commenced management of the site, on behalf of the then consent holder Waikaikai Farms Limited. In November 2014, the consent was transferred from Waikaikai Farms Limited to Waste Remediation Services Limited (the Company).

During the 2013-2014 monitoring period, there was a single disposal of approximately 1,200 m<sup>3</sup> of predominately water-based cuttings and fluids over an area of approximately 12,000 m<sup>2</sup>. No hydraulic fracturing wastes have been disposed of at this site during its life cycle.

During this monitoring period the Company applied for a change of consent conditions to allow for the surface application of 4,300 m<sup>3</sup> of hydrocarbon impacted soils from the margins of former blow down pits, this was part of Shell Todd Oil Services' Kapuni remediation programme.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consent held by the Company that relate to the discharges of drilling wastes from hydrocarbon exploration and production activities, oily waste from wellsites, and contaminated soil onto and into land via landfarming in the Mangaroa catchment. This is the third report to be prepared by the Council to cover the Company's discharges and their effects.

### **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 RMA and the Council's obligations and general approach to monitoring sites through annual programmes, the resource consents held by the Company in the Managaroa catchment, the nature of the monitoring programme in place for the period under review, and a description of the activities and operations conducted in the Company's site.

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 2015-2016 monitoring year.

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

### **1.1.3 The Resource Management Act 1991 and monitoring**

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

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

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



#### 1.1.4 Evaluation of environmental and administrative performance

Besides discussing the various details of the performance and extent of compliance by the consent holder during the period under review, this report also assigns a rating as to the 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 (that is a defence under the provisions of the RMA can be established) may be excluded with regard to the performance rating applied. For example loss of data due to a flood destroying deployed field equipment.

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

##### Environmental Performance

- **High:** No or inconsequential (short-term duration, less than minor in severity) breaches of consent or regional plan parameters resulting from the activity; no adverse effects of significance noted or likely in the receiving environment. The Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices or infringement notices in relation to such impacts.
- **Good:** Likely or actual adverse effects of activities on the receiving environment were negligible or minor at most. There were some such issues noted during monitoring, from self reports, or in response to unauthorised incident reports, but these items were not critical, and follow-up inspections showed they have been dealt with. These minor issues were resolved positively, co-operatively, and quickly. The Council was not obliged to issue any abatement notices or infringement notices in relation to the minor non-compliant effects; however abatement notices may have been issued to mitigate an identified potential for an environmental effect to occur.

For example:

- High suspended solid values recorded in discharge samples, however the discharge was to land or to receiving waters that were in high flow at the time;
- Strong odour beyond boundary but no residential properties or other recipient nearby.
- **Improvement required:** Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent minor

non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.

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

### **Administrative performance**

- **High:** The administrative requirements of the resource consents were met, or any failure to do this had trivial consequences and were addressed promptly and co-operatively.
- **Good:** Perhaps some administrative requirements of the resource consents were not met at a particular time, however this was addressed without repeated interventions from the Council staff. Alternatively adequate reason was provided for matters such as the no or late provision of information, interpretation of 'best practical option' for avoiding potential effects, etc.
- **Improvement required:** Repeated interventions to meet the administrative requirements of the resource consents were made by Council staff. These matters took some time to resolve, or remained unresolved at the end of the period under review. The Council may have issued an abatement notice to attain compliance.
- **Poor:** Material failings to meet the administrative requirements of the resource consents. Significant intervention by the Council was required. Typically there were grounds for an infringement notice.

For reference, in the 2014-2015 year, 75% 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 22% demonstrated a good level of environmental performance and compliance with their consents.

## **1.2 Process description**

### **Drilling waste**

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

### **Drilling fluids**

Oil and gas wells may be drilled with either synthetic based mud (SBM) or water based mud (WBM). As the names suggest, these are fluids with either water (fresh or saline) or synthetic oil as a base material, to which further compounds are added to modify the

physical characteristics of the mud (for example mud weight or viscosity). More than one type of fluid may be used to drill an individual well. In the past, oil based muds (OBM) (diesel/crude oil based) have also been used. Their use has declined since the 1980s due to their ecotoxicity; they have been replaced by SBM. SBM use olefins, paraffins or esters as a base material. While this is technically still a form of oil based fluid, these fluids have been engineered to remove polycyclic aromatic hydrocarbons, reduce the potential for bioaccumulation, and accelerate biodegradation compared with OBM.

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

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

### **Cuttings**

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

### **Landfarming**

The landfarming process has typically been used in the Taranaki region to assist the ultimate conversion of sandy coastal sites prone to erosion into productive pasture. Results of an independent research project conducted by AgKnowledge Ltd (2013) have indicated that the re-contoured sand dunes, after the inclusion of the drilling wastes (as per the consents), and with the addition of appropriate fertilisers and water (irrigation) are capable of producing high quality clover-based pastures and thus increasing the value of the land from about \$3-4,000/ha to \$30-40,000/ha (2013).

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

1. Drilling waste is transported from wellsites by truck (cuttings) or tanker (liquids). It may be discharged directly to land or placed in a dedicated storage pit.
2. The required area is prepared by scraping back and stockpiling existing pasture/topsoil and 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 Landfarm site was initially undertaken on a single application basis. This means dedicated spreading areas receive only single applications of waste. When disposal is complete, the area will be reinstated and monitored until consent surrender criteria have been met.

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

### 1.3 Site location and description

The Company operates a drilling waste landfarm off Manutahi Road, Manutahi. The site is owned by P. F. and K. M. Wards, trading under the name Waikaikai Farms Limited. The predominant land use was previously dairy farming. The site location is detailed in Figure 1. The predominant soil type has been identified as black loamy sand and vegetation growth consists mostly of pasture. Test pitting and the logging of boreholes on site indicated a relatively shallow water table. Test bores were augured to 10 m both around the 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 1,043 mm (taken from the nearby Patea monitoring station).

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

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:	1,043 mm
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



**Figure 1** Site location and regional 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.

The Company holds discharge permit 5956-1.7, to discharge drilling wastes from hydrocarbon exploration and production activities, and oily wastes from wellsites and contaminated soil onto and into land via landfarming. This permit was issued by the Council on 22 March 2002 under Section 87(e) of the RMA. This resource consent is due to expire on 1 June 2016. The consent holder has recently applied for a renewal of consent.

Condition 1 sets out definitions;

Condition 2 requires the consent holder to adopt the best practicable option to prevent or minimise any environmental effects;

Condition 3 requires the consent holder to install a minimum of three groundwater monitoring wells;

Condition 4 stipulates that all storage cells utilised for the storage of material shall be lined with a fit for purpose synthetic liner;

Conditions 5 to 11 set out the requirements for notifications, monitoring and reporting;

Condition 12 requires a buffer zone between areas of disposal and surface water bodies and property boundaries;

Condition 13 prohibits the discharge of fracturing fluids;

Condition 14 to 21 specifies discharge limits, locations and loading rate;

Conditions 22 to 27 specify receiving environment limits for both soil and water;

Condition 28 to 29 dictates surrender criteria;

Condition 30 concerns archaeological remains; and

Condition 31 is an amendment and review condition.

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 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 site consisted of four primary components.

### **1.5.2 Programme liaison and management**

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

- ongoing liaison with resource consent holders over consent conditions and their interpretation and application;
- in discussion over monitoring requirements;
- preparation for any 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 16 scheduled inspections were undertaken the site during the monitoring period, with regard to the consents for the discharge of drilling waste. This included the inspections which were undertaken during chemical sampling runs. Inspections focused on the following aspects:

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

#### **1.5.4 Chemical sampling**

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

The methodology utilised by the Council for collecting soil samples across the land farmed area is adapted from the Guidelines for the Safe Application of Biosolids to Land in New Zealand (2003), whereby a soil corer is inserted to a depth of 500 mm +/- to encompass the zone of application. Ten soil cores are collected, spaced 10 meters apart. These ten soil cores are then composited to gain one representative soil sample of an application area.

#### **1.5.5 Review of analytical data**

In line with the consented requirements the Company must supply the Council with representative analytical results of the material they intend to apply to land at this facility. They undertook this by providing the Council with pre-spreading analytical results of the material which was contained in the storage cells, this was analyzed by an International Accreditation New Zealand (IANZ) laboratory, Hill Laboratory, Hamilton. Chemical parameters tested are as follows:

- pH
- chlorides
- potassium
- sodium
- total nitrogen
- total barium
- heavy metals (As, Cd, Cr, Cu, Ni, Pb, Zn and Hg)
- BTEX
- PAH
- TPH ( including speciation analysis C<sub>7</sub>-C<sub>9</sub>, C<sub>10</sub>-C<sub>14</sub>, C<sub>15</sub>-C<sub>36</sub>)

The company must also provide the Council with a representative post spreading soil sample of the areas which were utilised for the application of material. The rationale for this post spread sample is to ascertain the consent specified application rates have been achieved.

In this monitoring period the Company supplied the Council with one post spread sample of soil material.

## **2. Results**

### **2.1 Inspections**

#### **03 July 2014**

No objectionable odours or visible emissions were found during the inspection. Two lined cell and one unlined cell contained muds at the storage site, a lined oily waste cell also contained material. Spreading equipment was present but no activities were occurring due to the ground conditions. The lined cell at the south eastern side of the storage site was full and had over-topped the level of the liner at the western side, the muds/stormwater were remaining in the cell area as the earth wall had been re-contoured/raised to form a bund. All mud cells were free of surface oils. The western lined cell had plenty of free-board available. The unlined cell had some muds removed, this was indicated by the 'tide-line' of mud adhered to the cell wall. The spreading area to the south west of the storage site was inspected and found to be satisfactory. The stockpiled topsoil was stable, the perimeter of the application area had been worked to incorporate the muds. The center of the spreading area appeared to have unblended mud on the surface. Some ponding was evident from recent heavy rain in the south west corner of the spreading area. No hydrocarbons were found around any of the spreading area. Historic application areas appeared healthy and the pasture cover was good. Mud clumps were identified within the soil profile in dig test pits.

The following action was to be taken: To ensure all muds are stored in lined cells and enough cell capacity was available to cope with all storm events. To undertake works to spread the remaining muds stored within the cells. To undertake works to incorporate the post spread muds into the soil profile.

#### **18 July 2014**

The inspection was conducted in conjunction with groundwater sampling. At the time of inspection, Contract Resources delivered a small load of material from the Waihapa Production Station. This was produced water tanks and it was discharged into the seaward cell at the Waikaikai Landfarm. The site manager was present. He mentioned that spreading had commenced and were awaiting fine weather to continue with follow-up operations. All cells at the site had waste stored within. Groundwater bore GND2293 adjacent to new spreading area had abundant soil around the bore. The site manager advised that this would be remedied once activity had ceased in the immediate area and contractors were being advised to show caution around the bore.

#### **18 August 2014**

No objectionable odour or visible emissions were found during the inspection. All lined cells at the site had plenty of freeboard available and the liners appeared in good repair. A new cell and health and safety signage had been added to the site. The unlined cell at the site still contained drilling mud, no visible tideline was present within the cell which indicated the level had risen since 3 July 2014 inspection. Muds from Puka 3 were being discharged into cell 2 during the inspection, with all discharges entering the cell. Cell 1 had the liquid portion emptied using a tanker and was being discharged into the recently contoured spreading area. The majority of the spreading area was bunded with stripped topsoil which was stable. The north west corner of the spreading area was found to be unbunded. Discharged liquids were leaving the spreading area via overland flow and ponding. The area to the west of the current spreading area was inspected, very little mud was identified within the soil profile and no hydrocarbon odours were noted. The historic application area was inspected, mud clumps had migrated to the surface in places and weathered. Muds



clumps were also identified within the soil profile, no hydrocarbon odours were noted and the muds were found to be quite sticky and did not break apart easily. The pasture cover across the area appeared healthy but was yet to establish where seed had not been sown.

The following action was to be taken: To undertake works to incorporate ponded liquids. To ensure no ponding or overland flow occurs during spreading activities to ensure compliance with special condition 14 of resource consent 5956-1.

#### **16 September 2014**

No objectionable odours or visible emissions were found during the inspection. The unlined cell at the site still contained material but did not appear to have had any more added. The southern lined cell had two piles of contaminated gravel type materials mixed within the plastic liner stored on the cell edge, and plenty of freeboard available within the cell. The western lined cell contained a black surface oil. The liner had a rip near the top within the historic tide-line. The rip was affected by gusty wind at the time of inspection. Plenty of freeboard was available before the level would reach the rip in its current state. A small mud patch was observed around the tanker loading area. Recent application area had been contoured and appeared good. Seed had been sown and the pasture strike looked good across the entire area. Some ponded rain water was present, clear and no hydrocarbon sheen sighted.

#### **23 September 2014**

An inspection was conducted in conjunction with soil sampling. Two composite soil samples were obtained from most recent spreading area "A", which had been sown and good primary pasture growth was observed. Drilling mud was evident in some cores at approximately 50 cm depth. All cells contained drill waste and were signposted. Previously spread area to the south-west of the cell area had just had fertilizer applied.

#### **10 October 2014**

A site inspection was conducted in conjunction with soil sampling in area F1. Transects that were sampled in 2013 and found to be outside of surrender limits, were resampled. Three samples were collected. The landward transects sampled near the former cell area were difficult to sample as there was a hard mud layer starting at approximately 50 mm.

The samples had distinctive drilling mud evident in them, but no hydrocarbon odours were detected. Pasture growth was generally good. The landowner and site operator were both present at the time of inspection. Discussions were held with them about the removal of oily waste for processing. The site was generally tidy and no issues were noted. Stock exclusion fencing was in place at the recently spread areas 'A' and 'B'.

#### **03 November 2014**

No objectionable odours or visible emissions were found beyond the site boundary during the inspection. Three lined cells and one unlined cell were in use. All cells had materials within, but plenty of capacity was available and the liners appeared to be coping with weather events. The liner of cell 2 was observed to be inflated around the northern perimeter. Some thick black surface oils were present in cell 2. Some oily sludge was stored in an IBC and 100 L barrels were adjacent to cell 3 which also had a waxy crude present on the surface. The original spreading area had been sprayed out to be put into crop. The pasture was essentially complete across all areas of the most recently spread area. Muds were identified at the surface in places and within the soil

profile in all dug test pits. Hydrocarbon/mud odours were noted in the buried material. No recent spreading had occurred.

#### **07 November 2014**

The inspection was conducted in conjunction with groundwater sampling (monitoring bores GND2290, GND2291, GND2292). Lined cells contained wastes, as did the unlined 'contingency' cell. The pasture within spreading area F1 appeared dry/dead and had been cut. Pasture within new spreading areas A1 and A2 looked good.

#### **24 November 2014**

An inspection was conducted in conjunction with groundwater sampling of bores GND2293 and GN2294. Peter Ward (the landowner) onsite, pasture on the recently spread areas (A1 and A2) appeared in good order.

#### **09 January 2015**

No objectionable odours or visible emissions were found during the inspection. No site activity occurred at the time of the inspection as the gates were locked. All cells at the site contained drilling wastes and fluids. The liners appeared in good repair for the three lined cells. Very little surface hydrocarbon was present in the two large cells, the oily waste cell had thick oils removed and the material was stored in drums adjacent to the cells. Surface hydrocarbons were present within the cell. A strong hydrocarbon odour was noted around the area. The unlined cell did not appear to have had anymore material introduced. The liquid had a yellow/green colour and was free of surface hydrocarbons. The historic application areas had essentially complete pasture cover which appeared healthy. Muds identifiable within the soil profile. No recent spreading activities had occurred.

#### **14 January 2015**

No objectionable odours or visible emissions were found during the inspection. Kapuni impacted soil deliveries had occurred. At the time of inspection, the material was deposited onto the topsoil in the paddock on the coast side of storage cells. The bull dozer was on-site and would spread the muds out when enough deliveries had occurred or prior to forecast rain events. The muds were to be ripped and power harrowed until acceptable blending had occurred. The material had a drilling mud appearance and was very compact. Strong hydrocarbon type odours were present around the area. Discussions were held regarding the stockpiling of materials and the TRC requirement to ensure all stockpiles only occur on the impervious liners. No recent deliveries to the storage cells had occurred and liners appeared in good repair. Oily wastes stored in drums were to be removed from site and processed by Origin.

#### **25 February 2015**

The inspection was conducted in conjunction with groundwater sampling. Impacted soils from Kapuni had all been received. The site management were waiting on the weather before spreading and sowing commenced. The soils were currently stockpiled on site as per consent conditions. Groundwater was sampled using a peristaltic pump. No odour, sheen or foam was encountered in any of these bores.

#### **23 March 2015**

No objectionable odours or visible emissions were found during the inspection. A noticeable mud/hydrocarbon odour was observed around the recent spreading area west of storage cells. No site activity occurred during the inspection and the gates were locked. Impacted soil and unused muds had been spread across spreading area

through the use of a bulldozer. This was undertaken on 21 and 22 March 2015. No works had occurred to incorporate the material into the soil profile as yet. Rocks and plastic were prevalent across the recently spread area. Three lined cells at the site contained drilling wastes and one unlined cell also contained drilling wastes. No surface oils were present in the unlined cell and the material had a yellow appearance. The liner of the western cell had a small rip at the top on the western wall. Plenty of freeboard was available before the liquid would reach the rip level. Oily wastes remained onsite in barrels adjacent to the oily waste cell. A pile of soil looking material was currently stored on the northern side of the southern lined cell and a plastic liner material visible within the cell. Some of the material had been discharged into the cell; this material should be stored in lined cells.

The following action was to be taken: To fix the rip in the top of the western cell liner. To undertake works to incorporate the impacted soils into the soil profile. To undertake works to spread the muds in the unlined cell in accordance with resource consent conditions. To undertake works to remove from site or spread the oily wastes in the oily wastes cell as it has been on-site for longer than a year. To ensure all waste materials brought to site are stored in cells with impervious liners rather than stockpiling adjacent to the cell.

#### **02 April 2015**

An inspection was conducted following the spreading of impacted soils over spreading area F1. The site was unoccupied. Large volume of rubbish and debris (plastic, bottles etc) was mixed in with soil. There was no noticeable odour. Phone conversation with K. Brodie (a representative of the company) on 26 Feb 2015 informed that the site was to be reworked and rubbish removed. The spreading area was to be sown following this. It was noted that soil sampling was to be scheduled after works completed.

#### **04 May 2015**

An inspection was conducted in conjunction with groundwater monitoring. All five bores were sampled using a peristaltic pump. No odour, sheen or foaming was observed in any samples. The site was unoccupied. There was evidence of recent reworking of soil to remove debris following the spreading of the Kapuni impacted soil. No pasture had established.

#### **09 June 2015**

An inspection was conducted in conjunction with sampling of recently-spread impacted soils from Kapuni blow-down cells. Spreading area F1 was sampled. Pasture establishing well, although there was evidence of drilling and overland flow in the southern corner of the spreading area. Soils had not been worked into the underlying material, with an obvious layer of yellow brown, predominantly clay material 100 - 200 mm thick overlying a darker brown, moist, predominantly sandy layer with occasional traces of drilling mud. Transect was undertaken which composited 10 samples, approximately 600 mm depth each.

## 2.2 Results of abstraction and discharge monitoring

### 2.2.1 Provison of company data

During the monitoring period of this report, the Waikaikai landfarm received landfarmable material from six different well site locations, the type and weight of the material delivered is provided in the table below.

**Table 1** Material delivery register

Wellsite	Liquid m <sup>3</sup>	Solid m <sup>3</sup>	Oily Sludge
TAG Cheal B	224	50	
NZEC Waihapa			65.5
NZEC Copper Moki			41
KEA Puka	337	183	
Origin	277		
STOS		2,748	
<b>Total m<sup>3</sup></b>	<b>838</b>	<b>2,981</b>	<b>106</b>

The company must notify the Council within 48 hours prior to receiving material. These notifications which are a consented obligation, detail the amount of material, the type of material and the volume to be stored<sup>1</sup>. The Company undertakes the collection and analysis of a representative sample of the material to be stored prior to application to land<sup>2</sup>. This analysis that was undertaken by the Company is supplied in their annual report which is provided in the Appendix II.

### 2.2.2 Results of receiving environment monitoring

#### 2.2.2.1 Council soil results

The Council undertook the collection of soil samples throughout the monitoring period. The rationale was to ascertain the quality of the landfarming operations in the first instance, to check the application rates have been undertaken in a sufficient way. Secondly the parcels of land which have received applications of material are monitored to quantify the degradation rates of the material as it bio remediates in an in-situ state. The Council collected six composite soil samples in the 2014-15 period. The methodology utilised by the Council for the collection of soils is dictated in Section 1.5.4. The analysis of the Council collected soils is provided in Table 2.

**Table 2** Council soil sample results Waikaikai Landfarm 2014-15

Parameter	Unit	23 Sep 2014	23 Sep 2014	10 Oct 2014	10 Oct 2014	10 Oct 2014	09 Jun 2015
Calcium	mg/kg	4.5	23.2	180.6	121.9	64.6	30.1
Chloride	mg/kg	15.1	53.7	32.0	47.6	63.4	10.7
Conductivity	mS/m@20°C	12.2	43.2	95.5	89.7	68.4	29.6
Total Hydrocarbon	mg/kg	6	83	107	110	73	246
Potassium	mg/kg	-	-	115.4	119.0	126.2	47.4
Moisture factor	nil	1.113	1.138	1.122	1.101	1.067	1.130
Magnesium	mg/kg	1.9	5.0	19.3	15.4	8.2	5.1
Sodium	mg/kg	8.3	18.9	14.2	15.5	15.7	28.6
Ammoniacal	mgN/kg	-	-	1.47	1.49	1.23	0.39

<sup>1</sup> Consent 5956-1.7 Condition 5

<sup>2</sup> Consent 5956-1.7 Condition 7

Parameter	Unit	23 Sep 2014	23 Sep 2014	10 Oct 2014	10 Oct 2014	10 Oct 2014	09 Jun 2015
Nitrogen							
Nitrite/ Nitrate Nitrogen	mgN/kg	-	-	1.13	1.02	0.85	1.78
pH	pH	6.0	6.9	7.4	7.4	7.5	6.88
Sodium Absorption Ratio	None	0.82733	0.92819	0.26831	0.35171	0.48918	1.26920
Total Soluble Salts	mg/kg	95.5	336.5	747.4	702.0	535.3	231.6

Soil samples collected and analysed by the Council in this monitoring period are detailed above in Table 2 and locations are depicted in Figure 2. The analysis detailed no exceedance in comparison to the stipulated consent conditions with respect to chloride, conductivity, sodium and total soluble salts. However, metal analysis and speciation of hydrocarbon is undertaken by the Company and this is provided in the following section.



**Figure 2** Council soil sample transects

#### 2.2.2.2 Company provided soil result

The Company provided the Council with one soil sample in this monitoring period (Table 3). Analysis of heavy metals undertaken in this sample detailed no exceedance with respect to consent conditions. All metals were below their stipulated criteria<sup>3</sup>. However, salt concentrations in terms of sodium were close to their surrender limit of 460 mg/kg.

Hydrocarbon speciation analysis returned a low concentration in the diesel range of C15-C36 -165 mg/kg which is minimal. The remaining mono aromatic hydrocarbon and poly-aromatic analysis returned results below the limit of detection.

<sup>3</sup> Consent 5956-1.7 Condition 27 Heavy Metal Concentration Appendix I

The location of the soil samples and the analysis technique are detailed in the Company supplied annual report which is attached in Appendix II.

The consent holder must be mindful when collecting a soil sample to encapsulate the zone of application, which in some cases may extend to a depth of 450 mm+/- bgl, rather than the stated 75 mm bgl.

**Table 3** Company supplied soil sample results

Parameter	Unit	22 May 2015
Dry matter (Env)	g/100g as rcvd	79
Total recoverable arsenic	mg/kg dry wt	< 2
Total recoverable cadmium	mg/kg dry wt	< 0.10
Total recoverable chromium	mg/kg dry wt	9
Total recoverable copper	mg/kg dry wt	25
Total recoverable lead	mg/kg dry wt	3.8
Total recoverable mercury	mg/kg dry wt	< 0.10
Total recoverable nickel	mg/kg dry wt	5
Total recoverable sodium	mg/kg dry wt	450
Total recoverable vanadium	mg/kg dry wt	108
Total recoverable zinc	mg/kg dry wt	49
Chloride	mg/kg dry wt	21
Hydrocarbons C7 - C9	mg/kg dry wt	< 9
Hydrocarbons C10 - C14	mg/kg dry wt	< 20
Hydrocarbons C15 - C36	mg/kg dry wt	165
Total hydrocarbons (C7 - C36)	mg/kg dry wt	165
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	< 0.14
Phenanthrene	mg/kg dry wt	< 0.03
Pyrene	mg/kg dry wt	< 0.03
Benzene	mg/kg dry wt	< 0.06
Toluene	mg/kg dry wt	< 0.06
Ethylbenzene	mg/kg dry wt	< 0.06
m&p-Xylene	mg/kg dry wt	< 0.11
o-Xylene	mg/kg dry wt	< 0.06
Soluble Salts	g/100g dry wt	< 0.05
Conductivity from soluble salts	mS/cm	< 0.2

### 2.2.2.3 Council groundwater results

During the 2014-2015 monitoring period the Council undertook groundwater sampling of the operational monitoring bore network. The network, which is a conditional requirement of the consent<sup>4</sup>, was installed to quantify the quality of the groundwater onsite. The intent of this monitoring is to specifically understand if any effects are permeating from the storage cells and/or the spreading areas.



**Figure 3** Groundwater monitoring well locations with respect to the site

The locations of the monitoring wells are detailed in Figure 3. GND 2290-2292 are located in close proximity to the storage cells, while GND 2293 and 2294 are located at the down gradient perimeter to ascertain the potential for offsite effects.

The Council monitored the groundwater wells four times throughout the monitoring year, this was undertaken to understand the seasonal fluctuations which may occur across the site. The analysis undertaken by the Council is provided in the following four Tables 4-8.

**Table 4** Annual groundwater monitoring results for GND 2290

Parameter	Unit	GND2290	GND2290	GND2290	GND2290
		18 Jul 2014	07 Nov 2014	25 Feb 2015	04 May 2015
Acid soluble barium	g/m <sup>3</sup>	0.064	0.065	0.031	0.032
Dissolved barium	g/m <sup>3</sup>	0.045	0.065	0.031	0.025
Benzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Chloride	g/m <sup>3</sup>	67.4	62.5	40.6	38.6
Conductivity	mS/m@20°C	45.0	55.0	35.4	31.9
Ethylbenzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010

<sup>4</sup> Consent 5956-1.7 Condition 3, Appendix I

Parameter	Unit	GND2290	GND2290	GND2290	GND2290
		18 Jul 2014	07 Nov 2014	25 Feb 2015	04 May 2015
Total Hydrocarbon	g/m <sup>3</sup>	<0.7	<0.7	<0.7	<0.7
HC C7-C9	g/m <sup>3</sup>	<0.10	<0.10	<0.10	<0.10
HC C10-C14	g/m <sup>3</sup>	<0.2	<0.2	<0.2	<0.2
HC C15-C36	g/m <sup>3</sup>	<0.4	<0.4	<0.4	<0.4
Water Level	m	3.314	3.164	3.442	3.070
Sodium	g/m <sup>3</sup>	31.6	38.5	29.3	29.6
pH	pH	6.8	6.6	6.8	6.6
Total Dissolved Salts	g/m <sup>3</sup>	348	425	273	246
Temperature	°C	14.7	16.8	17.3	16.5
Toluene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
meta-XYLENE	g/m <sup>3</sup>	<0.002	<0.002	<0.002	<0.002
ortho-XYLENE	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010

**Table 5** Annual groundwater monitoring results for GND 2291

Parameter	Unit	GND2291	GND2291	GND2291	GND2291
		18 Jul 2014	07 Nov 2014	25 Feb 2015	04 May 2015
Acid soluble barium	g/m <sup>3</sup>	0.17	0.015	0.12	0.011
Dissolved barium	g/m <sup>3</sup>	0.011	0.013	0.020	0.010
Benzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Chloride	g/m <sup>3</sup>	83.7	182	729	625
Conductivity	mS/m@20°C	52.9	85.1	257	206
Ethylbenzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Total Hydrocarbon	g/m <sup>3</sup>	<0.7	<0.7	<0.7	<0.7
HC C7-C9	g/m <sup>3</sup>	<0.10	<0.10	<0.10	<0.10
HC C10-C14	g/m <sup>3</sup>	<0.2	<0.2	<0.2	<0.2
HC C15-C36	g/m <sup>3</sup>	<0.4	<0.4	<0.4	<0.4
Water Level	m	5.196	4.900	5.350	4.988
Sodium	g/m <sup>3</sup>	41.0	54.0	81.0	72.4
pH	pH	6.2	6.2	6.1	6.0
Total Dissolved Salts	g/m <sup>3</sup>	409	658	1,988	1,593
Temperature	°C	15.2	15.5	16.6	15.9
Toluene	g/m <sup>3</sup>	<0.0010	<0.0010	0.0022	0.0078
meta-XYLENE	g/m <sup>3</sup>	<0.002	<0.002	<0.002	<0.002
ortho-XYLENE	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010

**Table 6** Annual groundwater monitoring results for GND 2292

Parameter	Unit	GND2292	GND2292	GND2292	GND2292
		18 Jul 2014	07 Nov 2014	25 Feb 2015	04 May 2015
Acid soluble barium	g/m <sup>3</sup>	0.103	0.56	1.1	0.73



Parameter	Unit	GND2292	GND2292	GND2292	GND2292
		18 Jul 2014	07 Nov 2014	25 Feb 2015	04 May 2015
Dissolved barium	g/m <sup>3</sup>	0.037	0.07	0.83	0.69
Benzene	g/m <sup>3</sup>	<0.0010	<0.0010	0.0012	<0.0010
Chloride	g/m <sup>3</sup>	858	550	<b>2,780</b>	2,370
Conductivity	mS/m@20°C	276	170	790	660
Ethylbenzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Total Hydrocarbon	g/m <sup>3</sup>	<0.7	<0.7	<0.7	<0.7
HC C7-C9	g/m <sup>3</sup>	<0.10	<0.10	<0.10	<0.10
HC C10-C14	g/m <sup>3</sup>	<0.2	<0.2	<0.2	<0.2
HC C15-C36	g/m <sup>3</sup>	<0.4	<0.4	<0.4	<0.4
Water Level	m	4.959	5.177	5.463	4.960
Sodium	g/m <sup>3</sup>	114	109	735	687
pH	pH	6.1	6.2	6.0	6.0
Total Dissolved Salts	g/m <sup>3</sup>	2,134	1,315	<b>6,112</b>	<b>5,106</b>
Temperature	°C	16.8	15.8	16.6	16.0
Toluene	g/m <sup>3</sup>	<0.0010	0.0088	<0.0010	<0.0010
meta-XYLENE	g/m <sup>3</sup>	<0.002	<0.002	<0.002	<0.002
ortho-XYLENE	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010

**Table 7** Annual groundwater monitoring well results for GND 2293

Parameter	Unit	GND2293	GND2293	GND2293	GND2293
		18 Jul 2014	24 Nov 2014	25 Feb 2015	04 May 2015
Acid soluble barium	g/m <sup>3</sup>	0.52	0.372	0.47	0.34
Dissolved barium	g/m <sup>3</sup>	0.52	0.37	0.35	0.31
Benzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Chloride	g/m <sup>3</sup>	2020	924	964	944
Conductivity	mS/m@20°C	581	312	311	306
Ethylbenzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Total Hydrocarbon	g/m <sup>3</sup>	<0.7	<0.7	<0.7	<0.7
HC C7-C9	g/m <sup>3</sup>	<0.10	<0.1	<0.10	<0.10
HC C10-C14	g/m <sup>3</sup>	<0.2	<0.2	<0.2	<0.2
HC C15-C36	g/m <sup>3</sup>	<0.4	<0.4	<0.4	<0.4
Water Level	m	1.777	1.748	2.225	1.742
Sodium	g/m <sup>3</sup>	346	192	192	166
pH	pH	6.4	6.7	6.6	6.7
Total Dissolved Salts	g/m <sup>3</sup>	<b>4,495</b>	2,414	2,406	2,367
Temperature	°C	15.2	15.9	18.3	16.5
Toluene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	0.0025
meta-XYLENE	g/m <sup>3</sup>	<0.002	<0.002	<0.002	<0.002
ortho-XYLENE	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010

**Table 8** Annual groundwater monitoring well results for GND 2294

Parameter	Unit	GND2294	GND2294	GND2294	GND2294
		18 Jul 2014	24 Nov 2014	25 Feb 2015	04 May 2015
Acid soluble barium	g/m <sup>3</sup>	0.019	0.010	0.010	0.008
Dissolved barium	g/m <sup>3</sup>	0.008	<0.005	0.008	0.008
Benzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Chloride	g/m <sup>3</sup>	44.5	38.8	41.2	41.8
Conductivity	mS/m@20°C	29.1	28.5	28.4	27.8
Ethylbenzene	g/m <sup>3</sup>	<0.0010	<0.0010	0.0010	<0.0010
Total Hydrocarbon	g/m <sup>3</sup>	<0.7	<0.7	<0.7	<0.7
HC C7-C9	g/m <sup>3</sup>	<0.10	<0.10	<0.10	<0.10
HC C10-C14	g/m <sup>3</sup>	<0.2	<0.2	<0.2	<0.2
HC C15-C36	g/m <sup>3</sup>	<0.4	<0.4	<0.4	<0.4
Water Level	m	2.347	2.339	2.651	2.386
Sodium	g/m <sup>3</sup>	29.8	29.8	27.6	28.3
pH	pH	7.0	7.2	7.1	7.0
Total Dissolved Salts	g/m <sup>3</sup>	225.1	220.5	219.7	215.1
Temperature	°C	14.4	15.1	16.5	15.1
Toluene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
meta-XYLENE	g/m <sup>3</sup>	<0.002	<0.002	<0.002	<0.002
ortho-XYLENE	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010

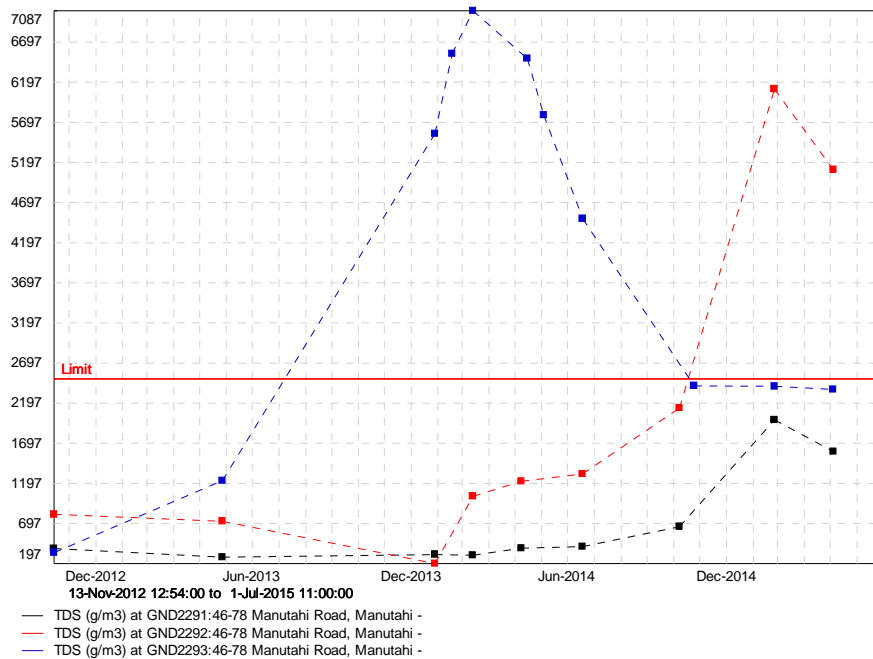
The analysis of the groundwater at the Waikaikai Landfarm is detailed in Tables 4-8 respectively. Throughout the monitoring year no detections above the limit of detection were observed in any of the monitoring wells in terms of speciated hydrocarbon or BTEX analysis.

The results did pick up a minor non conformance with respect to the concentration of total dissolved salts (TDS) specifically in well GND 2292, whereby the concentration of the TDS in the groundwater rose from 2,134 g/m<sup>3</sup> July 2014 to 5,106 g/m<sup>3</sup> May 2015.

This is a breach of one of the consent conditions, which states:

*Condition 22 of consent 5956-1.7*

*'The exercise of this consent shall not result in a level of total dissolved salts within any surface or groundwater of more than 2,500 g/m<sup>3</sup>'.*



**Figure 4** Long term TDS concentrations at the Waikaikai Landfarm

The long term TDS record is provided in Figure 4. In the previous period the degree of salt concentration was evident at the boundary line and specifically GND2293. In this period the concentration has decreased. However, in the same period the TDS concentration in GND2292 has increased above the conditional limit of 2,500 g/m<sup>3</sup> and constitutes a non-conformance with consent conditions as already discussed.

The impacted well of GND 2292 is located in the vicinity of the former storage cells, as such, legacy issues may well be impacting the ground water in the locality of that specific monitoring well GND2292. The Council will continue to monitor this impacted well moving forward.

Of note this high concentration appears to be localised and due to the location (in close proximity to the current storage cells) does not constitute an adverse environmental effect.

As the facility contains an unlined contingency cell which was observed in this monitoring period to have contained drilling mud, there is the potential that this unlined storage pit may be contributing to the increased salt concentration

The Company do not undertake groundwater monitoring.

## 2.3 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 Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance

with consents, which may damage the environment. The Incident Register (IR) 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 2014-2015 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans.

However, an incident in the previous monitoring period is still being investigated, whereby an abatement notice was issued for the discharge of drilling mud into an unlined storage pit. The findings of this investigation will be reported in the following monitoring period.

### 3. Discussion

#### 3.1 Discussion of site performance

During the monitoring year the operator sequestered close to 4,000 m<sup>3</sup> of drilling mud, associated oily waste and contaminated soil (Table 1). This was spread over area F1 and area A2. Area F1 was spread in early 2015 while area A2 was spread at the end of 2014.

A degree of analytical quantification was undertaken on behalf of the Company which led to the formation of an amended consent which allowed the Company to accept material from STOS's clean up of their Kapuni operations. This analysis was undertaken by an independent third party consultant and was considerable.

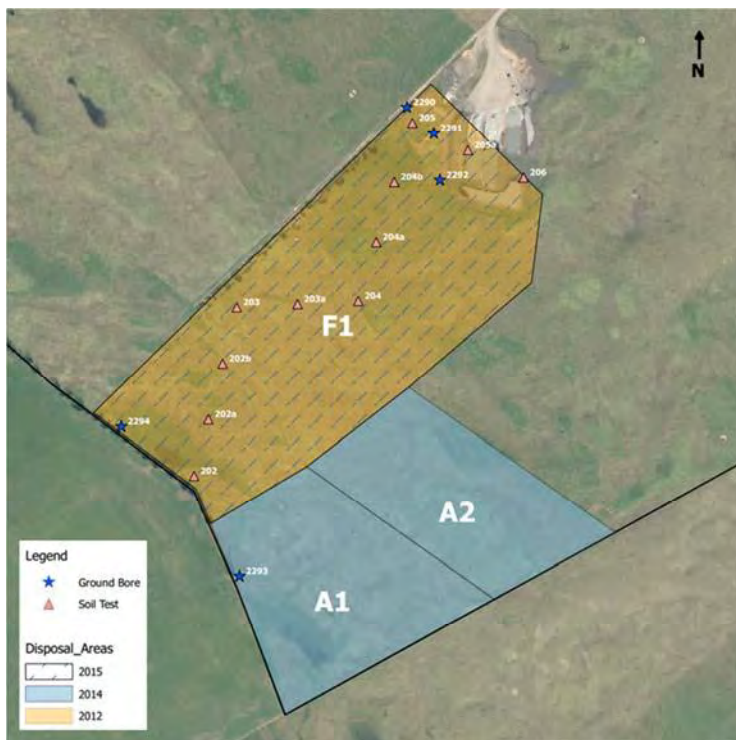
From the Council's prospective, this allows for greater transparency into the material and specifically the chemicals that are sequestered to land. The details of the analysis are provided in Appendix II.

The operator provided the Council with one composite soil sample collected from area F1 as detailed in Figure 5. However no soil sample was provided for area A2. The operator must be mindful of their obligations to their consent specifically:

*Condition 9 – j)*

*Details of monitoring, including sampling locations, sampling methods and the results of analysis*

Area A2 was completed on 31 July 2014 and the operator stipulated that post spread analysis would be undertaken within three months of application.



By comparison the Council undertook six composite soil samples. The methodology utilised by the Company (a collection of a soil sample from 75 mm bgl) does not fully encapsulate the zone of application which in some cases may be as deep as 500 mm bgl.

Moving forward the Company has been asked to undertake compliant environmental soil samples which encompass the true zone of application.

The storage site which encapsulates the storage cells has seen an improvement in terms of signage with a sign in cabin installed with a first aid station present on site. There is also a posted speed limit across the facility as well as a requirement to be mindful of stock prior to reaching the facility.

However, contained within the facility is an unlined storage cell which is termed the contingency cell by the Company. Of note is condition 4 of consent 5956-1.7 which stipulates the following:

*Condition 4:*

*Any pits intended for the storage of solid or liquid wastes shall be lined with high-grade synthetic liners or equivalent and the consent holder shall demonstrate, that the lined pits are suitable for storing liquid without leakage through the base or side walls. The Consent holder will continue to monitor the integrity of the pit liners and repair or replace liners as required.*

Highlighted by the Council's Investigating Officer in this period was the observation that the contingency (unlined) cell was at times holding drilling related material; this was detailed in section 2.1. The Officer had requested that this unlined cell be emptied (March 2015).

The Company is in the process of working with the Council on the issue of the unlined storage cell and this investigation is currently ongoing. The result of this investigation will be reported in the following monitoring period.

The landfarmed areas are growing well and the site does not suffer the same fate as other farms in the area which are very exposed to wind blown erosion. The topsoil is stable and the re-vegetation cover has been undertaken to a high standard.

In this monitoring period two specific consent conditions (conditions 22 and 24) have been breached. This is in regard to a high concentration of total dissolved salts in the groundwater ( $>2,500 \text{ g/m}^3$ ) analysed in monitoring well GND 2292. Due to this reason the Company will achieve a lower environmental performance grading for this period.

### **3.2 Environmental effects of exercise of consents**

The monitoring undertaken by the Council in relation to the Company's operation is focused on understanding the consent holder's compliance with the consent conditions. These conditions when followed should negate any adverse effect on the environment.

To understand how the Company is complying with the specific consent conditions and to quantify any potential effects, the Council monitors the mediums of groundwater and soil through analytical compliance testing. The Council also inspects the facility at various times throughout the monitoring year to cast an eye over operations and to liaise with the consent holder.

The only quantified, measured effect associated with the exercise of this consent in this monitoring period was the high concentration of salts detected in close proximity to the storage cells, Figure 4. This well is located in an area where the former storage cells were situated prior to being leveled. There could be a legacy associated with previously unlined storage cells which were levelled and then molded into the now lined storage cells which exist on the site presently.

However, as there is also a contingency cell which is unlined and observed in this monitoring period to have contained drilling related material, which could constitute to be the source of the high salt concentration, remains to be determined. The Council will continue its investigation by working with the Company to resolve this issue.

### 3.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Table 9.

**Table 9** Summary of performance for consent 5956-1.7

<b>Purpose: To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsites, and contaminated soil onto and into land via landfarming</b>		
<b>Condition requirement</b>	<b>Means of monitoring during period under review</b>	<b>Compliance achieved?</b>
1. Definitions of material, stockpiling and landfarming	N/A	N/A
2. Adoption of best practicable option	Inspection, sampling and liaison with consent holder	For the most part
3. Groundwater monitoring well installation	Monitoring	Yes
4. Cell lined with fit for purpose liner	Inspection	No- one contingency cell used but not lined, investigation on going
5. Notify TRC 48 hours prior to transfer of waste to disposal site	Notifications received	Yes
6. Notify TRC 48 hours prior to landfarming wastes	Notifications received	Yes
7. 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 and report	Yes
8. Representative sample of every 10 <sup>th</sup> load of waste	Sampling and report	Yes
9. Keep records relating to wastes, areas, compositions, volumes, dates, treatments and monitoring	Company records	Mostly- One area not sampled by Company

<b>Purpose: To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsites, and contaminated soil onto and into land via landfarming</b>		
<b>Condition requirement</b>	<b>Means of monitoring during period under review</b>	<b>Compliance achieved?</b>
10. Report on records in condition 7 to Council by 31 August each year		Yes
11. No discharge within 25 m of surface water	Inspection	Yes
12. Discharge of hydraulic fracturing fluids is prohibited	Inspection, sampling, records	Yes
13. Contaminated soil application direction	Inspection	Yes
14. All waste landfarmed within 12 months	Inspection	Yes
15. Maximum application thickness for solid wastes: a) 100 mm TPH <5% b) 50mm TPH >5%	Company records and sampling	Yes
16. Liquid wastes to be applied in a manner that prevents overland flow and ponding	Inspection	Mostly – small ponded area was noted during inspection
17. Incorporation into soil as soon as practicable to a depth of at least 250mm	Inspection and sampling	Yes
18. Hydrocarbon concentration to not exceed 20,000 mg/kg following application and incorporation	Sampling	Yes
19. Farming of contaminated soil to occur in a specific area	Inspection	Yes
20. Specific application area for secondary application	Inspection	Yes
21. Re-vegetate landfarmed areas as soon as practicable	Company records and inspections	Yes
22. Total dissolved salts in any fresh water body shall not exceed 2,500g/m <sup>3</sup>	Sampling	No -- high concentration of TDS in GND 2292
23. Consent shall not lead or be liable to lead to contaminants entering a surface water body.	Inspections and sampling	Yes
24. Activities shall not result in any adverse impacts on groundwater or surface water	Inspections and sampling	No -- , high concentration of TDS in GND 2292
25. Conductivity must be less than 400 mSm <sup>-1</sup> . If background soil has an conductivity greater than 400 mSm <sup>-1</sup> , then conductivity after disposal shall not exceed original conductivity by more than 100 mSm <sup>-1</sup>	Sampling	Yes



<b>Purpose: To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsites, and contaminated soil onto and into land via landfarming</b>		
<b>Condition requirement</b>	<b>Means of monitoring during period under review</b>	<b>Compliance achieved?</b>
26. 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
27. Concentrations of heavy metals in the soil shall at all times comply with MfE guidelines	One sample provided by the Company in this monitoring period	For the most part, one area not sampled by Company
28. Prior to expiry/cancellation of consent these levels must not be exceeded: a) conductivity, 290 mSm <sup>-1</sup> b) chloride, 700 g/m <sup>3</sup> c) dissolved salts, 2,500 g/m <sup>3</sup> d) sodium, 460 g/m <sup>3</sup> e) MAH's/PAH MfE 1999 CS NZ Table 4.15 f) TPH CCME 2008 Table 5.3 Ecological direct contact	Not applicable – sampling prior to surrender of consent	N/A
29. Consent cannot be surrendered until standards in condition 25 have been met	Not applicable	N/A
30. Notification of discovery of archaeological remains	Not applicable – none found	N/A
31. Review condition	To be undertaken in 2016	
Overall assessment of environmental performance in respect of this consent		<b>Good</b>
Overall assessment of administrative compliance in respect of this consent		<b>Good</b>

During the year, the Company demonstrated a Good level of environmental and a Good level of administrative performance with the resource consent as defined in Section 1.1.4

The Company did not receive a High rating due to the following reasons:

- Inline with best practicable option, analysis of post spread soils should be supplied by the Company in this monitoring period, this includes all areas utilised. This analysis should be undertaken to encapsulate the zone of application.
- Condition 22, the exercise of the consent shall not lead to a concentration of total dissolved salts within the groundwater of more than 2,500 g/m<sup>3</sup>. GND2292 is currently above this limit.
- Condition 24, activities shall not result in adverse effects on the groundwater or surface water.

Note the unlined cell investigation is still on going and this has not been included in the evaluation of this consent.

### **3.4 Recommendations from the 2013-2014 Annual Report**

In the 2013-2014 Annual Report, it was recommended:

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.

### **3.5 Alterations to monitoring programmes for 2015-2016**

In designing and implementing the monitoring programmes for discharges in the region, the Council has taken into account the extent of information made available by previous authorities, its relevance under the RMA, its obligations to monitor emissions/discharges and effects under the RMA, and report 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 discharging to the environment.

It is proposed that for 2015-2016 the following is recommended:

1. THAT the monitoring programme for the Waste Remediation Services Limited site of Waikaikai Landfarm in the 2015-2016 year remains unchanged from that for 2014-2015 monitoring period.
2. Investigation into the contingency pit integrity.
3. THAT the consent holder provides analytical soil results for all the recently landfarmed areas within the monitoring period and these samples are representative of the true zone of application.

### **3.6 Exercise of optional review of consent**

Resource consent 5956-1.7 provided for an optional review of the consent in June 2015. This was not undertaken as the consent is due to expire in June 2016. The Company has submitted for a renewal of Consent which will be processed once the relevant authorisations and approvals have been supplied.

## **4. Recommendations**

1. THAT the monitoring programme for the Waste Remediation Services Limited site of Waikaikai landfarm in the 2015-2016 year remains unchanged from that for 2014-2015 monitoring period.
2. Investigation into the contingency pit integrity.
3. THAT the consent holder provides analytical soil results for all the recently landfarmed areas within the monitoring period and these samples are representative of the true zone of application.
4. THAT the consent renewal be undertaken prior to expiry of the consent.

## 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.
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.
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
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 <sup>2</sup> /day	Grams/metre <sup>2</sup> /day.
g/m <sup>3</sup>	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.
IR	The Incident Register contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
L/s	Litres per second.
m <sup>2</sup>	Square Metres.

MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
mS/m	Millisiemens per metre.
Mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
NH <sub>4</sub>	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH <sub>3</sub>	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO <sub>3</sub>	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 <sub>10</sub>	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.
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 Biennial Report 2011-2013. Technical Report 2013-68.

Taranaki Regional Council (2015): Waikaikai Farm Limited Waikaikai Landfarm Monitoring Programme Annual Report 2013-14. Technical Report 2014-77.

## **Appendix I**

### **Resource consent held by Waste Remediation Services Limited**

**(For a copy of the signed resource consent  
please contact the TRC Consent Department)**





## **Appendix I**

**Resource consent held by WRS**  
**(For a copy of the resource consent**  
**please contact the TRC consent department)**



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

Name of Consent Holder:	Waste Remediation Services Limited PO Box 7150 New Plymouth 4341
Decision Date (Change):	27 November 2014
Commencement Date (Change):	27 November 2014 (Granted Date: 22 March 2002)

**Conditions of Consent**

Consent Granted:	To discharge drilling wastes from hydrocarbon exploration and production activities, oily wastes from wellsites, and contaminated soil onto and into land via landfarming
Expiry Date:	01 June 2016
Review Date(s):	January 2015
Site Location:	Lower Manutahi Road, Manutahi
Legal Description:	Lots 2 & 4 DP 7139 Lots 2 & 12 DP 14551 & Sec 742 Patea Dist Blk I Carlyle SD Sec 3 SO 453117
Grid Reference (NZTM)	1720190E-5605380N
Catchment:	Mangaroa

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

### **General condition**

- a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

### **Special conditions**

1. For the purposes of this consent the following definitions shall apply:
  - a) Drilling wastes consist of; drilling fluids and cuttings from drilling operations with water based muds, and drilling cuttings from drilling operations with synthetic based muds;
  - b) Oily wastes from wellsites consist of; sludge removed from tanks and separators, slops oil removed from well cellars, tank wax which builds up in separators and tanks, oily formation sand, contaminated ground material from leaks and spills;
  - c) Contaminated soil refers specifically to the hydrocarbon contaminated soil from the Kapuni gas field, as detailed in the application for this consent;
  - d) Storage means a discharge of wastes from vehicles, tanks, or other containers onto land for the purpose of temporary storage prior to landfarming, but without subsequently spreading onto, or incorporating the discharged material into the soil within 48 hours;
  - e) Landfarming means the discharge of wastes onto land, subsequent spreading and incorporation into the soil, for the purpose of attenuation of hydrocarbon and/or other contaminants, and includes any stripping and relaying of topsoil.
2. 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.
3. Prior to the exercise of this consent, the consent holder shall after consultation with the Chief Executive, Taranaki Regional Council, install a minimum of three groundwater monitoring bores. The bores shall be at locations and to depths that enable monitoring to determine any change in groundwater quality resulting from the exercise of this consent. The bores shall be installed in accordance with NZS 4411:2001 and all associated costs shall be met by the consent holder. The bores shall be sampled prior to stockpiling or landfarming for baseline water quality parameters and concentrations of contaminants.
4. Any pits intended for the storage of solid or liquid wastes shall be lined with high-grade synthetic liners or equivalent and the consent holder shall demonstrate, that the lined pits are suitable for storing liquid without leakage through the base or side walls. The Consent holder will continue to monitor the integrity of the pit liners and repair or replace liners as required.

5. The consent holder shall notify the Chief Executive, Taranaki Regional Council, (by emailing [worknotification@trc.govt.nz](mailto: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.
6. The consent holder shall notify the Chief Executive, Taranaki Regional Council, (by emailing [worknotification@trc.govt.nz](mailto:worknotification@trc.govt.nz)) at least 48 hours prior to landfarming stockpiled material, or material brought onto the site for landfarming within 48 hours. Notification shall include the following information:
  - a) the consent number;
  - b) the name of the well(s) from which the waste was generated;
  - c) the type(s) of waste to be landfarmed;
  - d) the volume and weight (or density) of the waste to be landfarmed;
  - e) the concentration of chlorides, nitrogen and hydrocarbons in the waste;
  - f) results of sampling undertaken in accordance with condition 10, including in a spreadsheet compatible format;
  - g) proposed loading rate and required area calculations showing compliance with condition 17 ; and
  - h) the specific location and area over which the waste will be landfarmed.
7. The consent holder shall take a representative sample of each type of waste, from each individual source, and have it analysed for the following:
  - a) total petroleum hydrocarbons (C<sub>6</sub>-C<sub>9</sub>, C<sub>10</sub>-C<sub>14</sub>, C<sub>15</sub>-C<sub>36</sub>);
  - b) benzene, toluene, ethylbenzene, and xylenes;
  - c) polycyclic aromatic hydrocarbons screening; and
  - d) chloride, nitrogen, pH, potassium, and sodium.

The consent holder shall record the data from these results onto a master spreadsheet to be supplied to the Taranaki Regional Council in accordance with conditions 9 and 10.

8. The consent holder shall take a representative sample of every 10<sup>th</sup> load of contaminated soil, and have it analysed for the following:
  - a) total petroleum hydrocarbons (C<sub>6</sub>-C<sub>9</sub>, C<sub>10</sub>-C<sub>14</sub>, C<sub>15</sub>-C<sub>36</sub>);
  - b) benzene, toluene, ethylbenzene, and xylenes;
  - c) polycyclic aromatic hydrocarbons screening

The consent holder shall record the data from these results onto a master spreadsheet to be supplied to the Taranaki Regional Council in accordance with conditions 9 and 10.

9. The consent holder shall keep records of the following:
- a) wastes from each individual well;
  - b) composition of wastes;
  - c) stockpiling area(s);
  - d) volumes of material stockpiled;
  - e) landfarming area(s), including a map showing individual disposal areas with GPS co-ordinates and up-to-date GIS shapefiles;
  - f) volumes and weights of wastes landfarmed;
  - g) dates of commencement and completion of stockpiling and landfarming events;
  - h) dates of sowing landfarmed areas;
  - i) treatments applied; and
  - j) details of monitoring, including sampling locations, sampling methods and the results of analysis;
- and shall make the records available to the Chief Executive, Taranaki Regional Council.
10. The consent holder shall provide to the Chief Executive, Taranaki Regional Council:
- a) By 31 August of each year, a report on all records required to be kept in accordance with conditions 7, 8 and 9, for the period of the previous 12 months, 1 July to 30 June;
  - b) Monthly records of all movements of waste to the site in spreadsheet format, including source, material type, transporter, volumes and receiving storage pit.
11. No discharge shall take place within 25 metres of surface water or property boundaries.
12. The discharge of hydraulic fracturing fluids is prohibited.
13. Contaminated soil shall be either:
- a) Spread directly upon arrival to site if weather conditions allow; or
  - b) Stockpiled to a maximum height of 1 m and then spread within 1 month of arriving onsite.
14. All wastes must be landfarmed as soon as practicable, but no later than twelve months after being brought onto the site.
15. 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.
16. 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.

## Consent 05956-1.7

17. 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.
18. The hydrocarbon concentration in the soil over the landfarming area shall not exceed 20,000 mg/kg dry weight at any point where:
  - a) liquid waste has been discharged; or
  - b) solid waste has been discharged and incorporated into the soil.
19. The farming of contaminated soil is restricted to the area specified in the application for this consent.
20. The secondary application of wastes is only permitted in the areas specified in condition 19. Any other areas of land used for the landfarming of wastes in accordance with conditions 13-18 of this consent, shall not be used for any subsequent discharges of waste
21. 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.
22. 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<sup>-3</sup>.
23. 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.
24. 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.
25. The conductivity of the soil/waste layer after application shall be less than 400 mSm<sup>-1</sup>, or alternatively, if the background soil conductivity exceeds 400 mSm<sup>-1</sup>, the landfarming of waste shall not increase the soil conductivity by more than 100 mSm<sup>-1</sup>.
26. The application of waste shall not increase the sodium adsorption ratio (SAR) of the soil by more than 2.0 and in no case shall the SAR of the soil/waste layer exceed 18.0 after application.

27. The concentration of heavy metals in the soil over the disposal area shall at all times comply with 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) and the *Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011*, as shown in the following table:

<u>Constituent</u>	<u>Standard (mg/kg dry weight)</u>
Arsenic	17
Cadmium	1
Chromium	600
Copper	100
Lead	160
Mercury	1
Nickel	60
Zinc	300

28. From 1 March 2016 (three months prior to the consent expiry date), constituents in the soil at any depth less than 500 mm 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). Table 4.15, for soil type sand. Canada-wide Standard for Petroleum Hydrocarbons (PHC) in Soil: Scientific rationale, Supporting Technical Document (CCME, 2008), Table 5.3 'Agricultural - ecological direct soil contact'

MAHs - benzene, toluene, ethylbenzene, xylenes  
 PAHs - naphthalene, non-carc. (pyrene), benzo(a)pyrene eq.  
 TPH - total petroleum hydrocarbons (C<sub>7</sub>-C<sub>9</sub>, C<sub>10</sub>-C<sub>14</sub>, C<sub>15</sub>-C<sub>36</sub>)

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.

29. This consent may not be surrendered unless the standards in condition 28 have been met.
30. 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.



31. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of January 2015, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 9 January 2015

For and on behalf of  
Taranaki Regional Council

---

A D McLay  
**Director - Resource Management**

Advice Note

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

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

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



## **Appendix II**

### **Company Supplied Annual Report**



23<sup>th</sup> August 2015

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

Attention Nathan Crook

**RE: Resource Consent 5956-1/ 1.7**  
**Waikaikai ( Wards )**  
**Waikaikai Farms Ltd**  
**78 Lwr Manutahi Rd**  
**RD 2, Patea 4598**

Dear Nathan,

As required under special condition 10 of resource consent 5956-1/1.7, please find information that WRS, as the operator of the site, have recorded from the 1 July 2014 to the 30<sup>th</sup> June 2015. WRS assisted with management of the site from May 2014. At that time all three pits were approximately 80% full largely with storm water with minor drilling mud and cuttings that had been placed in storage over the previous months from several different sources . The minor drilling wastes are those left in lined pits when pit emptying occurs to ensure the synthetic liner is not disturbed and to prevent wind shear from causing the liner to flog and become damaged.

From March 2014 WRS has records of drilling mud wastes placed into storage in the three lined pits ( approx. 500m<sup>3</sup> each). At the close of the reporting period on 30 June 2015 all three pits had practically no drilling wastes as these were been spread in the period June to August 2014. Some small quantities of drilling and production station wastes were received for storage from that time to the end of the reporting period. The quantities are insufficient to require another spread area be prepared and none is planned until drilling activities resume in the region.

A very dry first quarter of 2015 was followed by significant rain through to the end of June 15 resulting in the pits now largely containing storm water. Any residual wastes are now highly diluted and with low hydrocarbon levels due to removal and disposal of any oily wastes and natural volatilisation and degradation

In the spring of 2014 world oil prices were showing a steady downward trend. Returns were rapidly eroded especially for small field operators such as those operating in Taranaki. Exploratory oil and gas, and production support drilling was ceased by all junior exploration companies operating in the province. This hiatus has continued to the end of the 2015 reporting period with no new wells spudded in the region. Some development and completion rig operations continue, but the generation of drilling muds and solids for disposal within the province by landfarming has effectively ceased.

For the period from July 2014 to granting of the variation of the consent and the end of November 2104 the site was operated under the existing 5956-1 conditions. Drilling and production station waste was delivered to site only during this period; following the 27 November to the end of June 2015 no further drilling or production station material was received at the site with the exception of a small quantity of virgin water based "seal" mud that was direct spread as notified.

### Kapuni Impacted Soils Project ( KISP )

In Q3 2014 WRS were approached by STOS to provide a proposal to land farm approx. 4000m<sup>3</sup> of impacted soils from their Kapuni Gas field. Extensive sampling by STOS's consultants had established that these soils excavated from a number of producing well sites around the Kapuni field had varying levels of contaminants. The soils were in covered storage at 3 principal localities within the field. Aggregated averages of the levels of contaminants reported overall values were below the TRC's surrender criteria for land farmed soils. WRS undertook further sampling and analysis including leach tests of the soils. Following discussions with TRC an application to direct spread these soils directly over an area already land farmed where surrender criteria had already been recorded. A variation to consent was granted on 27<sup>th</sup> November 2014. Due to the inavailability of key contractors the project did not get underway until mid January 2015. Transport of the soils by sealed truck and trailer units was completed on the 20<sup>th</sup> February . Spreading of the soil was undertaken in March and following several phases of levelling, debris and rock removal, ground preparation was completed and the area re-sown in pasture in April 2015. The Kapuni soils were biologically moribund having been

stored for approximately 2 years plus in anoxic conditions developed within the fully encapsulated impermeable liners. For this reason, in spite of addition of organically rich chicken litter growth has been slow to develop. It is expected as warmer soil temperature occur and the biological activity recovers plant growth will recover and productive pasture develop. A more complete assessment and record of the KISP is contained within the AEE supplied with the application to vary the consent. Operations closely followed the descriptions provided in the AEE, the only material variation being that the soil remained as discharged in cone stockpiles to avoid dessication and dust generation until the unusually dry summer/autumn weather broke and spreading, ground preparation, and sowing could be undertaken with more certainty of autumn rain. Ground levelling and preparation was prolonged by removal of significant quantities of oilfield exploration and production type hardware waste and removal for disposal of significant volumes of boulders and rocks. Analytical results of very 10<sup>th</sup> sample ( Condition 8) from KA-4/001 to KA-6/242 were provided concurrently and directly to the TRC and WRS by email from RJ Hills Labs.

Information pertaining to resource consent 5956-1/1.7 is provided under the following headings

### **1) Delivery Record -attached 'Mud Register'**

The mud register contains the record of deliveries for storage, for each well/delivery campaign notified by email to the TRC as required by Condition 5.

### **2) Spread Areas and Events during 2014/15** **-attached diagramme Waikaikai 040615b** site map showing;

Area A 2 Disposal of Drilling/Prod. Station Wastes

Spread 16 /07 - 22/08/2014

Volume 1227m<sup>3</sup> , area 1.9Ha

Area F1 Disposal and Rehabilitation of Kapuni Impacted Soils  
Spread between 14/01 – 30/04/2015  
Volume Apprx. 2,800 m<sup>3</sup> , area 5.6Ha

### **3) Spreading Records**

All spreading campaigns were notified by email as required by Condition 5 (-1) or 6 (1.7) at least 48hrs before landfarming commenced. As all the pits at the site were emptied to a practical minimum during spreading campaigns The "Mud Register" contains a comprehensive record of the waste to be spread, viz delivery date, source of the wastes, type, volumes ( densities are not measured as this is impractical and varies hugely with time and drilling history). Key parameters are determined by analysis by RJ Hills Labs and spread location shown by the supplied diagramme .

### **4) Field Photographs - attached**

### **5) Composition of Wastes/Pre Disposal Analysis - attached**

Analytical results from RJ Hill Laboratories Ltd of sampling undertaken during the period are provided in the attached spreadsheet

### **6) TRC Inspection Notices**

The consent holder has copies of inspections, however it is not known if this is a complete record of all the inspections undertaken as there are no identifiers that would show this.



## 7) Operations Management Plan –attached

Operations at the Manawapou land farm are all undertaken generally in accordance with the Landfarm Management Plan. The document is a live document and is constantly reviewed and updated as necessary (most recently July-Aug 2015) to reflect operational requirements and practices.

### To summarise

Material stockpiled on the site is sampled prior to arrival on site. The sample can at best be considered as representative of the waste stream at a point in time in the drilling and completion cycle of a well and not the entire waste volume. Once wastes are mixed with other material in the storage pits individual consignments can no longer be identified or 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 three months of topsoil being re-applied and pasture planted. As spreading and rehabilitation was completed late in the reporting period no post disposal/spreading sampling was undertaken. Monitoring will be undertaken in the 2015-16 reporting period

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 site records which are updated as spreading and any other works are undertaken. See attached figure Waikaikai (Wards) 040615b

### Methods:

All sampling is undertaken as per standard Hill Laboratories sampling and reporting 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 75mm depth with an industry standard plug sampler, but sampling depths can vary depending on the location of the waste layer and the depth of waste disposal.

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

# 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		
B	Aug 2015		KMB		

## Table of contents

1.	Safety	1
2.	Scope	1
3.	Consents	1
4.	Definitions/ Acronyms	2
5.	Overview of Landfarming Process	2
6.	Wastes Consented for Landfarming	3
7.	Landfarm Management Process	3
8.	Landfarm Management Process	4
9.	Pre-disposal testing of Wastes	6
10.	Mixing Waste	6
11.	Calculating spreading area and depth requirements from pre-disposal sample	7
12.	Monitoring	7
	12.1 Site Inspections	7
	12.2 Soil Sampling	8
	12.3 Pasture/vegetation monitoring	9
	12.4 Photographic records	9
13.	Contingency Procedures _ Transport Spills	9
14.	Site Reinstatement and Closure	9
15.	Record Keeping	10
16.	Accountabilities/Responsibilities	10
17.	Reference Documents	11

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 5956-1.7 - Issued 27 November 2014, 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"> <li>Identify wastes types, characterisation and volumes for disposal, there are three possible types of waste:</li> <li>Water based muds;</li> <li>Synthetic based muds.</li> <li>Oily wastes</li> </ul>	Production supervisors/ drilling supervisors/ well services supervisors
2.	<p>Contact WRS Operations Manager to discuss waste type/volume/sampling/timing of disposal</p> <p>Fill out Notification of Disposal of Waste to Landfarm form and return to WRS Operations Manager</p> <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"> <li>Receive notification of well exploration activities and programme for collection and delivery of waste to land farm site</li> <li>Ensure forms are filled out completely;</li> <li>Identify mud types, approximate volumes, confirm sample collected and advise delivery</li> <li>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 if required ;and</li> <li>Disposal and monitoring can be tracked;</li> <li>Collect and submit pre-disposal sample for analysis .</li> </ul>	WRS Operations Manager
4.	<p>Notify TRC (delivery for storage):</p> <ul style="list-style-type: none"> <li>48 hours prior to delivery for stockpiling on site; and</li> <li>Advise: tracking number, consent number, name of well/site, type of waste, volume of waste.</li> </ul> <p>Planning for delivery/stockpiling:</p> <ul style="list-style-type: none"> <li>Arrange and assign storage pit into which the waste consignment is to be discharged taking into account mud type, characteristics and storage volumes available</li> <li>Ensure delivery driver completes delivery details into WRS/TRC Site Disposal Record located in hut at the disposal site shack</li> </ul>	<p>WRS Operations Manager</p> <p>WRS Operations Manager</p>
5.	<p>Delivery:</p> <ul style="list-style-type: none"> <li>Once location for stockpiling at landfarm has been arranged organize with a contractor for delivery; and</li> <li>Notify WRS of all deliveries to site, providing as much notice as practicable.</li> </ul>	Production supervisors/drilling supervisors/well services supervisors



Step	What	Who
6.	<p>Managing Stockpiles:</p> <ul style="list-style-type: none"> <li>• 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</li> <li>• Ensure material is not stockpiled at site for longer than 12 months.</li> </ul>	WRS Operations Manager
7.	<p>Planning for spreading:</p> <ul style="list-style-type: none"> <li>• Identify volumes delivered and sample results;</li> <li>• Consider mixing similar waste to provide the appropriate soil improvement properties sought by the landowner</li> </ul>	WRS Operations Manager
8.	<p>Resample for pre-disposal results</p> <ul style="list-style-type: none"> <li>• Calculate loading according to the consent for area and spreading rate calculations; and</li> <li>• 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).</li> </ul>	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)  
 $\text{volume (m}^3\text{)} / \text{depth allowed (0.10m)} = \text{area m}^2$

b) for TPH > 50,000 mg/kg  
 $\text{volume (m}^3\text{)} / \text{depth allowed (0.05m)} = \text{area m}^2$

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

Spread Area=  $200 / 0.05 = 4,000 \text{ sq.m} = 0.4\text{Ha}$

## 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 PAH Naphthalene Pyrene Benzo(a)pyrene TPH C6-C9 C10-C14 C15-C36	Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in [New Zealand MfE 1999]. Tables 4.12 and 4.15, for soil type sand.	/	/	/

### 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.
---------------------------------------	--

## 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.

Sample Type: Soil																						
		KA- 4/001 14-Jan-2015 4:00 pm	KA-4 /020 15-Jan-2015 1:00 pm	KA- 4 / 010 'B' 15-Jan-2015 1:10 pm	KA- 4 / 010 'A' 15-Jan-2015 1:10 pm	KA- 4 /040 21-Jan-2015 11:35 am	KA- A /050 22-Jan-2015 12:50 pm	KA-4 /060 22-Jan-2015 1:00 pm	KA- 4/080 27-Jan-2015 12:05 pm	KA- 4/070 27-Jan-2015 12:50 pm	KA- 4/1090 28-Jan-2015 3:10 pm	KA- 4 /100 30-Jan-2015 2:30 pm	KA-4/110 04 Feb-2015 9:10 am	KA-4/120 04 Feb-2015 3:08 pm	KA-4/130 05 Feb-2015 1:00 pm	KA-6 /140 10-Feb-2015 11:50 am	KA-6 /150 10 Feb-2015 5:00 pm	KA- 6/170 12 Feb-2015 12:00 pm	KA- 6/160 12-Feb-2015 1:00 pm	KA-6/190 16 Feb-2015 9:10 am	KA-6/200 17 Feb-2015 11:00 am	KA-6/180A 17-Feb-2015 11:15 am
	Sample Name:																					
	Lab Number:	1373137.1	1374141.1	1373675.1	1373675.2	1375759.1	1376210.1	1376850.1	1377781.2	1377781.1	1378343.1	1380151.1	1381682.1	1381682.2	1382027.1	1383230.1	1384916.1	1384914.1	1384915.1	1387188.1	1387188.3	1387188.2
Dry Matter	g/100g as rcvd	72	70	70	72	66	73	71	71	78	73	76	72	75	71	72	71	72	73	70	74	86
BTEX in Soil by Headspace GC-MS																						
Benzene	mg/kg dry wt	< 0.06	< 0.07	< 0.07	< 0.07	< 0.07	< 0.06	< 0.07	0.14	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.07	< 0.06	< 0.06	< 0.07	< 0.06	< 0.05
Toluene	mg/kg dry wt	< 0.06	< 0.07	< 0.07	< 0.07	< 0.07	< 0.06	< 0.07	0.15	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.07	< 0.06	< 0.06	< 0.07	< 0.06	< 0.05
Ethylbenzene	mg/kg dry wt	< 0.06	< 0.07	< 0.07	< 0.07	0.1	< 0.06	0.08	1.67	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	0.07	< 0.06	< 0.07	< 0.06	0.15	0.31	< 0.06	< 0.05
m&p-Xylene	mg/kg dry wt	< 0.12	< 0.13	0.96	0.67	0.5	< 0.12	0.37	18.7	< 0.11	0.32	< 0.11	< 0.12	< 0.12	1.28	0.24	< 0.13	< 0.12	0.69	0.95	0.21	< 0.10
o-Xylene	mg/kg dry wt	< 0.06	< 0.07	0.45	0.36	< 0.07	< 0.06	0.22	4.3	< 0.06	0.19	< 0.06	< 0.06	< 0.06	0.15	0.37	< 0.07	< 0.06	0.41	1.12	0.22	< 0.05
Polycyclic Aromatic Hydrocarbons Screening in Soil																						
Acenaphthene	mg/kg dry wt	< 0.03	0.03	0.23	0.16	0.2	0.08	0.21	0.77	0.07	0.17	0.13	0.03	0.06	0.2	0.2	< 0.04	0.21	0.73	0.36	0.38	0.14
Acenaphthylene	mg/kg dry wt	< 0.03	< 0.04	< 0.04	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.04	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.04	< 0.04	< 0.03	< 0.04	< 0.03	< 0.03
Anthracene	mg/kg dry wt	< 0.03	< 0.04	< 0.04	< 0.03	< 0.04	< 0.03	< 0.04	0.06	< 0.03	< 0.04	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.04	< 0.04	< 0.03	< 0.04	0.04	< 0.03
Benzo[a]anthracene	mg/kg dry wt	0.03	< 0.04	< 0.04	< 0.03	0.05	< 0.03	< 0.04	0.21	< 0.03	0.08	< 0.03	< 0.03	< 0.03	0.05	< 0.04	< 0.04	0.03	0.1	0.08	0.07	0.05
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.03	< 0.04	< 0.04	< 0.03	< 0.04	0.04	< 0.04	0.05	< 0.03	0.08	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.04	< 0.04	< 0.03	0.06	< 0.03	< 0.03
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	0.03	< 0.04	< 0.04	< 0.03	0.04	0.05	0.04	0.08	< 0.03	0.1	< 0.03	< 0.03	< 0.03	0.03	< 0.04	< 0.04	< 0.04	< 0.04	0.07	< 0.03	0.03
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.03	< 0.04	< 0.04	< 0.03	< 0.04	< 0.03	< 0.04	0.03	< 0.03	0.05	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.04	< 0.04	< 0.03	0.04	< 0.03	< 0.03
Benzo[k]fluoranthene	mg/kg dry wt	< 0.03	< 0.04	< 0.04	< 0.03	< 0.04	< 0.03	< 0.04	0.03	< 0.03	0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.04	< 0.04	< 0.03	< 0.04	< 0.03	< 0.03
Chrysene	mg/kg dry wt	0.04	< 0.04	0.06	0.05	0.08	0.07	0.06	0.23	< 0.03	0.1	0.04	< 0.03	< 0.03	0.07	< 0.04	< 0.04	0.05	0.1	0.09	0.07	0.07
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.03	< 0.04	< 0.04	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.04	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.04	< 0.04	< 0.03	< 0.04	< 0.03	< 0.03
Fluoranthene	mg/kg dry wt	0.09	0.05	0.12	0.1	0.19	0.14	0.14	0.52	0.06	0.21	0.1	0.04	0.04	0.16	0.09	0.05	0.13	0.43	0.25	0.22	0.21
Fluorene	mg/kg dry wt	0.63	0.14	1.16	1.02	0.87	0.38	1.37	3.5	0.37	0.77	0.58	0.2	0.29	0.84	0.89	0.15	1.27	4.5	2.1	2.4	1.18
Indeno[1,2,3-c,d]pyrene	mg/kg dry wt	< 0.03	< 0.04	< 0.04	< 0.03	< 0.04	< 0.03	< 0.04	0.04	< 0.03	0.06	< 0.03	< 0.03	< 0.03	< 0.03	< 0.04	< 0.04	< 0.04	< 0.03	0.04	< 0.03	< 0.03
Naphthalene	mg/kg dry wt	0.18	< 0.16	1.45	0.35	2	0.18	0.6	17.4	< 0.15	0.28	0.4	< 0.15	< 0.15	0.91	0.84	< 0.16	0.48	7.9	4.6	1.12	< 0.13
Phenanthrene	mg/kg dry wt	1.21	0.21	1.87	1.68	1.54	0.7	2	6.5	0.58	1.36	1.2	0.35	0.5	1.55	1.55	0.29	2.1	7.4	3.1	3.8	2.7
Pyrene	mg/kg dry wt	0.4	0.04	0.37	0.28	0.16	0.12	0.49	0.41	0.12	0.21	0.17	0.06	0.08	0.12	0.04	0.05	0.1	0.27	0.22	0.37	0.46
TPH Headspace in Soil																						
C6 - C9	mg/kg dry wt	< 4	7	12	21	14	4	4	114	3	9	< 4	< 4	11	14	12	< 4	< 4	21	14	8	< 3
C10 - C14	mg/kg dry wt	490	260	680	510	910	580	1,000	2,100	340	530	420	230	210	650	570	320	660	2,200	1,380	1,300	360
C15 - C36	mg/kg dry wt	4,000	1,190	2,600	2,000	3,000	2,400	3,700	7,500	1,530	2,100	2,300	1,150	940	2,300	1,740	1,270	2,800	6,800	3,500	4,900	4,600
Total hydrocarbons (C6 - C36)	mg/kg dry wt	4,400	1,460	3,300	2,500	3,900	3,000	4,700	9,800	1,870	2,600	2,800	1,370	1,160	3,000	2,300	1,590	3,400	9,000	4,900	6,200	4,900

Sample Type: Aqueous			
		Waikaikai Pit 3 07-Jan-2015 8:00 am	Waikaikai Pit 2 07-Jan-2015 8:20 am
	Sample Name:		
	Lab Number:	1374140.2	1374140.1
pH	pH Units	9.1	7.4
Total Potassium	g/m3	3,800	10,400
Total Sodium	g/m3	230	330
Chloride	g/m3	2,900	10,300
Total Nitrogen	g/m3	140	13.6
Nitrate-N + Nitrite-N	g/m3	< 0.10	< 0.10
Total Kjeldahl Nitrogen (TKN)	g/m3	140	13.5
BTEX in Water by Headspace GC-MS			
Benzene	g/m3	< 0.0010	0.0045
Toluene	g/m3	< 0.0010	0.0139
Ethylbenzene	g/m3	< 0.0010	< 0.0010
m&p-Xylene	g/m3	< 0.002	0.004
o-Xylene	g/m3	< 0.0010	0.0023
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq			
Acenaphthene	g/m3	< 0.0002	< 0.0007
Acenaphthylene	g/m3	< 0.0002	< 0.0007
Anthracene	g/m3	< 0.0002	< 0.0007
Benzo[a]anthracene	g/m3	< 0.0002	< 0.0007
Benzo[a]pyrene (BAP)	g/m3	< 0.0002	< 0.0007
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m3	< 0.0002	< 0.0007
Benzo[g,h,i]perylene	g/m3	< 0.0002	< 0.0007
Benzo[k]fluoranthene	g/m3	< 0.0002	< 0.0007
Chrysene	g/m3	< 0.0002	< 0.0007
Dibenzo[a,h]anthracene	g/m3	< 0.0002	< 0.0007
Fluoranthene	g/m3	< 0.0002	< 0.0007
Fluorene	g/m3	< 0.0002	< 0.0007
Indeno[1,2,3-c,d]pyrene	g/m3	< 0.0002	< 0.0007
Naphthalene	g/m3	< 0.0010	< 0.004
Phenanthrene	g/m3	< 0.0004	< 0.0007
Pyrene	g/m3	< 0.0002	< 0.0007
TPH Headspace in Water			
C6 - C9	g/m3	< 0.06	< 0.06
C10 - C14	g/m3	< 1.0	< 1.0
C15 - C36	g/m3	3	3
Total hydrocarbons (C6 - C36)	g/m3	< 4	3



KA-6 /210 19-Feb-2015 11:00 am	KA-6 /220 19-Feb-2015 11:10 am	KA-6 /230 19-Feb-2015 2:00 pm	KA- 6/240 25-Feb-2015 10:30 am	KA- 6/242 25-Feb-2015 10:25 am
1387938.1	1387938.2	1387938.3	1389790.1	1389790.2
71	75	66	78	70
< 0.07	< 0.06	< 0.07	< 0.06	< 0.07
< 0.07	< 0.06	< 0.07	< 0.06	< 0.07
< 0.07	< 0.06	0.43	< 0.06	< 0.07
< 0.13	< 0.12	2.6	< 0.11	< 0.13
< 0.07	< 0.06	1.11	< 0.06	< 0.07
< 0.3	< 0.3	0.5	< 0.03	0.13
< 0.3	< 0.3	< 0.4	< 0.03	< 0.04
< 0.3	< 0.3	< 0.4	< 0.03	< 0.04
< 0.3	< 0.3	< 0.4	< 0.03	< 0.04
< 0.3	< 0.3	< 0.4	< 0.03	< 0.04
< 0.3	< 0.3	< 0.4	< 0.03	< 0.04
< 0.3	< 0.3	< 0.4	< 0.03	< 0.04
< 0.3	< 0.3	< 0.4	0.06	0.05
< 0.3	< 0.3	< 0.4	< 0.03	< 0.04
< 0.3	< 0.3	< 0.4	0.15	0.13
1.1	0.7	2.4	0.11	0.56
< 0.3	< 0.3	< 0.4	< 0.03	< 0.04
< 1.5	< 1.5	8.1	< 0.14	0.27
2.4	1.2	3.7	0.26	0.91
0.3	< 0.3	< 0.4	0.23	0.19
< 4	9	21	< 4	8
570	350	1,220	210	620
3,700	2,000	3,400	2,800	2,900
4,300	2,400	4,600	3,000	3,500

Constituent	Standard
conductivity	290 mS/m
chloride	700 mg/kg
sodium	460 mg/kg
total soluble salts	2500 mg/kg
MAHs	Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Ministry for the Environment, 1999). Table 4.15, for soil type sand.
PAHs	
TPH	Canada-wide Standard for Petroleum Hydrocarbons (PHC) in Soil: Scientific rationale, Supporting Technical Document (CCME, 2008), Table 5.3 'Agricultural - ecological direct soil contact'

















## Analytical Report

**Final Report**

NAME: **New Zealand Energy Corp.**  
 ADDRESS: **Level 1, 5 Devon Street East, New Plymouth 4310**  
 Contact: **Sera Gibson**  
 Sample Type: **Sludge for disposal**  
 Date Sampled: **20.05.14** Date Received **20.05.14**  
 Site: **Waihapa**

TEST	Bottom layer T206A	Middle layer T206A	Units
Lab Number	M54596	M54597	
Dry Matter	<b>62</b>	<b>69</b>	g/100g as rcvd
Total Antimony*	<b>0.4</b>	<b>0.5</b>	mg/kg as rcvd
Total Arsenic*	<b>2.5</b>	<b>2.4</b>	mg/kg as rcvd
Total Boron*	<b>25</b>	<b>27</b>	mg/kg as rcvd
Total Cadmium*	<b>0.52</b>	<b>0.45</b>	mg/kg as rcvd
Total Chromium*	<b>20</b>	<b>12.7</b>	mg/kg as rcvd
Total Cobalt*	<b>3.8</b>	<b>3.7</b>	mg/kg as rcvd
Total Copper*	<b>107</b>	<b>101</b>	mg/kg as rcvd
Total Lead*	<b>57</b>	<b>55</b>	mg/kg as rcvd
Total Mercury*	<b>770</b>	<b>690</b>	µg/kg as rcvd
Total Molybdenum*	<b>11</b>	<b>6.6</b>	mg/kg as rcvd
Total Nickel*	<b>18.4</b>	<b>11.4</b>	mg/kg as rcvd
Total Potassium*	<b>430</b>	<b>350</b>	mg/kg as rcvd
Total Sodium*	<b>3,500</b>	<b>4,600</b>	mg/kg as rcvd
Total Tin*	<b>1</b>	<b>0.5</b>	mg/kg as rcvd
Total Zinc*	<b>360</b>	<b>330</b>	mg/kg as rcvd
pH	<b>7.9</b>	<b>7.9</b>	pH units
Total Nitrogen*	<b>&lt; 0.13</b>	<b>&lt; 0.13</b>	g/100g as rcvd
Chloride*	<b>3,700<sup>#</sup></b>	<b>- <sup>##</sup></b>	mg/kg as rcvd
BTEX			
Benzene	<b>580</b>	<b>520</b>	mg/kg dry wt
Toluene	<b>2,000</b>	<b>1,850</b>	mg/kg dry wt
Ethylbenzene	<b>340</b>	<b>260</b>	mg/kg dry wt
m&p-Xylene	<b>2,600</b>	<b>2,200</b>	mg/kg dry wt
o-Xylene	<b>720</b>	<b>560</b>	mg/kg dry wt
Total Petroleum Hydrocarbons	<b>300,000</b>	<b>330,000</b>	mg/kg dry wt
C7-C9	<b>18,400</b>	<b>22,000</b>	mg/kg dry wt
C10-C14	<b>40,000</b>	<b>47,000</b>	mg/kg dry wt
C15-C36	<b>240,000</b>	<b>260,000</b>	mg/kg dry wt



TEST	Bottom layer T206A	Middle layer T206A	Units
Lab Number	M54596	M54597	
Polycyclic-aromatic Hydrocarbons Screen			
Acenaphthene	7	6	mg/kg dry wt
Acenaphthylene	< 4	< 4	mg/kg dry wt
Anthracene	< 4	< 4	mg/kg dry wt
Benzo[a]anthracene	5	5	mg/kg dry wt
Benzo[a]pyrene (BAP)	4	5	mg/kg dry wt
Benzo[b]fluoranthene + Benzo[j]fluoranthene	9	9	mg/kg dry wt
Benzo[g,h,i]perylene	< 4	< 4	mg/kg dry wt
Benzo[k]fluoranthene	< 4	< 4	mg/kg dry wt
Chrysene	6	6	mg/kg dry wt
Dibenzo[a,h]anthracene	< 4	< 4	mg/kg dry wt
Fluoranthene	12	13	mg/kg dry wt
Fluorene	33	33	mg/kg dry wt
Indeno(1,2,3-c,d)pyrene	< 4	< 4	mg/kg dry wt
Naphthalene	460	500	mg/kg dry wt
Phenanthrene	62	64	mg/kg dry wt
Pyrene	15	16	mg/kg dry wt

**Comments:**

- Sample collected by Client and analysed as received at the laboratory.
- # The sample contained a significant amount of liquid, making it unsuitable for analysis by chloride in oil method. Sludge component analysed only and this should be considered when interpreting these results.
- ## Chloride in oil method could not be carried out due to the nature of the sample.
- This report must not be reproduced, except in full, without the written consent of the signatory.
- All analyses presented in this report other than those indicated (\*) have been carried out by Industrial Chemistry Services or by a sub contracted laboratory in accordance with International Accreditation New Zealand.

< End of Report >

Checked by:

(Laboratory Manager)

06/1

Page 2 of 2



## Analytical Report

**Final Report**

NAME: **New Zealand Energy Corp.**  
 ADDRESS: **Level 1, 5 Devon Street East, New Plymouth 4310**  
 Contact: **Sera Gibson**  
 Sample Type: **Sludge for disposal**  
 Date Sampled: **19.05.14** Date Received **19.05.14**  
 Site: **Waihapa**

TEST	Degasser 713-V-202	A Separator 713-V-025	Units
Lab Number	M54570	M54571	
Dry Matter	<b>65</b>	<b>45</b>	g/100g as rcvd
Total Antimony*	<b>0.3</b>	<b>0.3<sup>#</sup></b>	mg/kg as rcvd
Total Arsenic*	<b>3.5</b>	<b>1.4</b>	mg/kg as rcvd
Total Boron*	<b>13</b>	<b>13</b>	mg/kg as rcvd
Total Cadmium*	<b>0.28</b>	<b>&lt;0.05</b>	mg/kg as rcvd
Total Chromium*	<b>16.6</b>	<b>10.2</b>	mg/kg as rcvd
Total Cobalt*	<b>3.6</b>	<b>1.2</b>	mg/kg as rcvd
Total Copper*	<b>68</b>	<b>57</b>	mg/kg as rcvd
Total Lead*	<b>72</b>	<b>45</b>	mg/kg as rcvd
Total Mercury*	<b>400</b>	<b>&lt; 20</b>	µg/kg as rcvd
Total Molybdenum*	<b>8.4</b>	<b>7.4</b>	mg/kg as rcvd
Total Nickel*	<b>26</b>	<b>51</b>	mg/kg as rcvd
Potassium*	<b>320</b>	<b>72</b>	mg/kg as rcvd
Sodium*	<b>1,700</b>	<b>450</b>	mg/kg as rcvd
Total Tin*	<b>0.6</b>	<b>&lt;0.5</b>	mg/kg as rcvd
Total Zinc*	<b>210</b>	<b>62</b>	mg/kg as rcvd
Chloride*	<b>2,500</b>	<b>990</b>	mg/kg as rcvd
pH	<b>7.8</b>	<b>8.0</b>	pH units
Total Nitrogen*	<b>&lt;0.13</b>	<b>&lt;0.13</b>	g/100g as rcvd
BTEX			
Benzene	<b>740</b>	<b>700</b>	mg/kg dry wt
Toluene	<b>2,500</b>	<b>3,000</b>	mg/kg dry wt
Ethylbenzene	<b>250</b>	<b>480</b>	mg/kg dry wt
m&p-Xylene	<b>1,850</b>	<b>4,100</b>	mg/kg dry wt
o-Xylene	<b>510</b>	<b>1,250</b>	mg/kg dry wt
Total Petroleum Hydrocarbons	<b>410,000</b>	<b>1,200,000</b>	mg/kg dry wt
C7-C9	<b>62,000</b>	<b>99,000</b>	mg/kg dry wt
C10-C14	<b>70,000</b>	<b>210,000</b>	mg/kg dry wt
C15-C36	<b>280,000</b>	<b>880,000</b>	mg/kg dry wt



TEST	Degasser 713-V-202	A Separator 713-V-025	Units
Lab Number	M54570	M54571	
Polycyclic-aromatic Hydrocarbons Screen			
Acenaphthene	12	56	mg/kg dry wt
Acenaphthylene	10	54	mg/kg dry wt
Anthracene	<4	11	mg/kg dry wt
Benzo[a]anthracene	4	24	mg/kg dry wt
Benzo[a]pyrene (BAP)	<4	<5	mg/kg dry wt
Benzo[b]fluoranthene + Benzo[j]fluoranthene	4	8	mg/kg dry wt
Benzo[g,h,i]perylene	<4	<5	mg/kg dry wt
Benzo[k]fluoranthene	<4	<5	mg/kg dry wt
Chrysene	6	29	mg/kg dry wt
Dibenzo[a,h]anthracene	<4	<5	mg/kg dry wt
Fluoranthene	11	50	mg/kg dry wt
Fluorene	77	350	mg/kg dry wt
Indeno(1,2,3-c,d)pyrene	<4	<5	mg/kg dry wt
Naphthalene	940	3,900	mg/kg dry wt
Phenanthrene	146	680	mg/kg dry wt
Pyrene	13	27	mg/kg dry wt

**Comments:**

- Sample collected by Client and analysed as received at the laboratory.
- #Sample matrix has affected Antimony recovery, whereby recovery was 61%. Result may be underestimated.
- This report must not be reproduced, except in full, without the written consent of the signatory.
- All analyses presented in this report other than those indicated (\*) have been carried out by Industrial Chemistry Services or by a sub contracted laboratory in accordance with International Accreditation New Zealand.

**< End of Report >**

Checked by:

(Laboratory Manager)

06/1

Page 2 of 2

CHEAL-B Well Site									
Date	Tag Doc #	Liquid Type - m³	Solid Type - m³	Transport Company	Total Hours	Estimated Cost	Disposal Site	Pit Number	Entered By
13-05-14	779	10		Symons Tanker	4.75				
17-05-14		40		Symons Tanker	6				
18-05-14		60		Symons Tanker	8				
21-05-14	781	14		Symons Tanker	6				
22-05-14	782		15	Willy Tipper	4.5				
22-05-14	783	15		Symons Tanker	4.5				
23-05-14	784		15	Willy Tipper	5.5				
24-05-14	787		15	Willy Tipper	5.5				
23-05-14	785	16		Symons Tanker	4.75				
23-05-14	786	17.5		Symons Tanker	4.5				
23-05-14	788	16		Symons Tanker	4.5				
25-05-14	789		15	Willy Tipper	5.5				
	790	19		Symons Tanker	4.5				
21-05-14	780		9	Willy Tipper	4.5				
26-05-14	791		16	Willy Tipper	5				
26-05-14	792	18		Symons Tanker	4				
27-05-14	793		9	Willy Tipper	4				
27-05-14	794	18		Symons Tanker	4.5				
28-05-14	795		14	Willy Tipper	5.5				
28-05-14	796	20		Symons Tanker	4.5				
29-05-14	798		15	Willy Tipper	5.5				
30-05-14	800		12	Willy Tipper	5.5				
31-05-14	803		7	Willy Tipper	4				
29-05-14	797	19		Symons Tanker	5				
29-05-14	799	19		Symons Tanker	5.25				
30-05-14	801	19		Symons Tanker	4.5				
30-05-14	802	19		Symons Tanker	4.5				
31-05-14	804	19		Symons Tanker	4.5				
	<b>Totals</b>	<b>358.5</b>	<b>142</b>		<b>139.25</b>				
01-06-14	805		6	Willy Tipper	4				
02-06-14	806	19		Symons Tanker	4.5				
03-06-14	808		10	Willy Tipper	5		Lower Manutahi rd		Tony
03-06-14	807	20		Symons Tanker	5.75		Lower Manutahi rd		
05-06-14	811		9	Willy Tipper	4.5		Lower Manutahi rd		Tony
	809	19		Symons Tanker	4.5		Lower Manutahi rd		Tony
	810	38		Symons Tanker	9.25		Lower Manutahi rd		Tony
	812	12		Symons Tanker	4.5		Lower Manutahi rd		Tony
12-06-14	813		9	Willy Tipper	4.5		Lower Manutahi rd		Tony
	814	17		Symons Tanker	4.5		Lower Manutahi rd		Tony
	816	19		Symons Tanker	7		Lower Manutahi rd		Tony
	818	16		Symons Tanker	4.5		Lower Manutahi rd		Tony
	821	-		Symons Tanker	-		Lower Manutahi rd		Tony
	821	35		Symons Tanker	10		Lower Manutahi rd		Tony
13-06-14	815		14	Willy Tipper	4.5		Lower Manutahi rd		Tony
14-06-14	817		15	Willy Tipper	4.5		Lower Manutahi rd		Tony
15-06-14	819		15	Willy Tipper	5.5		Lower Manutahi rd		Tony
15-06-14	820		12	Willy Tipper	4.5		Lower Manutahi rd		Tony
16-06-14	820		14	Willy Tipper	4.75		Lower Manutahi rd		Tony
17-06-14	822		21	Willy Tipper	9		Lower Manutahi rd		Tony
18-06-14	824		12	Willy Tipper	5		Lower Manutahi rd		Tony
	823	16		Symons Tanker	4		Lower Manutahi rd		Tony
	825	20		Symons Tanker	4.5		Lower Manutahi rd		Tony
20-06-14	827		20	Willy Tipper	5.5		Lower Manutahi rd		Tony
20-06-14	826	19		Symons Tanker	5		Lower Manutahi rd		
20-06-14	828	19		Symons Tanker	4.5		Lower Manutahi rd		
22-06-14	830	19		Symons Tanker	5		Lower Manutahi rd		Tony
23-06-14	829		14	Willy Tipper	5.5		Lower Manutahi rd		Tony
23-06-14	831	19		Symons Tanker	5		Lower Manutahi rd		Tony
24-06-14	832		14	Willy Tipper	5.5		Lower Manutahi rd		Tony
25-06-14	833		7	Willy Tipper	4		Lower Manutahi rd		Tony
26-06-14	834	5		Symons Tanker	4		Lower Manutahi rd		Damion
27-06-14	835	19		Symons Tanker	4		Lower Manutahi rd		Damion
28-06-14	836		7	Willy Tipper	4		Lower Manutahi rd		Damion
28-06-14				Willy Tipper	1	Call-out	Lower Manutahi rd	Pit # 1	Damion
28-06-14	837	19		Symons Tanker	5		Lower Manutahi rd	Pit # 2	Damion
30-06-14	838		24	Willy Tipper	6		Wards - Lower Manutahi Rd	Pit # 1	Damion
	<b>Totals</b>	<b>350</b>	<b>223</b>		<b>182.75</b>				
02-07-14	840		7	Willy Tipper	4		Wards - Lower Manutahi Rd	Pit # 1	Damion
02-07-14	839	37		Symons Tanker	9		Wards - Lower Manutahi Rd	Pit # 2	Damion
03-07-14	841	19		Symons Tanker	6.5		Wards - Lower Manutahi Rd	Pit # 2	Damion
03-07-14	842		10	Willy Tipper	4		Wards - Lower Manutahi Rd	Pit # 1	Damion
04-07-14	843	19		Symons Tanker	4.5		Wards - Lower Manutahi Rd	Pit # 2	Tony
04-07-14		19							
05-07-14	844		14	Willy Tipper	8		Wards - Lower Manutahi Rd	Pit # 1	Tony
06-07-14	845	57		Symons Tanker	11.25		Wards - Lower Manutahi Rd		Damion
07-07-14	845	54		Symons Tanker	5		Wards - Lower Manutahi Rd		Damion
07-07-14	846		5	Willy Tipper	5		Wards - Lower Manutahi Rd		Damion
08-07-14	847	19		Symons Tanker	5.5		Wards - Lower Manutahi Rd		Damion
12-07-14	848		14	Willy Tipper	4.5		Wards - Lower Manutahi Rd		Damion
	<b>Totals</b>	<b>224</b>	<b>50</b>		<b>67.25</b>				
	<b>Totals</b>	<b>0</b>	<b>0</b>		<b>0</b>				
	<b>Totals</b>	<b>0</b>	<b>0</b>		<b>0</b>				
	<b>Totals</b>	<b>0</b>	<b>0</b>		<b>0</b>				
	<b>Totals</b>	<b>932.5</b>	<b>415</b>		<b>389.25</b>	<b>0</b>			

volumes recorded on 7

## 38K CTU Field Maintenance Tracker

# Tag Cheal G Well Site

[illegible]

## 38K CTU Field Maintenance Tracker

[illegible]

WBM



Grey Water

Black Water

 Solid

## 38K CTU Field Maintenance Tracker

# NZEC Copper Moki Well Site

[illegible]

KEA PUKA Well Site									
Date	Rig Doc #	Liquid Type - m³	Solid Type - m³	Transport Company	Total Hours	Estimated Cost	Disposal Site	Pit Number	Entered By
01-07-14					1				
04-07-14	Nil	15.87		Symons Tanker	6		Lower Man	Pit # 2	Tony
25-07-14	116		6						
25-07-14	117		5						
26-07-14	118		5	Willy Tipper					
27-07-14	119		11	Willy Tipper					
27-07-14	120		12	Willy Tipper					
28-07-14	121		9	Willy Tipper					
28-07-14	122		12	Willy Tipper	5		Lower Man	Pit # 1	Damion
30-07-14	123		12	Willy Tipper	5		Lower Man	Pit # 1	Damion
31-07-14	124		15	Willy Tipper	4.5		Lower Man	Pit # 1	Damion
31-07-14	125		9	Willy Tipper	4.5		Lower Man	Pit # 1	Damion
	Totals	15.87	96		21.5				
01-08-14			6	Symons Tipper	6.5		Lower Man	Pit # 1	Damion
02-08-14			6	Symons Tipper	5.5		Lower Man	Pit # 1	Damion
03-08-14		19		Tube	9		Lower Manutahi rd		Rachael
07-08-14		19		Tube	7		Lower Manutahi rd		Rachael
07-08-14			10	Symons Tipper	6		Lower Manutahi rd		Rachael
07-08-14		19		Tube	7.5		Lower Manutahi rd		Rachael
08-08-14		19		Tube	7.5		Lower Manutahi rd		Rachael
09-08-14		19		Tube	7.5		Lower Manutahi rd		Rachael
10-08-14		19		Tube	6.25		Lower Manutahi rd		Rachael
10-08-14			8	Symons Tipper	4.25		Lower Manutahi rd		Rachael
10-08-14			9	Symons Tipper	4.5		Wards - Lower Manutahi rd		Rachael
13-08-14		19		Tube	3.75		Wards - Lower Manutahi rd		Rachael
13-08-14		19		Tube	3.75		Wards - Lower Manutahi rd		Rachael
13-08-14							Cancelled Load		Rachael
13-08-14		19		Tube	6		Wards - Lower Manutahi rd		Rachael
14-08-14		19		Tube	3		Wards - Lower Manutahi rd		Rachael
17-08-14		18		Tube	6.5		Wards - Lower Manutahi rd		Rachael
18-08-14		18		Tube	5.25		Wards - Lower Manutahi rd		Rachael
18-08-14		19		Tube	6		Wards - Lower Manutahi rd		Rachael
19-08-14		19		Tube	6.5		Wards - Lower Manutahi rd		Rachael
19-08-14		19		Tube	6.5		Wards - Lower Manutahi rd		Rachael
20-08-14			7	Symons Tipper	4.5		Wards - Lower Manutahi rd		Rachael
20-08-14		19		Tube	3.75		Wards - Lower Manutahi rd		Rachael
20-08-14		19		Tube	3.75		Wards - Lower Manutahi rd		Rachael
21-08-14			9	Intergroup			Wards - Lower Manutahi rd		Rachael
21-08-14			12	Intergroup			Wards - Lower Manutahi rd		Rachael
29-08-14			20	Symons Tipper	8.45		Wards - Lower Manutahi rd		Rachael
	Totals								
		321	87		139.2				
	Totals								
		336.87	183		160.7				

[illegible]

Southern Cross Well Site									
Tag	Liquid	Solid	Transport	Total	Estimated	Disposal Site	Pit Number	Entered	
Date	Doc #	Type - m³	Type - m³	Company	Hours	Cost		By	
28-03-14	726		10	Willy Tipper	5		Lower Manutahi rd		WBM
29-03-14		20		Symons Tanker	6		Lower Manutahi rd		Grey Water
29-03-14	728		17	Willy Tipper	4.5		Lower Manutahi rd		Black Water
30-03-14	730		17	Willy Tipper	4.5		Lower Manutahi rd		Solid
31-03-14	731		16	Willy Tipper	5		Lower Manutahi rd		
01-04-14	732		17	Willy Tipper	5		Lower Manutahi rd		
02-04-14	734		11	Willy Tipper	4.5		Lower Manutahi rd		
29-03-14	729	20		Symons Tanker	4.75		Lower Manutahi rd		
04-04-14	736		11	Willy Tipper	5		Lower Manutahi rd		
05-04-14	737		12	Willy Tipper	5		Lower Manutahi rd		
05-04-14	739		10	Willy Tipper	4.5		Lower Manutahi rd		
06-04-14	741		12	Willy Tipper	5		Lower Manutahi rd		
07-04-14	743		12	Willy Tipper	5		Lower Manutahi rd		
08-04-14	745		6	Willy Tipper	4		Lower Manutahi rd		
11-04-14		80		Symons Tanker	11.25		Wards - Lower Manutahi Rd		
12-04-14	749	20		Symons Tanker	4.5		Wards - Lower Manutahi Rd		
13-04-14	750		6	Willy Tipper	4		Wards - Lower Manutahi Rd		
14-04-14	751	20		Symons Tanker			Wards - Lower Manutahi Rd		
23-04-14	766	20		Symons Tanker	4.5		Wards - Lower Manutahi Rd		
23-04-14	766	20		Symons Tanker	4.5		Wards - Lower Manutahi Rd		
24-04-14	767		12	Willy Tipper	5		Wards - Lower Manutahi Rd		
24-04-14	768	20		Symons Tanker	4.75		Wards - Lower Manutahi Rd		
25-04-14	769	20		Symons Tanker	4.5		Wards - Lower Manutahi Rd		
26-04-14	770	20		Symons Tanker	4.5		Wards - Lower Manutahi Rd		
26-04-14	771		14	Willy Tipper	4.5		Wards - Lower Manutahi Rd		
28-04-14	772	20		Symons Tanker	10		Wards - Lower Manutahi Rd		
29-04-14		20		Symons Tanker	4.5		Wards - Lower Manutahi Rd		
30-04-14		20		Symons Tanker	4		Wards - Lower Manutahi Rd		
	Totals	320	183		138.25				
	Totals	0	0		0				
				</					

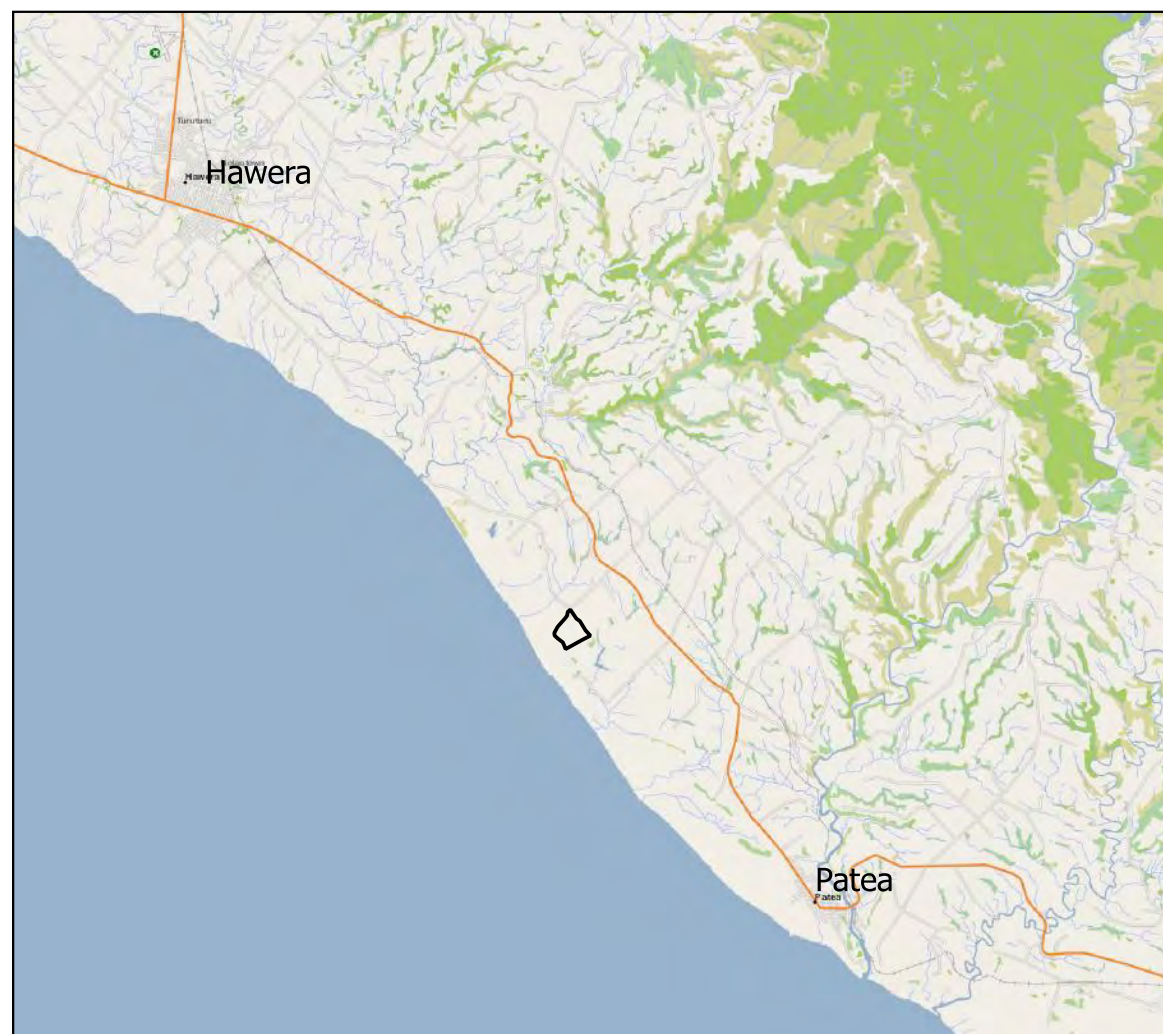


STOS Well Site												
Date	Symons Inv #	Symons Doc #	Rig Doc #	Liquid Type - m³	Solid Type - kg	Ton Conversion 0.00110231	Ton to M3 1.5 T = 1m3	Total Hours	Estimated Cost	Disposal Site	Pit Number	Entered By
04/02/2015		19789			28320	31.22	20.81	3.50		Wards - Lower Manutahi Rd		Tamarah
04/02/2015		19837			28140	31.02	20.68	2.50		Wards - Lower Manutahi Rd		Tamarah
04/02/2015		19835			28400	31.31	20.87	5.00		Wards - Lower Manutahi Rd		Tamarah
04/02/2015		19836			28900	31.86	21.24	3.00		Wards - Lower Manutahi Rd		Tamarah
04/02/2015		17163			26380	29.08	19.39	4.50		Wards - Lower Manutahi Rd		Tamarah
04/02/2015		17164			27180	29.96	19.97	2.25		Wards - Lower Manutahi Rd		Tamarah
04/02/2015		17165			26440	29.15	19.43	2.50		Wards - Lower Manutahi Rd		Tamarah
04/02/2015		16730			29140	32.12	21.41	4.50		Wards - Lower Manutahi Rd		Tamarah
04/02/2015		16728			28020	30.89	20.59	3.75		Wards - Lower Manutahi Rd		Tamarah
04/02/2015		16729			29200	32.19	21.46	2.75		Wards - Lower Manutahi Rd		Tamarah
04/02/2015		19786			28460	31.37	20.91	4.50		Wards - Lower Manutahi Rd		Tamarah
04/02/2015		18797			28780	31.72	21.15	2.50		Wards - Lower Manutahi Rd		Tamarah
04/02/2015		19788			28800	31.75	21.16	2.25		Wards - Lower Manutahi Rd		Tamarah
04/02/2015		16731			29320	32.32	21.55	3.00		Wards - Lower Manutahi Rd		Tamarah
05/02/2015		16732			29360	32.36	21.58	2.50		Wards - Lower Manutahi Rd		Tamarah
05/02/2015		16733			29120	32.10	21.40	2.50		Wards - Lower Manutahi Rd		Tamarah
05/02/2015		19790			28000	30.86	20.58	2.75		Wards - Lower Manutahi Rd		Tamarah
05/02/2015		19791			28820	31.77	21.18	2.50		Wards - Lower Manutahi Rd		Tamarah
05/02/2015		19838			28600	31.53	21.02	4.00		Wards - Lower Manutahi Rd		Tamarah
05/02/2015		19839			28300	31.20	20.80	3.00		Wards - Lower Manutahi Rd		Tamarah
05/02/2015		19840			29100	32.08	21.38	3.50		Wards - Lower Manutahi Rd		Tamarah
05/02/2015		17166			26640	29.37	19.58	4.00		Wards - Lower Manutahi Rd		Tamarah
05/02/2015		17167			26900	29.65	19.77	2.75		Wards - Lower Manutahi Rd		Tamarah
05/02/2015		17168			26540	29.26	19.50	2.75		Wards - Lower Manutahi Rd		Tamarah
05/02/2015		16734			29160	32.14	21.43	5.00		Wards - Lower Manutahi Rd		Tamarah
05/02/2015		19792			28380	31.28	20.86	5.00		Wards - Lower Manutahi Rd		Tamarah
05/02/2015		17169			27100	29.87	19.92	3.25		Wards - Lower Manutahi Rd		Tamarah
09/02/2015		19793			20680	22.80	15.20	4.00		Wards - Lower Manutahi Rd		Tamarah
09/02/2015		19794			29080	32.06	21.37	4.50		Wards - Lower Manutahi Rd		Tamarah
09/02/2015		16735			28700	31.64	21.09	4.75		Wards - Lower Manutahi Rd		Tamarah
09/02/2015		19841			28240	31.13	20.75	7.00		Wards - Lower Manutahi Rd		Tamarah
09/02/2015		17171			26680	29.41	19.61	3.50		Wards - Lower Manutahi Rd		Tamarah
10/02/2015		19797			28920	31.88	21.25	4.00		Wards - Lower Manutahi Rd		Tamarah
10/02/2015		19795			28320	31.22	20.81	3.00		Wards - Lower Manutahi Rd		Tamarah
10/02/2015		19796			29220	32.21	21.47	2.50		Wards - Lower Manutahi Rd		Tamarah
10/02/2015		16736			28960	31.92	21.28	4.25		Wards - Lower Manutahi Rd		Tamarah
10/02/2015		16738			29860	32.91	21.94	2.50		Wards - Lower Manutahi Rd		Tamarah
10/02/2015		16737			29080	32.06	21.37	2.75		Wards - Lower Manutahi Rd		Tamarah
10/02/2015		19843			29120	32.10	21.40	4.50		Wards - Lower Manutahi Rd		Tamarah
10/02/2015		19844			28700	31.64	21.09	4.00		Wards - Lower Manutahi Rd		Tamarah
10/02/2015		19845			29160	32.14	21.43	2.50		Wards - Lower Manutahi Rd		Tamarah
10/02/2015		17172			26800	29.54	19.69	2.50		Wards - Lower Manutahi Rd		Tamarah
10/02/2015		17173			27160	29.94	19.96	2.50		Wards - Lower Manutahi Rd		Tamarah
10/02/2015		17174			26620	29.34	19.56	2.25		Wards - Lower Manutahi Rd		Tamarah
11/02/2015		19800			29000	31.97	21.31	3.75		Wards - Lower Manutahi Rd		Tamarah
11/02/2015		19799			29000	31.97	21.31	2.25		Wards - Lower Manutahi Rd		Tamarah
11/02/2015		19798			29040	32.01	21.34	2.50		Wards - Lower Manutahi Rd		Tamarah
11/02/2015		17175			27020	29.78	19.86	2.50		Wards - Lower Manutahi Rd		Tamarah
11/02/2015		17176			26900	29.65	19.77	2.50		Wards - Lower Manutahi Rd		Tamarah
11/02/2015		16740			29660	32.69	21.80	3.75		Wards - Lower Manutahi Rd		Tamarah
11/02/2015		16741			28560	31.48	20.99	2.50		Wards - Lower Manutahi Rd		Tamarah
11/02/2015		16742			29000	31.97	21.31	2.50		Wards - Lower Manutahi Rd		Tamarah
11/02/2015		19846			28740	31.68	21.12	4.00		Wards - Lower Manutahi Rd		Tamarah
11/02/2015		19847			29520	32.54	21.69	3.00		Wards - Lower Manutahi Rd		Tamarah
11/02/2015		19848			29320	32.32	21.55	3.00		Wards - Lower Manutahi Rd		Tamarah
11/02/2015		17177			26960	29.72	19.81	2.50		Wards - Lower Manutahi Rd		Tamarah
12/02/2015		17178			27740	30.58	20.39	3.25		Wards - Lower Manutahi Rd		Tamarah
12/02/2015		17179			27160	29.94	19.96	2.25		Wards - Lower Manutahi Rd		Tamarah
12/02/2015		17180			27280	30.07	20.05	2.75		Wards - Lower Manutahi Rd		Tamarah
12/02/2015		15424			28860	31.81	21.21	2.75		Wards - Lower Manutahi Rd		Tamarah
12/02/2015		15425			28700	31.64	21.09	2.50		Wards - Lower Manutahi Rd		Tamarah
12/02/2015		15426			28880	31.83	21.22	3.00		Wards - Lower Manutahi Rd		Tamarah
12/02/2015		16743			29160	32.14	21.43	4.25		Wards - Lower Manutahi Rd		Tamarah
12/02/2015		16744			29180	32.17	21.44	3.00		Wards - Lower Manutahi Rd		Tamarah
12/02/2015		16745			29220	32.21	21.47	3.75		Wards - Lower Manutahi Rd		Tamarah
12/02/2015		13114			28680	31.61	21.08	2.75		Wards - Lower Manutahi Rd		Tamarah
12/02/2015		19849			28720	31.66	21.11	4.00		Wards - Lower Manutahi Rd		Tamarah
12/02/2015		19850			28580	31.50	21.00	3.25		Wards - Lower Manutahi Rd		Tamarah
13/02/2015		17181			27160	29.94	19.96	2.25		Wards - Lower Manutahi Rd		Tamarah
13/02/2015		17182			27120	29.89	19.93	2.25		Wards - Lower Manutahi Rd		Tamarah
13/02/2015		16746			28960	31.92	21.28	3.75		Wards - Lower Manutahi Rd		Tamarah
13/02/2015		16747			29180	32.17	21.44	3.00		Wards - Lower Manutahi Rd		Tamarah
13/02/2015		16748			29360	32.36	21.58	2.50		Wards - Lower Manutahi Rd		Tamarah
13/02/2015		15427			28860	31.81	21.21	2.50		Wards - Lower Manutahi Rd		Tamarah
13/02/2015		15428			28900	31.86	21.24	2.25		Wards - Lower Manutahi Rd		Tamarah
13/02/2015		15429			29520	32.54	21.69	4.00		Wards - Lower Manutahi Rd		Tamarah
13/02/2015		13115			28480	31.39	20.93	3.75		Wards - Lower Manutahi Rd		Tamarah
13/02/2015		13116			28760	31.70	21.13	3.00		Wards - Lower Manutahi Rd		Tamarah
13/02/2015		13117			28780	31.72	21.15	2.25		Wards - Lower Manutahi Rd		Tamarah
16/02/2015		17183			26820	29.56	19.71	2.75		Wards - Lower Manutahi Rd		Tamarah
16/02/2015		17184			26900	29.65	19.77	3.25		Wards - Lower Manutahi Rd		Tamarah
16/02/2015		17185			26880	29.63	19.75	2.75		Wards - Lower Manutahi Rd		Tamarah
16/02/2015		13118			28740	31.68	21.12	4.25		Wards - Lower Manutahi Rd		Tamarah
16/02/2015		13119			28780	31.72	21.15	3.50		Wards - Lower Manutahi Rd		Tamarah
16/02/2015		13120			28560	31.48	20.99	2.25		Wards - Lower Manutahi Rd		Tamarah
16/02/2015		16749			29080	32.06	21.37	4.00		Wards - Lower Manutahi Rd		Tamarah
16/02/2015		16750			29100	32.08	21.38	3.50		Wards - Lower Manutahi Rd		Tamarah
16/02/2015		15430			28980	31.94	21.30	2.75		Wards - Lower Manutahi Rd		Tamarah
16/02/2015		15431			29180	32.17	21.44	2.75		Wards - Lower Manutahi Rd		Tamarah
16/02/2015		17186			27280	30.07	20.05	4.75		Wards - Lower Manutahi Rd		Tamarah
16/02/2015		15432			28840	31.79	21.19	4.50		Wards - Lower Manutahi Rd		Tamarah
17/02/2015		17187			26940	29.70	19.80	2.50		Wards - Lower Manutahi Rd		Tamarah
17/02/2015		15433			28980	31.94	21.30	3.00		Wards - Lower Manutahi Rd		Tamarah
17/02/2015		15434			28720	31.66	21.11	4.00		Wards - Lower Manutahi Rd		Tamarah
17/02/2015		17503			29240	32.23	21.49	3.50		Wards - Lower Manutahi Rd		Tamarah
17/02/2015		17504			28960	31.92	21.28	3.00		Wards - Lower Manutahi Rd		Tamarah
17/02/2015		17505			29240	32.23	21.49	2.00		Wards - Lower Manutahi Rd		Tamarah
17/02/2015		13121			28600	31.53	21.02	3.50		Wards - Lower Manutahi Rd		Tamarah
17/02/2015		13122			28560	31.48	20.99	3.00		Wards - Lower Manutahi Rd		Tamarah
17/02/2015		13123			28620	31.55	21.03	3.00		Wards - Lower Manutahi Rd		Tamarah
17/02/2015		17188			26880	29.63	19.75	3.00		Wards - Lower Manutahi Rd		Tamarah
18/02/2015		17189			26920	29.67	19.78	3.00		Wards - Lower Manutahi Rd		Tamarah
18/02/2015		17190			27040	29.81	19.87	2.75		Wards - Lower Manutahi Rd		Tamarah
18/02/2015		13124			28700	31.64	21.09	4.25		Wards - Lower Manutahi Rd		Tamarah
18/02/2015		13125			28720	31.66	21.11	3.25		Wards - Lower Manutahi Rd		Tamarah
18/02/2015		13126			28760	31.70	21.13	2.50		Wards - Lower Manutahi Rd		Tamarah

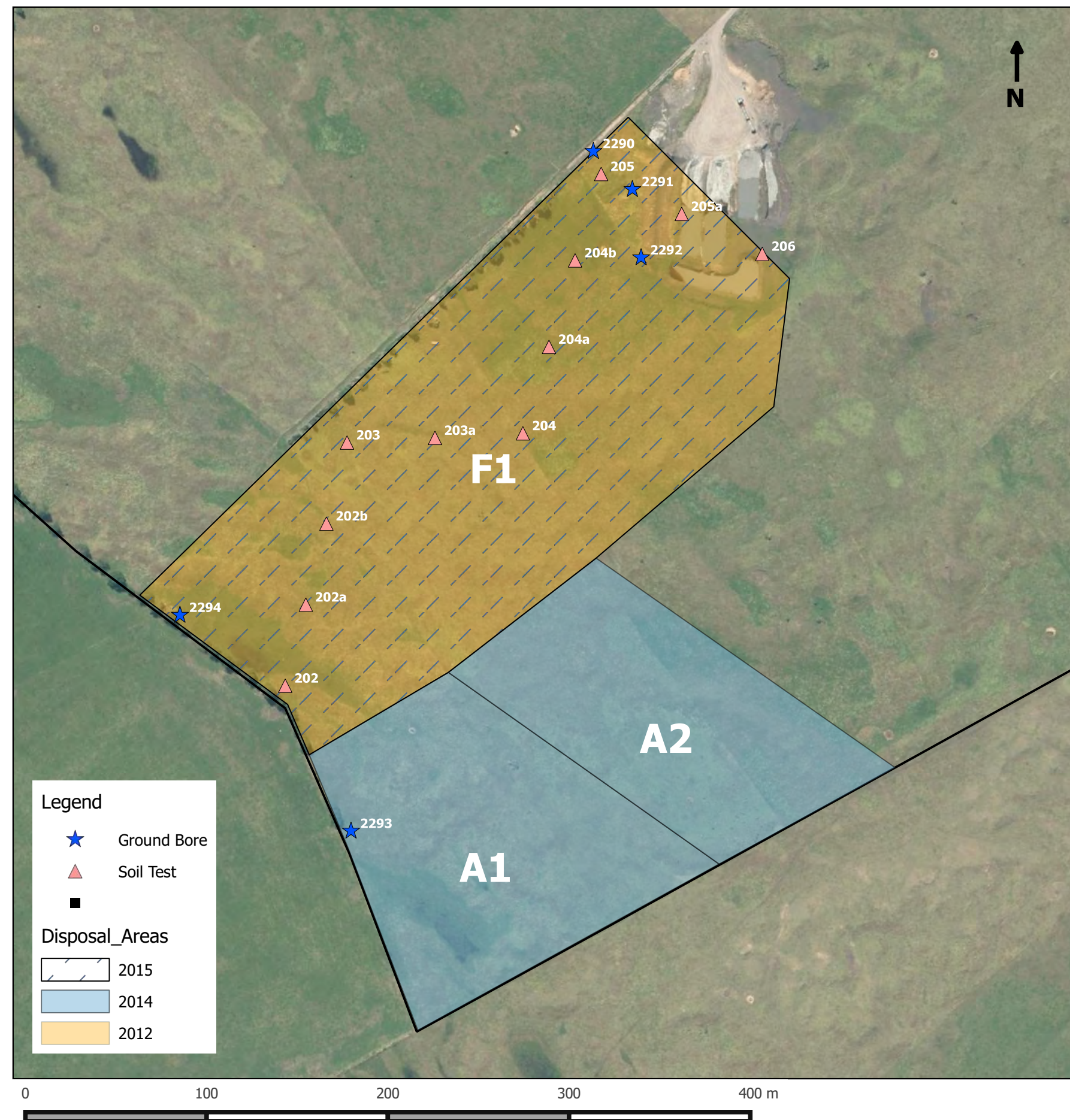
### 38K CTU Field Maintenance Tracker



[illegible]





FARM	ADDRESS	ID	NUMBER	AREA (HA)	AREA	CONSENT NO	START DATE	END DATE
WARDS	Lower Manutahi Road	F	1	5.7	56000	5956-1.7	2015-01-14	2015-04-30
WARDS	Lower Manutahi Road	A	2	1.9	19098.6	5956-1	2014-08-01	2014-08-10
WARDS	Lower Manutahi Road	A	1	2.28	22752.5	5956-1	2014-06-02	2014-07-31
WARDS	Lower Manutahi Road	F	1	5.7	56000	5956-1	2012-08-01	2012-08-30



									Datum: NZGD 2000/NZTM 2000 coordinates:EPSG 2193			Project: Waikaikai Kapuni Impacted Soil Project showing Areas of Disposal/Spreading Jan - Feb 2015						Project No. 14037		
									Notes: Aerial photography source TRC 2012 Contains data sourced from LINZ under CC-By.			Owner:  P and K Wards						Scale: 1:2500		
A 2015-06-02 Rev Date			Added Kapuni Impacted Soil Spread Area 5956-1.7 Revision Details			BLW KMB KMB By Ver App.			PO Box 8268   New Plymouth 4342   t 06 2811714 w geosync.co.nz   e info@geosync.co.nz									Drawing No. 14037_01		