

Waikaikai Farms Limited
Drilling Waste Disposal
Monitoring Programme
Biennial Report
2011-2013

Technical Report 2013 - 68

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Executive summary

Waikaikai Farms Ltd (Waikaikai) (the Company) operates a drilling waste landfarm located off Lower Manutahi Road at Manutahi. This report for the period July 2011-June 2013 describes the monitoring programme implemented by the Taranaki Regional Council to assess the Company's environmental performance during the period under review, and the results and environmental effects of the Company's activities.

The Company holds one resource consent, which includes a total of 27 conditions setting out the requirements that the Company must satisfy. This consent allows for the discharge of drilling waste onto and into land.

The Council's monitoring programme for the period under review included eighteen inspections, collection of two composite soil samples, one additional soil sample, sixteen groundwater samples, data review, and on-going liaison with the Company. No spreading of wastes had occurred in the 2011-2012 monitoring year, and hence, no receiving environment soil sampling was conducted during that monitoring year. Groundwater and receiving environment soil sampling was conducted in the 2012-2013 monitoring year, in accordance with spreading and stockpiling activities.

The monitoring indicated that during the 2011-2012 monitoring year, the site was significantly mismanaged by the contractor on behalf of the consent holder. The Council took appropriate enforcement action against the Company and the operator. The monitoring for the 2012-2013 monitoring year indicated that no adverse environmental impacts on groundwater had occurred as a result of the site mismanagement. Receiving soil sample results showed general compliance with consent conditions. There were some results where parameters relating to salinity were in excess of the limits, it will be necessary to resample to assess whether these parameters return to within the range of compliance in the 2013-2014 monitoring period.

During the 2011-2012 monitoring year, under the management of the initial operators, the Company demonstrated a poor level of environmental performance and compliance with the resource consent. During the 2012-2013 monitoring year the Company improved its level of environmental performance and compliance with the resource consent. However, as a consequence of the timing in enforcement action undertaken by the Council, the consent holder is still rated as 'poor' in the 2012-2013 year as well. There were three unauthorised incidents in relation to site activities resulting in the issuing of an abatement notice and an infringement notice.

The overall rating for this site for the monitoring period is "poor". Significant improvements were made during the 2012-2013 year following enforcement action by the Council. However, the initial mismanagement of the site was significant enough to warrant a poor rating for the entire monitoring period. Monitoring indicates that the environmental effects of the poor performance were no more than minor.

For reference, in the 2012-2013 year, 35% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 59% demonstrated a good level of environmental performance and compliance with their consents.

This report includes recommendations for the 2013-2014 year.

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1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is the Biennial Report for the period July 2011-June 2013 by the Taranaki Regional Council on the monitoring programme associated with a resource consent held by Waikaikai Farms Limited (Waikaikai) (the Company). The Company operates a landfarm situated on Manutahi Road in Manutahi, South Taranaki.

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

The consent was then transferred from Origin Energy Ltd in 2011 to the current consent holder, and was again varied in 2011 to include the disposal of oily waste. During the 2011-2012 monitoring year, Redback Contracting Ltd (Redback) began exercising the consent on behalf of the Company. In the 2012-2013 monitoring year the Council were required to intervene in site operations and Redback were no longer contracted to run the site. The site currently remains on standby for potential future use under a different site management team.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consent held by Waikaikai Farms Limited that relates to the discharge of drilling cuttings, drilling fluids and oily wastes onto and into land. This is the first Technical Report to be prepared by the Taranaki Regional Council to cover Waikaikai Farms Limited'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 Resource Management Act and the Council's obligations and general approach to monitoring sites through annual programmes, the resource consent held by Waikaikai Farms Limited, the nature of the monitoring programme in place for the period under review, and a description of the activities and operations conducted at Waikaikai Farms Limited's landfarm site.

Section 2 presents the results of monitoring during the period under review, including scientific and technical data.

Section 3 discusses the results, their interpretation, and their significance for the environment.

Section 4 presents recommendations to be implemented in the 2013-2014 monitoring year.

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

1.1.3 The Resource Management Act (1991) and monitoring

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

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

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

1.1.4 Evaluation of environmental and consent performance

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

- a **high** level of environmental performance and compliance indicates that essentially there were no adverse environmental effects to be concerned about, and no, or inconsequential (such as data supplied after a deadline) non-compliance with conditions.
- a **good** level of environmental performance and compliance indicates that adverse environmental effects of activities during the monitoring period were negligible or minor at most, or, the Council did not record any verified unauthorised incidents

involving significant environmental impacts and was not obliged to issue any abatement notices or infringement notices, or, there were perhaps some items noted on inspection notices for attention but these items were not urgent nor critical, and follow-up inspections showed they have been dealt with, and any inconsequential non compliances with conditions were resolved positively, co-operatively, and quickly.

- **improvement required (environmental) or improvement required (administrative compliance)** (as appropriate) indicates that the Council may have been obliged to record a verified unauthorised incident involving measurable environmental impacts, and/or, there were measurable environmental effects arising from activities and intervention by Council staff was required and there were matters that required urgent intervention, took some time to resolve, or remained unresolved at the end of the period under review, and/or, there were on-going issues around meeting resource consent conditions even in the absence of environmental effects. Abatement notices may have been issued.
- **poor performance (environmental) or poor performance (administrative compliance)** indicates generally that the Council was obliged to record a verified unauthorised incident involving significant environmental impacts, or there were material failings to comply with resource consent conditions that required significant intervention by the Council even in the absence of environmental effects. Typically there were grounds for either a prosecution or an infringement notice.

For reference, in the 2012-2013 year, 35% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 59% demonstrated a good level of environmental performance and compliance with their consents.

1.2 Process descriptions

1.1.1 Drilling waste

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

Drilling fluids

Oil and gas wells may be drilled with either synthetic based mud (SBM) or water based mud (WBM). As the names suggest, these are fluids with either water (fresh or saline) or synthetic oil as a base material, to which further compounds are added to modify the physical characteristics of the mud (for example mud weight or viscosity). More than one type of fluid may be used to drill an individual well. In the past, oil based muds (diesel/crude oil based) have also been used. Their use has declined since the 1980s due to their ecotoxicity; they have been replaced by SBM. SBM use olefins, paraffins or esters as a base material. While this is technically still a form of oil based fluid, these

fluids have been engineered to remove polycyclic aromatic hydrocarbons, reduce the potential for bioaccumulation and accelerate biodegradation compared with OBM.

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

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

Cuttings

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

1.1.2 Landfarming

The landfarming process has typically been used in the Taranaki region to assist the conversion of sandy coastal sites prone to erosion into productive pasture. Results of an independent research project conducted by AgKnowledge Ltd (2013) have indicated that the re-contoured sand dunes, after the inclusion of the drilling wastes (as per the consents), and with the addition of appropriate fertilisers and water (irrigation) are capable of producing high quality clover-based pastures and thus increasing the value of the land from about \$3-4000/ha to \$30-40,000/ha (2013). The full report is attached in Appendix IV.

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

1. Drilling waste is transported from wellsites by truck (cuttings) or tanker (liquids). It may be discharged directly to land or placed in a dedicated storage pit.
2. The required disposal area is prepared by scraping back and stockpiling existing pasture/topsoil and leveling out uneven ground.
3. The more viscous fraction of the 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.

Consent 5956-1 allows for the disposal of WBM cuttings and fluids, SBM cuttings, and oily waste.

The landfarming process utilized at the Waikaikai site is on a single application basis. This means dedicated spreading areas receive only single applications of waste.

When disposal is complete, the area will be able to be used for grazing following stabilisation, re-grassing and pasture development taking several months.

1.3 Site location and description

Waikaikai Farms Ltd operates a drilling waste landfarm off Manutahi Road, Manutahi. The site is owned by the resource consent holders P. F. and K. M. Wards, trading under the name Waikaikai Farms Limited. The predominant land use has previously been dairy farming. The site location is given in Figure 1. The predominant soil type has been identified as black loamy sand and vegetation growth consists mostly of pasture. Test pitting and the logging of boreholes on site indicated a relatively shallow water table. Test bores were augured to 10 m both around the wastes holding pit area and to the south-western site boundary, revealing alternating layers of sand and clays. Bore construction also revealed localised peat layers within some augured cores (approximately 4–8 m below surface). Average annual rainfall for the site is 1043 mm (taken from the nearby Patea monitoring station).

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

A summary of site data is presented below:

Site data

Location

Word descriptor:	Lower Manutahi Road, Manutahi, Taranaki
Map reference:	E 1719720
(NZTM)	N 5605515
Mean annual rainfall:	1043 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
Land use:	Farming livestock / grazing cattle

Table 1 Bore construction data

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

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

1.4 Resource consent

Waikaikai Farms Limited holds discharge permit **5956-1** to discharge drilling wastes from hydrocarbon exploration and production activities, and oily wastes from wellsites, onto and into land via landfarming. This permit was issued by the Taranaki

Regional Council on 13 October 2011 under Section 87(e) of the Resource Management Act. This resource consent is due to expire on 1 June 2016.

Condition 1 sets out definitions.

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

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

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

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

Condition 10 prohibits the discharge of fracturing fluids.

Condition 11 dictates the storage of wastes.

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

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

Condition 26 dictates surrender criteria.

Condition 27 concerns archaeological remains.

The permit is attached to this report in Appendix I.

1.5 Monitoring programme

1.5.1 Introduction

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

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

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

1.5.2 Programme liaison and management

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

- discussion, information and advice on site and waste disposal operational matters
- 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 eighteen inspections were made of the site during the monitoring period, with regard to the consents for the discharge of drilling waste. Further inspections were conducted at the site during sampling and incident follow up inspections were also conducted. Inspections focussed on the following aspects:

- Observable and/or ongoing effects upon soil, groundwater and surface water quality associated with the land disposal process
- Effective incorporation of material, application rates and associated earthworks
- Vegetation establishment and associated land stabilisation
- Integrity and management of storage facilities
- Dust and odour effects in proximity of the site boundaries
- Housekeeping and site management
- The neighbourhood was surveyed for environmental effects.

1.5.4 Chemical sampling

During the monitoring period the Council collected two composite soil samples from the Waikaikai site. During the 2011-2012 year, no spreading had been undertaken, and as such, no receiving environment soil sampling was conducted. During the 2012-2013 year one area had been spread, and two transects were sampled across this area. Each transect was sampled for a total of 12-15 subsamples at 10 m intervals to a depth of 250 mm and composited. The samples were analysed for chloride, conductivity, hydrocarbons, pH, sodium and total soluble salts.

During the monitoring period, five monitoring wells were constructed and each sampled three times. Samples were analysed for pH, temperature, conductivity, chloride, TPH and BTEX.

1.5.5 Review of analytical results

The Council reviewed soil sampling results and the annual report provided by the Company. The Company collected representative pre-disposal samples from individual waste streams prior to disposal, and receiving environment soil samples from all spreading areas post waste application. These samples were sent to an independent IANZ accredited laboratory for analysis for a wider range of contaminants.

Chemical parameters tested were (all solid/sludge samples):

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

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

2. Results

2.1 Inspections

There were a total of eighteen compliance monitoring inspections carried out at the Waikakai site during the monitoring period. Most of the inspections were scheduled compliance monitoring inspections. Several were investigative/incident follow up inspections. These are further discussed in Section 2.5 of this report, along with action taken on any matters of non-compliance.

29 August 2011

At the time of inspection a flat bed truck carrying a tank of drilling fluids had just arrived at the site and was preparing to unload. A single bund had been constructed and there appeared to be a small volume of liquid at one end of it. A small volume of cuttings was observed on the ground near the bund. The Company was informed that all material was required to be stored in allocated storage pits.

18 April 2012

No objectionable odours or visible emissions were detected upon inspection. The inspection was undertaken with the resource consent holder present to assess the activities and scale of the site. It was found that six unlined pits had been dug, of which five contained drilling wastes/muds. No signage was present. Two of the pits (the fullest) drained into an overflow liquid collection pit at the rear of the site. However, no discharge from the pits was occurring above ground at the time of inspection, and no surface water was present within 25 metres of the site. It was stated that no muds had yet been land-farmed. Discussions were then held with the resource consent holder regarding the special condition requirements and responsibility for the consent. It was further outlined that the appropriate notifications were not given prior to muds being accepted at the site. It was then agreed that in future the requirements of the resource consent would be adhered to.

15 May 2012

No objectionable odours or visible emissions were detected at the time of inspection. More muds had been added to the site pits since the last inspection. All pits contained muds. The most recent pit to receive muds was discharging liquid through the far wall, which had remained localised below the pit. No signage was present. No landfarming had yet occurred.

18 July 2012

At the time of inspection hydrocarbon odours were present around the site downwind of the pits. All pits contained muds and cuttings, some surface oils were present in two of the pits. The grass around the fringes of these pits were observed to be yellowing. Another unlined pit was found to contain a dark liquid; a sample was taken for analysis. One pit had had a bund established at the base of the far wall where the liquid had discharged through the pit wall and ponded next to the pit. Due to recent heavy rains, the level of the 'liquid' observed within the receiving pond for five pits had risen and a second pond was dug behind it. The wall was removed and reinstated after the level dropped. Groundwater levels were discussed at length with the site owner and a good knowledge of the area was demonstrated. Provision of the monitoring report was discussed also. Stockpiles of gravel type material containing some plastic lining material was present above ground away from the pits, it was outlined that if the

material originated from a well-site then it must be considered potentially contaminated material and should therefore be stored within a pit. BTW Company Ltd had recently inspected the site in order to map the disposal area and mud pits.

28 August 2012

Strong hydrocarbon odours were detected downwind of the pits. Liquid throughout some pit areas was quite dark and some solidified surface oils/grease was present through the system. Limited free-board was available in the main displaced liquid receiving pit. Washings from transport bin cleaning appeared to have been discharged into a sandy unlined pit, which had a small amount of water in the bottom. It was outlined to site staff that due to the liquid nature of the washings, in future they were to be discharged into the main pit area (lined), thus containing the material within the pond system for spreading with the other mud. No earthworks had yet occurred. It was further outlined that any muds which had been on-site for one year would need to be spread, and to advise on probable time frames.

29 August 2012

Scientific staff conducted an onsite follow-up inspection and meeting to discuss operations at the site. An incident was registered against the site, the details of which are given in Section 2.5. An abatement notice was issued to the Company directing them to complete necessary preparatory measures (install groundwater monitoring wells, remove waxy hydrocarbon material from pit surfaces) and then spread the drilling muds as per the requirements of the consent. The Company engaged BTW Company Ltd as contractors to meet the requirements of the abatement notice and to assist in the short-term management of the site.

13 September 2012

An inspection was conducted in conjunction with planning groundwater monitoring well locations. The pit area was still unkempt. BTW had dug out a new pit to the south of the existing pits and were expecting to line it over the course of the next few days. One of the pit walls had been breached and a small quantity of stormwater/WBM fluid had run off 20m into a paddock and pooled in an area.

14 September 2012

An inspection was conducted as part of a meeting with the consent holder and site staff. A pit had been lined and looked purpose fit. Contouring of the farming area had also been conducted, and no waste had been spread, which was consistent with the directives given to the Company in the abatement notice.

24 September 2012

An inspection was conducted in conjunction with finalising groundwater bore augering plans. All bores were drilled by Strata drilling services. The existing pit area was untouched as instructed by the Council. A small oily waste pit had been dug and lined to satisfaction and it was confirmed by Council staff that the waxy hydrocarbon material could be removed and stored temporarily in the newly lined pit.

25 September 2012

An inspection was conducted in conjunction with an onsite meeting with site staff. Observations were made of the progress of the groundwater bore construction. The earthworks contractor was scooping oily waste into the lined pit with a digger bucket. Discussions regarding the plan forward for farming the remaining material in the

existing pit area were held. It was agreed that farming would commence upon completion and sampling of the groundwater bores.

26 September 2012

An inspection was conducted in conjunction with groundwater bore sampling. It was confirmed that BTW would begin spreading material on Friday 29 September.

28 September 2012

An inspection was conducted in conjunction with groundwater bore sampling of the final monitoring well within the spreading area. Four of the five wells had been completed and since been sampled. Spreading was planned to commence on the following afternoon. In addition, the final well was to be completed before the weekend.

1 October 2012

An inspection was conducted in conjunction with groundwater bore sampling. All wells had been completed. Well GND2293 had been partially in-filled with sand and it was noted that it may have to be cleaned out within the next 6-12 months. The earthworks contractors had begun to farm material from the old pit area. A soil sample was collected from the base of one of the pits, which had a strong hydrocarbon /chemical odour. The method for emptying the liquid fraction of the waste was questioned, as the earthworks operator had breached the pit walls and allowed the liquid to runoff into part of the spreading area where some ponding had occurred. Discussions with management would ensue as to whether this is acceptable practice as it seems likely that there would be risk to groundwater. It was also noted that the natural barium muds 'seal' of the drained pit was patchy and unlikely to be overall impermeable, giving support to the current initiative of lining all storage pits with high-grade synthetic liners.

9 October 2012

The spreading areas and former pit area were inspected, material had been spread and the top soil was being applied. The spreading area looked acceptable. Waxy hydrocarbon material was observed in the new lined pit (non-oily waste pit) however notification had not been received for this material.

7 January 2013

The pit area was observed to be tidy, there were two lined pits in place and a third larger pit that was yet to be lined as it was not yet required for use. The pad area was well compacted and tidy. The pits contained small volumes of material to be farmed. Site staff were present at the time of inspection and discussions were held regarding the management of the site moving forward. The farmed area looked fairly good, with decent initial pasture establishment. There were a couple of small patches that would have to be re-sown. No odours or visible emissions were detected.

17 January 2013

No objectionable odours or visible emissions were detected during the inspection. Two of the lined pits at the site contained waste material; the main mud pit had plenty of freeboard available and was free of surface oils. The oily waste pit contained turbid liquid with a very small amount of windblown surface oil and blackened vegetation around the fringes. The area where muds had been previously spread was inspected, with very little mud detected within the soil profiles.

Some small areas had poor pasture strike and more mud was present in these areas. It was outlined by the consent holder that no materials had been recently received and no clients were scheduled to utilise the disposal area.

30 January 2013

An inspection was conducted in conjunction with soil sampling. The paddock had been mown and fertilised during the previous week. Small patches were observed where pasture seeding had not taken and mud was still visible. Samples taken had a hydrocarbon odour.

2 April 2013

At the time of inspection no objectionable odours or visible emissions were detected beyond the site boundary. All pits containing material were lined and found to have plenty of freeboard available, the liquid inside all of the pits were found to be dark with very little visible surface oiling. The area where muds had previously been applied had good pasture cover. No recent disposal had occurred at the site and no sources of mud had yet been arranged.

2.2 Results of discharge monitoring

During the monitoring period there was a single disposal of waste in October 2012 as directed under an abatement notice (detailed below). The material disposed of was sourced from the Cheal A, B & C, Copper Moki, Douglas and Waitapu wellsites, and consisted of mainly WBM fluids and solids with smaller quantities of waste water and some oily waste. The disposal area is identified in Figure 2.

As per the consent conditions, the Company is required to supply pre-disposal results of material to be discharged prior to discharge for the Council to review. Under Redback management, no predisposal sampling had been undertaken. Following the abatement notice BTW assisted the Company in conducting predisposal sampling directly from the storage pits. The sampling methodology was slightly altered to ensure adequate representation of the entire pit content. Spreading rate calculations were on the basis of the 'worst case' pit results reflecting the oily waste contained in some of the pits.

This oily waste material was removed from the top of the pits and stored in a high-grade synthetic lined pit prior to farming of the muds.

Pit samples results are included in the supplied report attached in Appendix II.

2.3 Provision of Company data

The Company is required to provide data regarding stockpiling, discharges to land via landfarming, predisposal results and receiving environment soil sample results to the Council throughout the monitoring period. The Company also supplies this data for review annually as a report as per the consent requirement.

A brief report was prepared for the Company by BTW for the 2011-2012 year and is attached in Appendix II.

The 2012-2013 supplied annual report for this site was received on time. A summary of the receiving environment results is provided in Table 6. The full supplied report is attached in Appendix II.

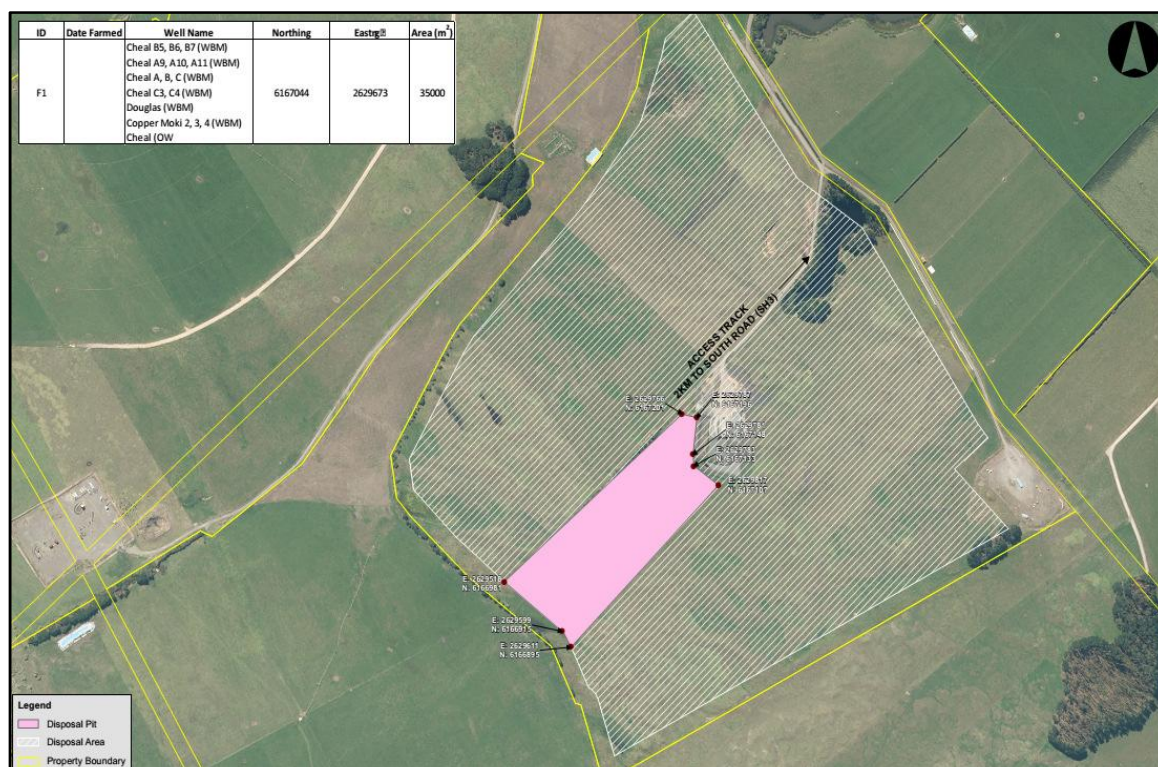


Figure 2 Supplied spreading map showing area F1, Waikaikai Landfarm

2.4 Results of receiving environment monitoring

2.4.1 TRC soil results

During the monitoring period, one spreading area had been completed. Two composite soil samples were collected by the Council by sub-sampling to a depth of 250mm across the landfarmed area F1. The results of this sampling are presented in Table 2.

Table 2 2011-2013 TRC soil sample results, Waikaikai Landfarm

Parameter	Unit	F1 (transect 1)	F1 (transect 2)	Consent limit
		30-Jan-13	30-Jan-13	
Calcium	mg/kg	176	178	-
Chloride	mg/kg DW	1010	878	700
Conductivity	mS/m@20C	496	454	400
Hydrocarbons	mg/kg DW	110	170	50,000 (application)
Moisture Factor	none	1.081	1.021	-
Magnesium	mg/kg	29.1	22.7	-
Sodium	mg/kg	141	118	460
pH	pH	7.6	7.9	-

Parameter	Unit	F1 (transect 1)	F1 (transect 2)	Consent limit
Sodium Absorption Ratio	None	2.6	2.2	18
Total Soluble Salts	mg/kg	3882	3553	2500

Bold type indicates non-compliance

The Council soil samples for the spread area of Waikaikai demonstrate, for the most part, compliance with the limits stipulated in the conditions of consent 5956-1. The levels of hydrocarbons detected are relatively low. Chloride, conductivity and total soluble salts have, on both sampled occasions, exceeded consent level limits, however at these levels are unlikely to have any sustained detrimental effects on soil structure and biota, or groundwater quality. Company supplied receiving environment soil results are summarised in Table 6 and full results are included in Appendix IV.

2.4.2 TRC groundwater results

A total of sixteen groundwater results were taken over three occasions from five monitoring wells during the monitoring period. The monitoring well locations are shown in Figure 3, and the well schematics are attached in Appendix IV. Site GND2295 was also sampled, this is a water supply bore located on the consent holder's property. The results are presented in Tables 3, 4 and 5 below.

Table 3 TRC groundwater results for monitoring wells GND2290 and GND2291, Waikaikai landfarm

Parameter	Unit	GND2290			GND2291		
		26-Sep-12	13-Nov-12	27-May-13	26-Sep-12	13-Nov-12	27-May-13
Barium	g/m3	0.034	0.04	0.024	0.014	0.01	0.43
Benzene	g/m3	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chloride	g/m3	33.6	30.3	58.7	90.6	94.6	66.8
Conductivity	mS/m@20C	-	37.5	37	-	49.9	35.8
Ethylbenzene	g/m3	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbon	g/m3	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
Nitrate	g/m3 N	23.5	23.2	22.1	35.3	34.8	32.8
pH	pH	6.8	6.8	6.8	6.6	6.5	7.8
Toluene	g/m3	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
meta-Xylene	g/m3	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
ortho-Xylene	g/m3	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

Table 4 TRC groundwater results for monitoring wells GND2292 and GND2293, Waikaikai landfarm

Parameter	Unit	GND2292			GND2293		
		27-Sep-12	13-Nov-12	27-May-13	28-Sep-12	13-Nov-12	27-May-13
Barium	g/m3	0.025	0.15	0.54	0.039	0.028	0.16
Benzene	g/m3	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chloride	g/m3	244	268	242	74.2	75.7	447
Conductivity	mS/m@20 C	-	104.8	99.6	37.9	43.2	159
Ethylbenzene	g/m3	-	<0.0010	<0.0010	-	<0.0010	<0.0010

Parameter	Unit	GND2292			GND2293		
Hydrocarbon	g/m3	-	<0.7	<0.7	-	<0.7	<0.7
Nitrate	g/m3 N	54.2	56.8	98.8	35.9	35	99.1
pH	pH	6.4	6.4	6.8	6.9	6.6	7.5
Toluene	g/m3	-	<0.0010	<0.0010	-	<0.0010	<0.0010
meta-Xylene	g/m3	-	<0.002	<0.02	-	<0.0010	<0.002
ortho-Xylene	g/m3	-	<0.0010	<0.0010	-	<0.002	<0.0010

Table 5 TRC groundwater results for monitoring wells GND2294 and GND2295, Waikaikai landfarm

Parameter	Unit	GND2294			GND2295
		01-Oct-12	13-Nov-12	27-May-13	27-Sep-12
Barium	g/m3	0.028	0.017	0.024	0.009
Benzene	g/m3	<0.0010	<0.0010	<0.0010	-
Chloride	g/m3	52	42.8	44.6	64.2
Conductivity	mS/m@20C	31.3	34.4	33.4	-
Ethylbenzene	g/m3	<0.0010	<0.0010	<0.0010	-
Hydrocarbon	g/m3	<0.7	<0.7	<0.7	-
Nitrate	g/m3 N	-	29.5	30.4	34
pH	pH	7.0	7.0	7.0	7.2
Toluene	g/m3	<0.0010	<0.0010	<0.0010	-
meta-Xylene	g/m3	0.002	<0.0010	<0.002	-
ortho-Xylene	g/m3	<0.0010	<0.002	<0.0010	-

No hydrocarbons were detected in any of the groundwater samples taken during the monitoring period, except for a single detection of meta-xylene at an inconsequential level. On all sampling occasions, chloride was elevated in bore GND2292 when compared with results of the other site bores; however, it was within the range of chloride concentrations seen in bores at other coastal sites, where chloride is naturally elevated. Monitoring well GND2293 also has shown elevated chlorides and conductivity. No adverse environmental effects are anticipated from slightly elevated salts in non-consumable coastal groundwater. (Additionally, even the highest chloride result was barely above the NZ drinking water standard).

Barium was also slightly elevated above natural levels in some of the samples taken. As has become apparent from groundwater monitoring at some of the landfarm sites, barium levels may appear elevated above what would be considered 'background'. However, review of analytical methods for barium in water indicates that the methodology utilized by the Council (acid soluble barium) may give a less relevant (and higher) result than the methodology utilized by RJ Hill Laboratories (dissolved barium through filtration). It is therefore recommended that the Council adopt the dissolved barium through filtration method of assessing available barium levels in all subsequent water samples for this site.

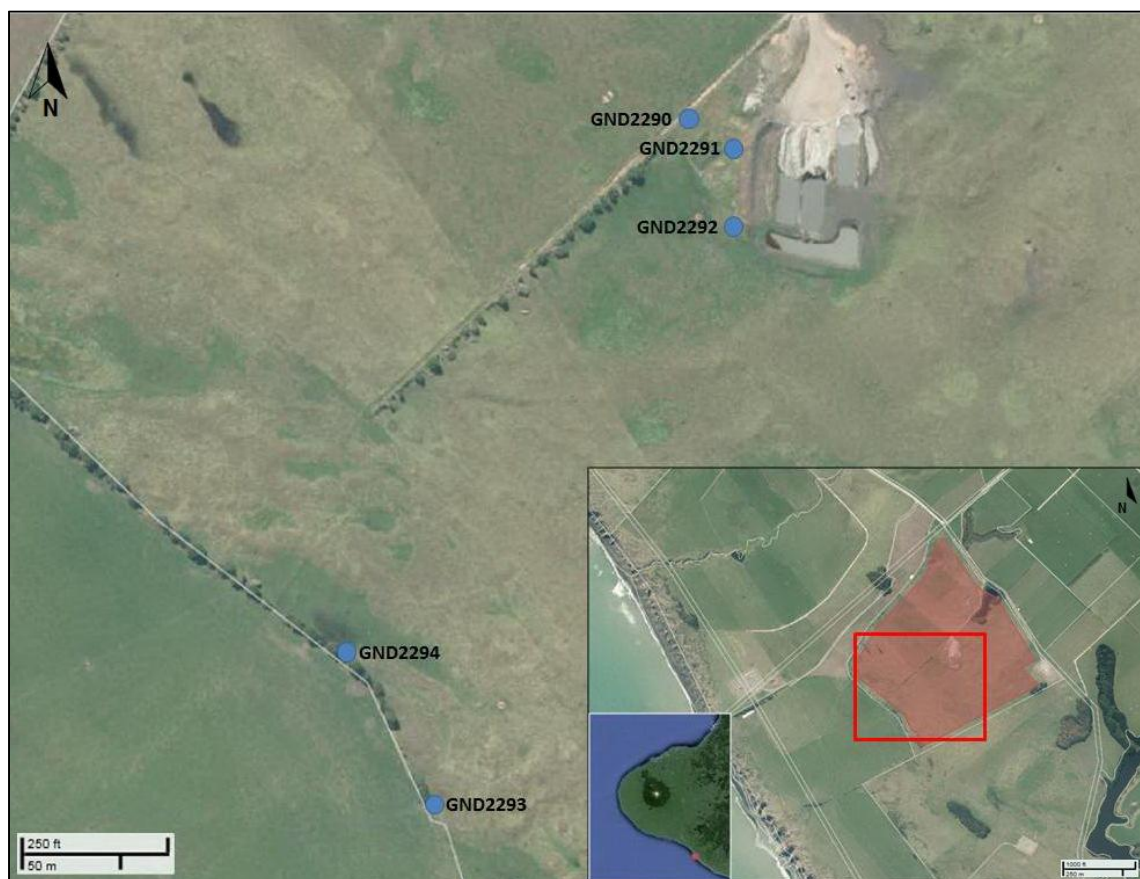


Figure 3 Monitoring well locations, Waikaikai landfarm

2.4.3 Waikaikai supplied soil results

Table 6 summarises the receiving environment composite soil samples taken by the consent holder during the 2012-2013 monitoring year.

Table 6 Supplied receiving environment soil results, Waikaikai landfarm

Parameter	Unit	F1	F1	Consent Limits
Date		30-Jan-13	9-July-13	
Dry Matter	g/100g	91	86	-
Volume Weight / Density	g/mL	0.91	1.4	-
Chloride	mg/kg dry wt	930	43	700
pH	pH units	7.2	-	-
Total Nitrogen	g/100g dry wt	0.12	-	-
Barium	mg/kg	196	<20	-
Arsenic	mg/kg	<2	<2	17
Cadmium	mg/kg	<0.10	<0.10	0.8
Chromium	mg/kg	14	13	290
Copper	mg/kg	11	10	100
Lead	mg/kg	3.4	1.5	160
Mercury	mg/kg	<0.10	<0.10	1
Nickel	mg/kg	6	6	60
Zinc	mg/kg	63	60	300

Parameter	Unit	F1	F1	Consent Limits
Potassium	mg/kg	5,300	172	-
Sodium	mg/kg	2,100	24	460
C7-C9	mg/kg	<8	<8	-
C10-C14	mg/kg	<20	<20	-
C15-C36	mg/kg	<40	<40	-
Total petroleum hydrocarbons	mg/kg	<70	<70	4000
Benzene	mg/kg	<0.05	<0.05	1.1
Toluene	mg/kg	<0.05	<0.05	68
Ethylbenzene	mg/kg	<0.05	<0.05	53
m & p-xylene	mg/kg	<0.10	<0.10	48
o-xylene	mg/kg	<0.10	<0.10	48
Acenaphthene	mg/kg	<0.3	<0.3	-
Acenaphthylene	mg/kg	<0.3	<0.3	-
Anthracene	mg/kg	<0.3	<0.3	-
Benzo[a]anthracene	mg/kg	<0.3	<0.3	-
Benzo[a]pyrene (BAP)	mg/kg	<0.3	<0.3	0.027
Benzo[b,j]fluoranthene	mg/kg	<0.3	<0.3	-
Benzo[g,h,i]perylene	mg/kg	<0.3	<0.3	-
Benzo[k]fluoranthene	mg/kg	<0.3	<0.3	-
Chrysene	mg/kg	<0.3	<0.3	-
Dibenzo[a,h]anthracene	mg/kg	<0.3	<0.3	-
Fluoranthene	mg/kg	<0.3	<0.3	-
Fluorene	mg/kg	<0.3	<0.3	-
Indeno[1,2,3-c,d]pyrene	mg/kg	<0.3	<0.3	-
Napthalene	mg/kg	<0.12	<0.14	7.2
Phenanthrene	mg/kg	<0.3	<0.3	-
Pyrene	mg/kg	<0.3	<0.3	-

The supplied soil results are similar to the TRC results, with elevated sodium and chloride in the initial sample, taken in January 2013. Hydrocarbon concentrations are effectively at or below detection levels, and heavy metals are all well within consent limits.

2.5 Investigations, interventions, and incidents

The monitoring programme for the period was based on what was considered to be an appropriate level of monitoring, review of data, and liaison with the consent holder. During the period matters may arise which require additional activity by the Council eg provision of advice and information, or investigation of potential or actual courses of non-compliance or failure to maintain good practices. A pro-active approach that in the first instance avoids issues occurring is favoured.

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

The Unauthorised Incident Register (UIR) includes events where the company concerned has itself notified the Council. The register contains details of any investigation and corrective action taken.

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

In the 2011-2013 period, it was necessary for the Council to undertake significant additional investigations and interventions, and record incidents, in association with Waikaikai's conditions in resource consents or provisions in Regional Plans in relation to the Company's activities during the monitoring period.

The initial site operator (Redback) had been exercising the consent under an informal arrangement with the consent holder and had managed the site to a very poor standard. Three incidents were recorded against the landfarm site during the monitoring period. These incidents are summarised below.

Incident 22720 / Infringement 275 - 18 April 2012

During routine compliance monitoring it was discovered that drilling mud had been delivered to the site without the required notifications to the Council. A letter requesting an explanation was sent to the resource consent holder and a meeting was held to discuss the breach of consent. The resource consent holder outlined that an alternative contracting company had been authorised to operate and administer the resource consent activities and so they were unaware of what had or had not been occurring. A meeting was held with the contracting company and the requirements of the resource consent were outlined. All information required by the resource consent was subsequently received. As a result of the investigation, an Infringement Notice was issued under section 338(1)(a) of the Resource Management Act 1991 and Council's delegated authority.

Incident 22993 / Abatement 11875 - 29 August 2012

During routine compliance monitoring it was discovered that the best practicable option with regard to the storage and disposal of the muds at the site had not been adopted. At the time that this incident was registered, material had been being stockpiled haphazardly in unlined pits, and housekeeping was very poor in general. (Figure 4, below). As a result Abatement Notice 11875 was issued and required groundwater monitoring bores to be installed prior to landfarming of the muds and for oily wastes to be removed from the water based mud pits and discharged into a lined pit.

Following the completion of these measures, the Company were required to farm the stockpiled mud as per the resource consent requirements. BTW Company Ltd were brought in on contract to assist the consent holder in meeting the directives outlined in Abatement Notice 11875.

Incident 22970 - 30 August 2012

An incident was registered following investigative monitoring conducted under the previous incident 22993. It was suspected that groundwater contamination was occurring from drilling waste being stored in unlined pits at the land disposal site, as

seen in Figure 4 below. Bores were subsequently installed on the site to allow sampling to occur and to ascertain consent compliance. Sampling results to date show compliance with resource consent conditions.



Figure 4 Photographs of waste stored poorly in unlined pits at Waikaikai landfarm under Redback management

As part of the investigations conducted at this site, during farming of material and reinstatement of the original pit area, soil sampling was undertaken through test pitting at the base of one of the previously unlined pits. The sample taken had a strong hydrocarbon/chemical odour and drilling mud was evident in the sample. The results of this sample are provided in Table 7.

Table 7 Receiving soil results from pit base post spreading, Waikaikai landfarm

Parameter	Unit	Pit base	Consent limit
Calcium	mg/kg	157	-
Chloride	mg/kg DW	2540	700
Conductivity	mS/m@20C	1040	400
Hydrocarbons (TRC)	mg/kg DW	<5	50,000 (application)
Moisture factor	nil	1.042	-
Moisture factor 1	nil	1.107	-
Magnesium	mg/kg	12.1	-
Sodium	mg/kg	148	460

Parameter	Unit	Pit base	Consent limit
pH	pH	6.4	-
SAR	None	3.1	18
Total soluble solids	mg/kg	8139	2500
Benzene	mg/kg DW	<0.05	1.1*
Ethylbenzene	mg/kg DW	<0.05	53*
TPH	mg/kg DW	<70	50,000 (application)
Toluene	mg/kg DW	<0.05	68*
O-Xylene	mg/kg DW	<0.05	48*
M & P Xylene	mg/kg DW	<0.1	48*

*Consent surrender limit only

No significant hydrocarbons were detected in the pit base sample, but the parameters relating to salinity were found to be in excess of the consent limits. Post spreading results indicated that salinity levels were decreasing as salts are rapidly leached from the site.

As a result of these incidents, under instruction from the Council, several improvements to site operations were made during the later part of the monitoring period (following enforcement action). Groundwater monitoring wells were constructed at the site to allow for ongoing groundwater monitoring. The oily waste was largely removed and discharged into a lined pit, and all remaining material was farmed as per the consent conditions. New pits were constructed and lined with purpose-fit synthetic liners to be consistent with other disposal sites. Housekeeping at the site has since been very good, pasture establishment has been good, and the supply of records has improved. Figure 5 illustrates some of the improvements undertaken by the Company under direction from BTW and under advice from the Council.



Figure 5 Waikakai Landfarm activities post-abatement showing site improvements. Clockwise from top left: initial pasture establishment, installation of groundwater bores, spreading area F1 looking seaward post cut and carry, lined pits

3. Discussion

3.1 Discussion of site performance

Under Redback Contracting Ltd the site was very poorly run from both record keeping and physical operational perspectives. Notifications were not supplied to the Council for several months, predisposal results were not taken as required by the consent, transporting records were difficult to recover from the operator, and the stockpiling area was poorly set up and created a risk to localised groundwater. As a result, enforcement action was undertaken by the Council.

The level of enforcement action taken was deemed appropriate due to the absence of any significant and/or ongoing adverse environmental effects. Had the groundwater or soil results shown any significant impacts from the site activities, further enforcement action would have been undertaken.

The removal of Redback as the site operator and earthworks contractor, and the remedial work undertaken by the Company with assistance from BTW has greatly improved the condition and management of this site. The site is currently in good physical condition and on standby to receive further wastes. However, prior to any further activity at the site it will be necessary for the Company to engage competent site operators.

In the following monitoring period it will be necessary for the Council to work with the Company to ensure that the data supply (reporting) methodology utilised by the Company is of an improved standard. A recommendation to this effect is given in Section 4.

3.2 Environmental effects of exercise of consents

Monitoring indicates that there appears to be no more than minor adverse environmental effects due to activities at the site. Levels of contaminants in the surface soil meet the required consent conditions for metals and hydrocarbons. There was some initial non-compliance for salinity parameters (chlorides, conductivity and total soluble solids). Incident 22970 was related to Council concerns about the potential effect of poor stockpiling practices at the site on localised groundwater. Groundwater results have not indicated that there are any significant impacts on groundwater resources from activities conducted at this site. Further monitoring of the site will ensure that compliance with all consent limits is demonstrated prior to surrender. Due to the location of the site and the significant distance to any neighbours no air monitoring was undertaken as effects on air quality are known to be minimal.

3.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the period under review is set out in Tables 8 and 9. Table 8 addresses the 2011-2012 monitoring year under Redback management, Table 9 addresses the 2012-2013 monitoring year.

Table 8 Summary of performance for Consent 5956-1 to discharge drilling wastes from hydrocarbon exploration and production activities, and oily wastes from wellsites, onto and into land via landfarming during the **2011-2012** monitoring year

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Definitions of material, stockpiling and landfarming	N/A	N/A
2. Exercise in accordance with application documentation	Inspection, sampling and liaison with consent holder	No
3. Adoption of best practicable option	Inspection, sampling and liaison with consent holder	No
4. Notify TRC 48 hours prior to transfer of waste to disposal site	Notifications received	No
5. Notify TRC 48 hours prior to landfarming wastes	No disposals in monitoring period	N/A
6. The consent holder shall sample for the following: a. Total Petroleum Hydrocarbons b. Benzene, toluene, ethylbenzene, xylenes c. Polycyclic aromatic hydrocarbons d. Chloride, nitrogen, pH, potassium, sodium	Sampling	No
7. Keep records relating to wastes, areas, compositions, volumes, dates, treatments and monitoring	Company records	No
8. Report on records in condition 7 to Council by 31 August each year	2011-2012 report received 31 August 2012	Yes
9. No discharge within 25m of surface water	Inspection	Yes
10. Discharge of hydraulic fracturing fluids is prohibited	Inspection, sampling, records	Yes
11. Oily wastes to be stored in a tank or lined pit or mixed with WBM	Inspection	No
12. All wastes must be landfarmed within 12 months of arrival onsite	Company records and inspection	No
13. Maximum application thickness for solid wastes: a) 100 mm TPH <5% b) 50mm TPH >5%	No discharges during monitoring period	N/A
14. Liquid wastes to be applied in a manner that prevents overland flow and ponding	No discharges during monitoring period	N/A
15. Incorporation into soil as soon as practicable to a depth of at least 250mm	No discharges during monitoring period	N/A

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

*At the beginning of the 2012-2013 monitoring year (as a result of activities during the 2011-2012 year) it was suspected that groundwater contamination may have been occurring at the site. Results have since shown negligible impact on groundwater.

Table 9 Summary of performance for Consent 5956-1 to discharge drilling wastes from hydrocarbon exploration and production activities, and oily wastes from wellsites, onto and into land via landfarming during the **2012-2013** monitoring year

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Definitions of material, stockpiling and landfarming	N/A	N/A
2. Exercise in accordance with application documentation	Inspection, sampling and liaison with consent holder	No
3. Adoption of best practicable option	Inspection, sampling and liaison with consent holder	No
4. Notify TRC 48 hours prior to transfer of waste to disposal site	Notifications received	No
5. Notify TRC 48 hours prior to landfarming wastes	Notifications received	Yes
6. The consent holder shall sample for the following: a) Total Petroleum Hydrocarbons b) Benzene, toluene, ethylbenzene, xylenes c) Polycyclic aromatic hydrocarbons d) Chloride, nitrogen, pH, potassium, sodium	Sampling	Yes (direct composite from pits)
7. Keep records relating to wastes, areas, compositions, volumes, dates, treatments and monitoring	Company records	Yes
8. Report on records in condition 7 to Council by 31 August each year	2012-2013 report received 19 August 2013	Yes
9. No discharge within 25m of surface water	Inspection	Yes
10. Discharge of hydraulic fracturing fluids is prohibited	Inspection, sampling, records	Yes
11. Oily wastes to be stored in a tank or lined pit or mixed with WBM	Inspection	Yes (following abatement)
12. All wastes must be landfarmed within 12 months of arrival onsite	Company records and inspection	No
13. Maximum application thickness for solid wastes: a) 100 mm TPH <5% b) 50mm TPH >5%	Company records and sampling	Yes
14. Liquid wastes to be applied in a manner that prevents overland flow and ponding	Inspection	No
15. Incorporation into soil as soon as practicable to a depth of at least 250mm	Inspection and sampling	Yes

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

For the 2011-2013 monitoring period, the Company demonstrated poor consent compliance and environmental performance.

During the period under review there were three incidents recorded against the site and one infringement notice and one abatement notice issued to the Company in respect of activities at the site. The incidents were registered in the 2012-2013 monitoring year, but relate to matters pre-dating this monitoring period. In the later part of the 2012-2013 year significant improvements were made to site operations.

However, because the enforcement action was largely undertaken in the beginning of the 2012-2013 monitoring year, according to the definitions given in Section 1.1.4, the site receives a 'poor' rating for the 2012-2013 year as well.

Overall, the Company demonstrated a poor level of environmental performance and consent compliance. Significant improvements will be required if and when activity resumes at the site.

3.4 Alterations to monitoring programmes for 2013-2014

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

It is proposed that for 2013-2014 the monitoring programme for the Waikaikai Farms Limited site remains unchanged from that for the 2011-2013 monitoring period. A recommendation to this effect is attached to this report.

4. Recommendations

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

Glossary of common terms and abbreviations

The following abbreviations and terms are used within this report:

Al*	aluminium
As*	arsenic
Biomonitoring	assessing the health of the environment using aquatic organisms
BOD	biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate
BODF	biochemical oxygen demand of a filtered sample
BTEX	MAH's benzene, toluene, ethylbenzene and xylene
bund	a wall around a tank to contain its contents in the case of a leak
CBOD	carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate
cfu	colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample
COD	chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction
Condy	conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m
Cu*	copper
Cumec	A volumetric measure of flow- 1 cubic metre per second (1 m ³ s ⁻¹)
DO	dissolved oxygen
DRP	dissolved reactive phosphorus
<i>E.coli</i>	<i>escherichia coli</i> , an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample
Ent	enterococci, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre of sample
F	fluoride
FC	faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample
Fresh	elevated flow in a stream, such as after heavy rainfall
g/m ³	grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures
IANZ	International Accreditation New Zealand
Incident	an event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred
Intervention	action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring
Investigation	action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident
l/s	litres per second

MAHs	monocyclic aromatic hydrocarbons, molecules consist of a single six-sided hydrocarbon ring
MCI	macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats
mS/m	millisiemens per metre
Mixing zone	the zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point
NH ₄	ammonium, normally expressed in terms of the mass of nitrogen (N)
NH ₃	unionised ammonia, normally expressed in terms of the mass of nitrogen (N)
NO ₃	nitrate, normally expressed in terms of the mass of nitrogen (N)
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water
O&G	oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons)
OW	Oily waste
PAHs	polycyclic aromatic hydrocarbons, molecules consist of more than two six-sided hydrocarbon rings
Pb*	lead
pH	a numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5
Physicochemical	measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment
PM ₁₀	relatively fine airborne particles (less than 10 micrometre diameter)
Resource consent	refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15)
RMA	Resource Management Act 1991 and including all subsequent amendments
SBM	Synthetic based mud
SS	suspended solids
SQMCI	semi quantitative macroinvertebrate community index;
Temp	temperature, measured in °C (degrees Celsius)
TPH	total petroleum hydrocarbons
Turb	turbidity, expressed in NTU
UI	Unauthorised Incident
UIR	Unauthorised Incident Register – contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan
WBM	Water based mud
Zn*	zinc

*an abbreviation for a metal or other analyte may be followed by the letters 'As', to denote the amount of metal recoverable in acidic conditions. This is taken as indicating the total amount of metal that might be solubilised under extreme environmental conditions.

The abbreviation may alternatively be followed by the letter 'D', denoting the amount of the metal present in dissolved form rather than in particulate or solid form.

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

Bibliography and references

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.

Appendix I

**Resource consent held by
Waikaikai Farms Limited**

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

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

Decision Date 13 October 2011
[Change]:

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

Conditions of Consent

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

Expiry Date: 1 June 2016

Site Location: Lower Manutahi Road, Manutahi

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

Catchment: Mangaroa

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

General conditions

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

Special conditions

- 1. For the purposes of this consent the following definitions shall apply:
 - a) Drilling wastes consist of; drilling fluids and cuttings from drilling operations with water based muds, and drilling cuttings from drilling operations with synthetic based muds.
 - b) Oily wastes from wellsites consist of; sludge removed from tanks and separators, slops oil removed from well cellars, tank wax which builds up in separators and tanks, oily formation sand, contaminated ground material from leaks and spills.
 - c) Storage means a discharge of wastes from vehicles, tanks, or other containers onto land for the purpose of temporary storage prior to landfarming, but without subsequently spreading onto, or incorporating the discharged material into the soil within 48 hours.
 - d) Landfarming means the discharge of wastes onto land, subsequent spreading and incorporation into the soil, for the purpose of attenuation of hydrocarbon and/or other contaminants, and includes any stripping and relaying of topsoil.
- 2. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of applications 1706, 2213, 3980 and 6894. In the case of any contradiction between the documentation submitted in support of applications 1706, 2213, 3980 and 6894, and the conditions of this resource consent, the conditions of this resource consent shall prevail.
- 3. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.

Notifications, monitoring and reporting

4. The consent holder shall notify the Chief Executive, Taranaki Regional Council, [by emailing worknotification@trc.govt.nz.] at least 48 hours prior to permitting wastes onto the site for storage. Notification shall include the following information:
 - a) the consent number;
 - b) the name of the well and wellsite, or other source, from which the waste was generated;
 - c) the type of waste to be stored; and
 - d) the volume of waste to be stored.
5. The consent holder shall notify the Chief Executive, Taranaki Regional Council, [by emailing worknotification@trc.govt.nz.] at least 48 hours prior to landfarming wastes. Notification shall include the following information:
 - a) the consent number;
 - b) the name of the well and wellsite, or other source, from which the waste was generated;
 - c) the type of waste to be landfarmed;
 - d) the volume of the waste to be landfarmed;
 - e) the concentration of hydrocarbons in the waste; and
 - f) the specific location and area over which the waste will be landfarmed.
6. The consent holder shall take a representative sample of each type of waste, from each individual source, and have it analysed for the following:
 - a) total petroleum hydrocarbons [C₆-C₉, C₁₀-C₁₄, C₁₅-C₃₆];
 - b) benzene, toluene, ethylbenzene, and xylenes;
 - c) polycyclic aromatic hydrocarbons screening; and
 - d) chloride, nitrogen, pH, potassium, and sodium.
7. The consent holder shall keep records of the following:
 - a) composition of wastes;
 - b) storage area[s];
 - c) volumes of material stored;
 - d) landfarming area[s], including a map showing individual disposal areas with GPS co-ordinates;
 - e) volumes and weights of wastes landfarmed;
 - f) dates of commencement and completion of storage and landfarming events;
 - g) dates of sowing landfarmed areas;
 - h) photographic evidence of pasture establishment;
 - i) treatments applied;
 - j) details of monitoring, including sampling locations, sampling methods and the results of analysis;

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

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

Waste types and waste storage

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

Discharge limits

13. For the purposes of landfarming, solid wastes shall be applied to land in a layer not exceeding:
 - a) 100 mm thick for wastes with a hydrocarbon concentration less than 50,000 mg/kg dry weight; or
 - b) 50 mm thick for wastes with a hydrocarbon concentration equal to or greater than 50,000 mg/kg dry weight.
14. For the purposes of landfarming, liquid wastes shall be applied to land:
 - a) at a rate such that there is no overland flow of liquids; and
 - b) at a rate such that no ponded liquids remain after one hour, after application.
15. As soon as practicable following the application of solid wastes to land, the consent holder shall incorporate the wastes into the soil to a depth of at least 250 mm.
16. The hydrocarbon concentration in the soil over the landfarming area shall not exceed 50,000 mg/kg dry weight at any point where:
 - a) liquid waste has been discharged; or
 - b) solid waste has been discharged and incorporated into the soil.
17. Any areas of land used for the landfarming of wastes in accordance with conditions 13-15 of this consent, shall not be used for any subsequent discharges of waste
18. As soon as practicable following landfarming, areas shall be sown into pasture [or into crop]. The consent holder shall monitor revegetation and if adequate establishment is not achieved within two months of sowing, shall undertake appropriate land stabilisation measures to minimise wind and stormwater erosion.

Receiving environment limits - water

19. The exercise of this consent shall not result in a level of total dissolved salts within any surface or groundwater of more than 2500 gm⁻³.
20. The exercise of this consent, including the design, management and implementation of the discharge, shall not lead or be liable to lead to contaminants entering a surface water body.
21. The exercise of this consent shall not result in any adverse impacts on groundwater as a result of leaching, or on surface water including aquatic ecosystems, and/or result in a change to the suitability of use of the receiving water as determined by the Chief Executive, Taranaki Regional Council.

Receiving environment limits - soil

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

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

MAHs - benzene, toluene, ethylbenzene, xylenes

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

TPH - total petroleum hydrocarbons [C₇-C₉, C₁₀-C₁₄, C₁₅-C₃₆]

The requirement to meet these standards shall not apply if, before 1 March 2016, the consent holder applies for a new consent to replace this consent when it expires, and that application is not subsequently withdrawn.

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

Archaeological remains

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

Signed at Stratford on 13 October 2011

For and on behalf of
Taranaki Regional Council

Director-Resource Management

Appendix II

Supplied annual reports

26th August 2013

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

Attention Colin McLellan

RE: Resource Consent 5956-1
Manutahi Disposal Site
78 Lower Manutahi Road
RD 2, Patea

Dear Colin

As required under special condition 8 of resource consent 5956-1, please find all information related to disposal activities undertaken from the 28th November 2011 to the 30th July 2013.

Information pertaining to resource consent 5956-1 will be displayed in the following Manner:

Appendix 1

The site map showing stockpiling and disposal areas.

Appendix 2

Stockpiling & Landfarming records (November 2011-July 2013)

Appendix 3

Photographic evidence of pasture re-establishment

Appendix 4

Existing environment data

Appendix 5

Chemical products & constituents of drilling mud & fluids

Appendix 6

Pre disposal samples and analysis

Appendix 7

Monitoring results & Compliance table

Appendix 8

TRC Inspection notices

The following details regarding monitoring and sampling are also supplied:

Monitoring:

All material stockpiled on the site is tested prior to arrival on site to assess its exact nature. Testing takes place prior to arrival on site as mud is mixed with other material in the storage pits on site before spreading.

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

Monitoring of the landfarm area begins within the first month of topsoil being re-applied. At this point the entire suite of tests is undertaken to assess the receiving environment against consent conditions. Water based mud (WBM) monitoring is taken 6 monthly for the first 12 months post application, until compliance with consent conditions is achieved.

Sampling Locations:

Specific landfarmed areas are located through the use of a GPS navigational system. These co-ordinates are contained within the Manutahi Disposal area-the site plan which shows areas of disposal and is updated following Landfarming events. A central point is located within each area and a composite sample retrieved in a transect line from the central point. The line direction is dependent on the underlying orientation of the landfarmed material. Composite samples that are collected are marked with the hand held GPS system and included on future disposal maps, or as required.

Methods:

Sampling involves collecting a composite of 6 sub-samples which are GPS along a transect line running from a central point of a landfarmed area. Typically samples are retrieved from approximately 250mm but this can vary depending on the location of the mud layer.

TRC Inspection Notices:

There have been a number of TRC inspection notices issued to the previous operator of the site which has raised concerns about site management. The site was closed down voluntarily for a period of time, at the end of 2012 by the land owner to sort through management issues. The TRC also issued an abatement notice under sections 322 & 324 of the Resource Management Act 1991, to ensure the following actions were taken:

1. Ensure no further drilling waste is taken to the pre-existing pit area.
2. Ensure ground water bores are installed and sampled prior to Landfarming
3. Ensure oily waste portion of the drilling mud is separated and discharged into the oily waste pit.
4. Upon completion of the required action list, ensure all materials currently within the pit area are land farmed as soon as practicable.

The action list was completed within two weeks of being served; the site has had no further issues since the change of the last management group. The site has also taken very little material in 2013. The property owners

are working with several parties to take over the running and management of the site, this process is on-going. The TRC will be notified if and when a new management group is introduced.

The site is in very good order today and as the monitoring reports demonstrate the site complies with all resource consent conditions.

Best Regards

Michael Collins

Appendix 1

Site Map



btw company

surveyors
planners
engineers
land & gas services



Gtr. Courtenay & Eliot Sts
P.O. Box 551, NEW PLYMOUTH 4140
Ph (06) 759 5040
Ph (06) 267 787
Fax (06) 759 5049
E-mail: survey@btwcompany.co.nz
Web: www.btwcompany.co.nz

GENERAL NOTES:

1. Coordinates are in terms of NZ Map Grid GD 1949
DISCLAIMER:
Boundary information has been imported from external sources
Dimensions and dimensions may be subject to scale error
Use of this drawing for other purposes is at the user's risk
Printed from PDF, scale not accurate
Lines are indicative only
Aerial Photography was photographed in 2007
Artificial dwellings may have been constructed or be in the process of being constructed in the interim period

NO	DATE	BY	CHK	REVISIONS	DESCRIPTION
3	12/09/12	JH	MC	Added disposal pit F1	
2	05/09/12	JH	MC	Added disposal pit F1	
1	23/08/12	JH	MC	Added disposal pit #9	

DRAWN	MASTERS	10/09/12
CHECKED	COLLINS	10/09/12
PROJECT NO	1225	
LOCATION	MANUTAH	
ORIGINAL SIZE	A3	
SCALE	1:1000	

MANUTAH DISPOSAL SITE

PETER & KAREN
WARDS

DRAWING NO: 12358-101-GIS
REVISION: 3

Appendix 2

Stockpiling & Landfarming Records

Well	Waste type	Volume (M ³)	Volumes Landfarmed/Stored	Stock piling Dates	Landfarming Dates	Sowing Dates	Treatments
Cheal B5	WBM Solids	336	Landfarmed F1	Nov/Dec 2011	Oct-12	November 2012 April 2013	Fertiliser
	WBM Fluids	410	Landfarmed F1				
Cheal B6	WBM Solids	168	Landfarmed F1	Dec/April 2012			
	WBM Fluids	370	Landfarmed F1				
Cheal B7	WBM Solids	310	Landfarmed F1	Jan/Feb 2012			
	WBM Fluids	292	Landfarmed F1				
Cheal A9	WBM Solids	128	Landfarmed F1	Feb/March 2012			
	WBM Fluids	133	Landfarmed F1				
Cheal A10	WBM Solids	23	Landfarmed F1	Feb/March 2012			
	WBM Fluids	135	Landfarmed F1				
Cheal A Tophole	WBM Solids	31	Landfarmed F1	March/April 2012			
	WBM Fluids	21	Landfarmed F1				
Cheal B Tophole	WBM Solids	14	Landfarmed F1	March/April 2012			
	WBM Fluids	30	Landfarmed F1				
Cheal C	WBM Solids	120	Landfarmed F1	Feb/May 2012			
	WBM Fluids	87	Landfarmed F1				
Cheal C3	WBM Solids	136	Landfarmed F1	Many/June 2012			
	WBM Fluids	386	Landfarmed F1				
Cheal C4	WBM Solids	365	Landfarmed F1	June/July 2012			
	WBM Fluids	779	Landfarmed F1				
Cheal A11	WBM Solids	151	Landfarmed F1	Jul-12			
	WBM Fluids	414	Landfarmed F1				
Kea Douglas-1	Waste Water	1907	Landfarmed F1				
Contract Resources	WBM Solids	13	Landfarmed F1	Nov/Aug 2011/12			
	Waste Water	266.88	Landfarmed F1				
	Oily Waste	157	Landfarmed F1				
Kea Douglas	WBM Solids	176	Landfarmed F1	April/May 2012			
	WBM Fluids	395	Landfarmed F1				
Cooper Moki 2	WBM Solids	300	Landfarmed F1	Jan/Feb 2012			
	WBM Fluids	567	Landfarmed F1				
Cooper Moki 3	WBM Solids	500	Landfarmed F1	Mar-12			

	WBM Fluids	781	Landfarmed F1			
Cooper Moki 4	WBM Solids	350	Landfarmed F1	April/May 2012		
	WBM Fluids	717	Landfarmed F1			
Cheal A12	WBM Solids	238	Landfarmed F1	July/Aug 2012		
	WBM Fluids	720	Landfarmed F1			
Waitapu-1	WBM Solids	74	Landfarmed F1	Aug-12		
	WBM Fluids	60	Landfarmed F1			
Cheal A	Waste Water	36	Stockpiled Pit A	Sept/Oct 2012		
	Oily waste	16	Stockpiled OW Pit			
Cheal C	WBM Solids	12	Stockpiled Pit A	Sept/Oct 2012		
	WBM Fluids	7	Stockpiled Pit A			
	Waste Water	3	Stockpiled Pit A			
Origin	Waste Water	38	Stockpiled Pit A	Oct-12		
Puka-2	Oily Waste	2	Stockpiled OW Pit	June/july 2013		
	Waste Water	8	Stockpiled Pit A			

Appendix 3

Photographic Evidence of Pasture Re-Establishment

















Appendix 4

Existing Environmental Data



Hill Laboratories
BETTER TESTING BETTER RESULTS

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

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

ANALYSIS REPORT

Page 1 of 2

Client:	BTW Company Ltd	Lab No:	1038443	shpv1
Address:	PO Box 551 NEW PLYMOUTH 4340	Date Registered:	23-Aug-2012	
		Date Reported:	29-Aug-2012	
		Quote No:	32402	
		Order No:		
		Client Reference:		
Phone:	06 759 5040	Submitted By:	Michael Collins	

Sample Name: Manutahi Existing Environment

Lab Number: 1038443.1

Sample Type: SOIL General, Outdoor (S10)

		Found	Medium Range	Low	Medium	High
Soluble Salts (Field)	%	< 0.05	0.05 - 0.30			
Calcium (Sat Paste)*	mg/L	10				
Magnesium (Sat Paste)*	mg/L	3				
Sodium (Sat Paste)*	mg/L	19				
Sodium Absorption Ratio*		1.3				

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



This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.

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



Hill Laboratories
BETTER TESTING BETTER RESULTS

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

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

ANALYSIS REPORT

Page 2 of 2

Client:	BTW Company Ltd	Lab No:	1038443	shpvi
Address:	PO Box 551 NEW PLYMOUTH 4340	Date Registered:	23-Aug-2012	
		Date Reported:	29-Aug-2012	
		Quote No:	32402	
		Order No:		
		Client Reference:		
Phone:	06 759 5040	Submitted By:	Michael Collins	

SUMMARY OF METHODS

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

Sample type: Soil			
Test	Method Description	Default Detection Limit	Samples
Sample Registration*	Samples were registered according to instructions received.	-	1
Soil Prep (Dry & Grind)*	Air dried at 35 - 40°C overnight (residual moisture typically 4%) and crushed to pass through a 2mm screen.	-	1
Soluble Salts (Field)	1:5 soil:water extraction followed by potentiometric determination of conductivity. Calculated by EC (mS/cm) x 0.35.	0.05 %	1
Calcium (Sat Paste)*	Saturated Paste extraction followed by ICP-OES.	1 mg/L	1
Magnesium (Sat Paste)*	Saturated Paste extraction followed by ICP-OES.	1 mg/L	1
Sodium (Sat Paste)*	Saturated Paste extraction followed by ICP-OES.	1 mg/L	1
Sodium Absorption Ratio (SAR)*	Calculation from the sodium, calcium and magnesium determined on a Saturated Paste extract.	0.2	1

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

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

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

Wendy Homewood
Quality Assurance Officer - Agriculture Division

Appendix 5

Chemical products and Constituents

[illegible]

BTW COMPANY		Section of Regulations Sub-section	Test Certificates	Emergency Management														Sched 4				
		Reference	Location & Transit manipulation and Use	Approved Handler	Hazardous atmosphere zone	Tracking	EM Level 1	EM Level 2	EM Level 3	Fire Ecogroup	Fire Ecogroup	Documen- tation	Signage	Signage	Separation	Separation	Separation	Incom- patibility	Disposal	Bundling		
		Schedule Table reference from Regulations	Table 1	Table 2	Table 3	Table 4	Table 5	Table 6	Table 7	Table 8	Table 9	Table 10	Table 10	Table 11	Table 11	Table 11	Table 11	Table 12	Table 13	Table 14		
		Description of what the numbers relate to in table below	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level		
Safe Side	Liquid	6.1D (Oral) Acutely toxic	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		6.5B Contact sensitizer	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
Safe Solv E	Liquid	9.3C Harmful to terrestrial vertebrates	-	-	-	-	-	-	-	-	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		6.1E Acutely toxic	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
Safe Solv O	Liquid	6.5A Respiratory Sensitizer	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		6.5B Contact sensitizer	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
Safe Surf O	Liquid	8.2C Corrosive to dermal tissue	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		8.3A Corrosive to eyes	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
Salt PVD	Solid	9.1D Slightly harmful to the aquatic environment or otherwise designed for biocidal action	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		9.3C Harmful to terrestrial vertebrates	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
Seraline 18SV	Liquid	6.1E Acutely toxic	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		6.4A Irritating to the eye	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
Soda Ash	Solid	3.1B Flammable Liquids: high hazard	-	-	-	-	-	1.0L	1.0L	1000L	250L	2	1.0L	250L	250L	-	-	-	0.1L	1.0L	1000L	
		6.1E Acutely toxic	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
Sodium Formate	Liquid	6.3B Mildly irritating to the skin	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		6.3A Skin irritant	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
Sodium Formate	Solid	6.4A Irritating to the eye	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		6.9B Toxic to human target organs or systems	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
Versawet	Liquid	6.1E Acutely toxic	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		6.9B Toxic to human target organs or systems	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
DISTRIBUTION CHEMICALS		8.3A Corrosive to eyes	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
A3-1	Liquid	9.1D Slightly harmful to the aquatic environment or otherwise designed for biocidal action	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		9.3B Ecotoxic in the soil environment	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
A5-5	Liquid	9.3B Ecotoxic to terrestrial vertebrates	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		6.1D (Oral) Acutely toxic	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
Calcium Chloride	Solid	3.1B Flammable Liquids: High hazard	-	-	-	-	-	1.0L	1.0L	1000L	250L	2	1.0L	250L	250L	-	-	-	0.1L	1.0L	1000L	
		6.1E Acutely toxic	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
CFR-3	Solid	6.3A Irritating to the skin	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		6.3B Mildly irritating to the skin	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
CFR-3L	Liquid	6.4A Irritating to the eye	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		6.9B Toxic to human target organs or systems	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
Class G Cement	Solid	9.1D Slightly harmful to the aquatic environment or otherwise designed for biocidal action	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		9.3B Ecotoxic in the soil environment	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
Cleanbore_B	Liquid	6.1D (Oral) Acutely toxic	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		6.3A Irritating to the skin	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
D-Alr 3000	Liquid	8.3A Corrosive to ocular tissue	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		9.1D Slightly harmful to the aquatic environment or otherwise designed for biocidal action	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
Econolite Liquid	Liquid	9.3C Harmful to terrestrial vertebrates	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		6.3B Mildly irritating to the skin	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		6.4A Irritating to the eye	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		6.1D (Oral) Acutely toxic	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		8.2C Corrosive to dermal tissue	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		8.3A Corrosive to ocular tissue	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	
		9.3C Harmful to terrestrial vertebrates	-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	0.1L	1.0L	1000L	

BTW COMPANY	Section of Regulations Sub-section	Reference Schedule Table reference from Regulations Description of what the numbers relate to in table below	Test Certificates					Emergency Management															Sched 4																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
			Location at Transit	Approved manufac- turer and Use	Approved Handler	Hazardous atmosphere zone	Trading	EM Level 1	EM Level 2	EM Level 3	Fire Extinguisher	Fire Extinguisher	Discom- muni- cation	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage		Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	Signage	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Appendix 6

Predisposal Samples & Analysis



Hill Laboratories
BETTER TESTING BETTER RESULTS

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ANALYSIS REPORT

Page 1 of 3

Client:	BTW Company Ltd	Lab No:	840635	SPv1
Contact:	D Riley	Date Registered:	28-Oct-2010	
	C/- BTW Company Ltd	Date Reported:	05-Nov-2010	
	PO Box 551	Quote No:	32966	
	NEW PLYMOUTH 4340	Order No:		
		Client Reference:	Predisposal Sample	
		Submitted By:	D Riley	

Sample Type: Soil

Sample Name:		Cheal B-6 WBM 26-Oct-2010 4:00 pm			
Lab Number:		340635.1			
Individual Tests					
Dry Matter	g/100g as rcvd	70	-	-	-
Density*	g/mL at 20°C	1.55	-	-	-
Total Recoverable Barium	mg/kg dry wt	1,520	-	-	-
Total Recoverable Boron	mg/kg dry wt	< 20	-	-	-
Total Recoverable Vanadium*	mg/kg dry wt	< 100	-	-	-
Chloride*	mg/kg dry wt	14,700	-	-	-
Total Nitrogen	g/100g dry wt	< 0.05	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg					
Total Recoverable Arsenic	mg/kg dry wt	4	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	-	-	-
Total Recoverable Chromium	mg/kg dry wt	20	-	-	-
Total Recoverable Copper	mg/kg dry wt	18	-	-	-
Total Recoverable Lead	mg/kg dry wt	8.6	-	-	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	-	-	-
Total Recoverable Nickel	mg/kg dry wt	14	-	-	-
Total Recoverable Zinc	mg/kg dry wt	60	-	-	-
BTEX in Soil by Headspace GC-MS					
Benzene	mg/kg dry wt	< 0.07	-	-	-
Toluene	mg/kg dry wt	< 0.07	-	-	-
Ethylbenzene	mg/kg dry wt	< 0.07	-	-	-
m&p-Xylene	mg/kg dry wt	< 0.13	-	-	-
o-Xylene	mg/kg dry wt	< 0.07	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil					
Acenaphthene	mg/kg dry wt	< 0.04	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.04	-	-	-
Anthracene	mg/kg dry wt	< 0.04	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.04	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.04	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.04	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.04	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.04	-	-	-
Chrysene	mg/kg dry wt	< 0.04	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.04	-	-	-
Fluoranthene	mg/kg dry wt	< 0.04	-	-	-
Fluorene	mg/kg dry wt	< 0.04	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.04	-	-	-



This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the international Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.

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

Sample Type: Soil					
Sample Name:		Cheal B-6 WBM 26-Oct-2010 4:00 pm			
Lab Number:		840635.1			
Polycyclic Aromatic Hydrocarbons Screening in Soil					
Naphthalene	mg/kg dry wt	< 0.18	-	-	-
Phenanthrene	mg/kg dry wt	0.05	-	-	-
Pyrene	mg/kg dry wt	< 0.04	-	-	-
Total Petroleum Hydrocarbons in Soil					
C7 - C9	mg/kg dry wt	< 11	-	-	-
C10 - C14	mg/kg dry wt	< 30	-	-	-
C15 - C36	mg/kg dry wt	66	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 80	-	-	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

SUMMARY OF METHODS

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

Sample Type: Soil			
Test	Method Description	Default Detection Limit	Samples
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction.	-	1
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	1
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample	-	1
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270),. Tested on as received sample	-	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample	-	1
Dry Matter (Env)	Dried at 103°C (removes 3-5% more water than air dry) for 18hr, gravimetry. US EPA 3550.	0.10 g/100g as rcvd	1
es/Cexin*	Potassium phosphate extraction for Ion Chromatography. In House.	-	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1
Density*	Calculation: weight of sample / volume of sample at 20°C. Gravimetric determination.	0.02 g/mL at 20°C	1
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1
Total Recoverable Boron	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	20 mg/kg dry wt	1
Total Recoverable Vanadium*	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Chloride*	Ion Chromatography determination of es potassium phosphate extraction. APHA 4110 B 21 st ed. 2005.	3 mg/kg dry wt	1
Total Nitrogen	Catalytic Combustion (900°C, O ₂), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1

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

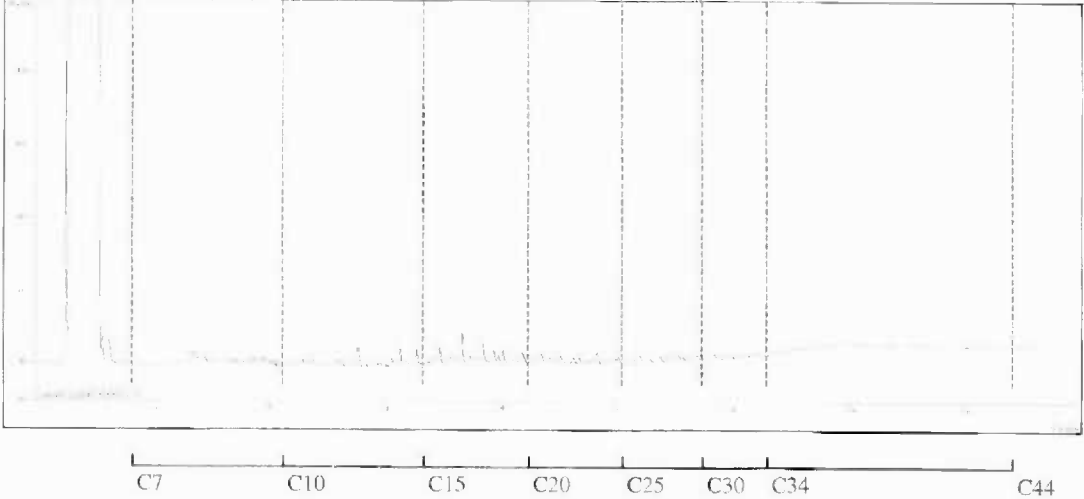
Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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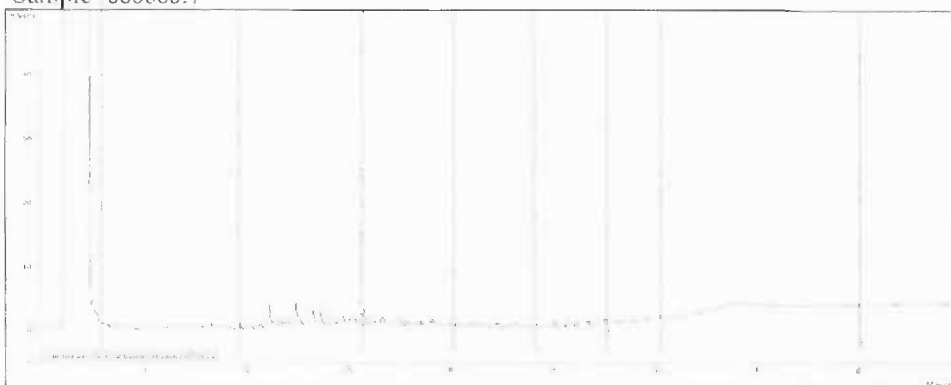
A handwritten signature in blue ink, appearing to be 'Ara Heron', written over a horizontal line.

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

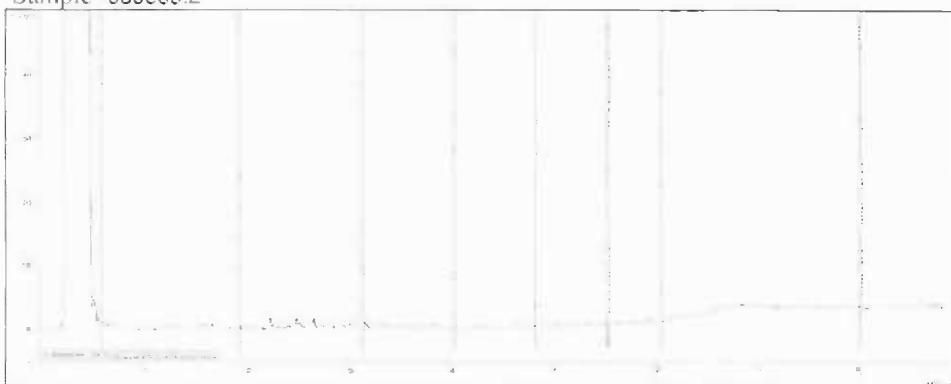
Sample : 840635.1



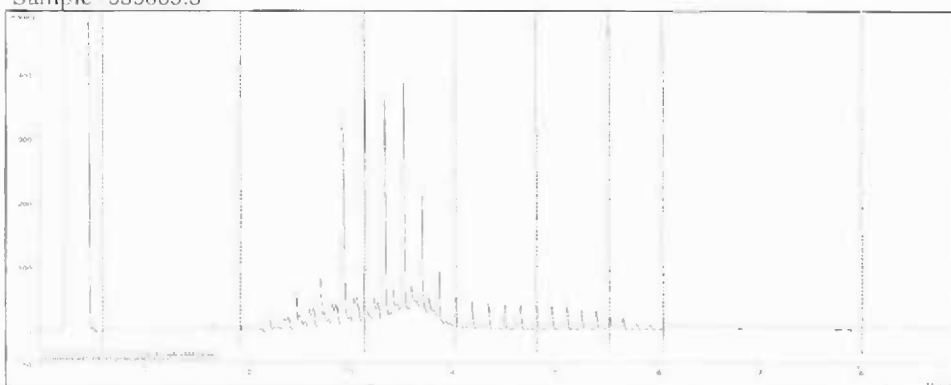
Sample 939069.1



Sample 939069.2

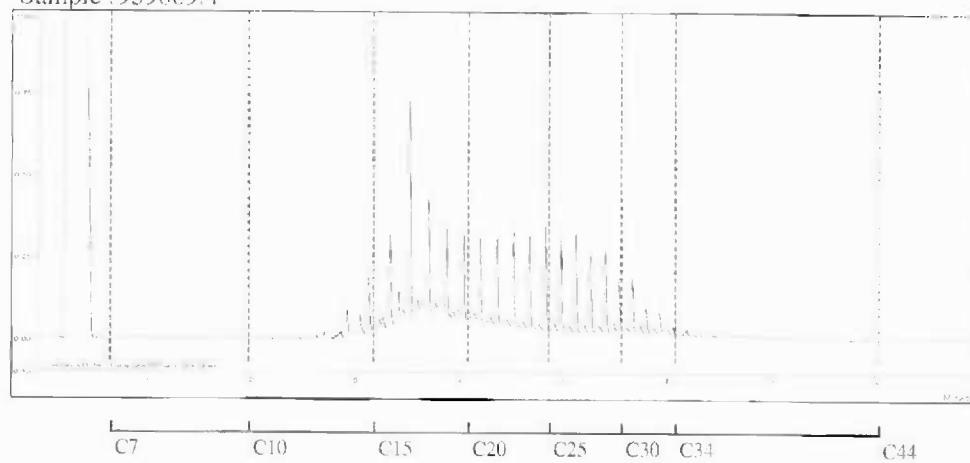


Sample 939069.3



C7 C10 C15 C20 C25 C30 C34 C44

Sample : 939069.4





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ANALYSIS REPORT

Page 1 of 2

Client:	BTW Company Ltd	Lab No:	931453	SPV1
Contact:	D Riley	Date Registered:	09-Sep-2011	
	C/- BTW Company Ltd	Date Reported:	16-Sep-2011	
	PO Box 551	Quote No:	32956	
	NEW PLYMOUTH 4340	Order No:		
		Client Reference:	Predisposal Sample	
		Submitted By:	D Riley	

Sample Type: Aqueous					
Sample Name:		Copper-Mok			
		31-Aug-2011 9:00 am			
Lab Number:		931453.1			
Individual Tests					
Total Barium	g/m ³	1.50	-	-	-
Total Potassium	g/m ³	51,000	-	-	-
Total Sodium	g/m ³	530	-	-	-
Chloride	g/m ³	48,000	-	-	-
Total Nitrogen	g/m ³	28	-	-	-
Nitrate-N + Nitrite-N	g/m ³	0.47	-	-	-
Total Kjeldahl Nitrogen (TKN)	g/m ³	27	-	-	-
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn					
Total Arsenic	g/m ³	< 0.21	-	-	-
Total Cadmium	g/m ³	0.014	-	-	-
Total Chromium	g/m ³	< 0.11	-	-	-
Total Copper	g/m ³	0.20	-	-	-
Total Lead	g/m ³	< 0.021	-	-	-
Total Nickel	g/m ³	< 0.11	-	-	-
Total Zinc	g/m ³	< 0.21	-	-	-
Total Petroleum Hydrocarbons in Water					
C7 - C9	g/m ³	5.5	-	-	-
C10 - C14	g/m ³	< 1.0	-	-	-
C15 - C36	g/m ³	< 2	-	-	-
Total hydrocarbons (C7 - C36)	g/m ³	5	-	-	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

SUMMARY OF METHODS

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

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Samples
Heavy metals, totals, trace As, Cd, Cr, Cu, Ni, Pb, Zn	Nitric acid digestion, ICP-MS, trace level	-	1
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis US EPA 8015B/MIE Petroleum Industry Guidelines	-	1
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total Digestion	Boiling nitric acid digestion, APHA 3030 E 21 st ed. 2005	-	1
Total Kjeldahl Digestion	Sulphuric acid digestion with copper sulphate catalyst.	-	1



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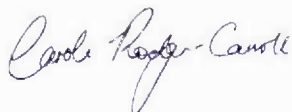
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Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Samples
Total Barium	Nitric acid digestion, ICP-MS, trace level, APHA 3125 B 21 st ed. 2005 / US EPA 200.8.	0.00011 g/m ³	1
Total Potassium	Nitric acid digestion, ICP-MS, trace level, APHA 3125 B 21 st ed. 2005.	0.053 g/m ³	1
Total Sodium	Nitric acid digestion, ICP-MS, trace level, APHA 3125 B 21 st ed. 2005.	0.021 g/m ³	1
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cl ⁻ E (modified from continuous flow analysis) 21 st ed. 2005.	0.5 g/m ³	1
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N.	0.05 g/m ³	1
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO ₃ ⁻ I (Proposed) 21 st ed. 2005.	0.002 g/m ³	1
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N _{org} C. (modified) 4500 NH ₃ F (modified) 21 st ed. 2005.	0.10 g/m ³	1

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

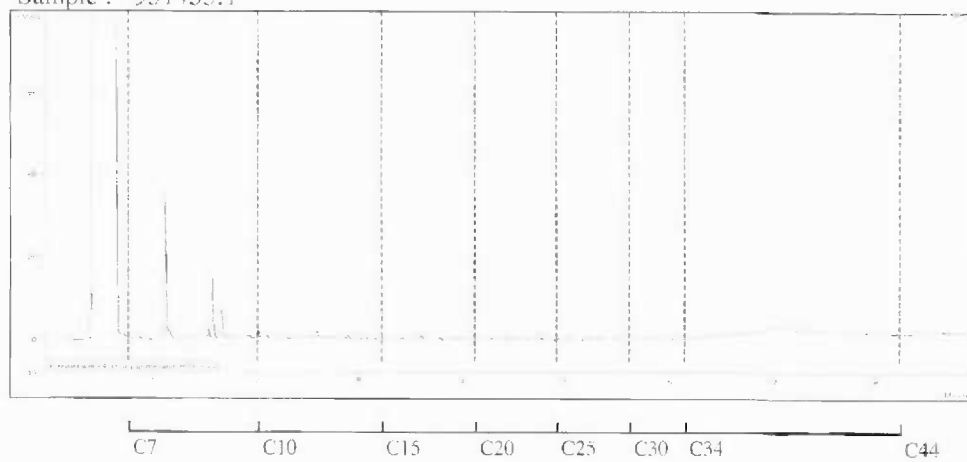
Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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

Sample : 931453.1





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ANALYSIS REPORT

Page 1 of 4

Client:	BTW Company Ltd	Lab No:	939069	SPV1
Contact:	D Riley	Date Registered:	30-Sep-2011	
	C/- BTW Company Ltd	Date Reported:	13-Oct-2011	
	PO Box 551	Quote No:	32966	
	NEW PLYMOUTH 4340	Order No:		
		Client Reference:	Predisposal Sample	
		Submitted By:	D Riley	

Sample Type: Soil			
Sample Name:	Waitui	Cheal - C	
	29-Sep-2011 1:00 pm	29-Sep-2011 1:00 pm	
Lab Number:	939069.3	939069.4	
Individual Tests			
Dry Matter	g/100g as recd	67	88
Total Recoverable Barium	mg/kg dry wt	182	180
Total Recoverable Potassium*	mg/kg dry wt	1,000	910
Total Recoverable Sodium	mg/kg dry wt	250	780
Chloride*	mg/kg dry wt	420	500
pH*	pH Units	7.7	6.9
Total Nitrogen*	g/100g dry wt	0.13	0.13
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg			
Total Recoverable Arsenic	mg/kg dry wt	< 2	6
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	20	6
Total Recoverable Copper	mg/kg dry wt	64	79
Total Recoverable Lead	mg/kg dry wt	13.8	12.3
Total Recoverable Mercury	mg/kg dry wt	< 0.10	< 0.10
Total Recoverable Nickel	mg/kg dry wt	3	4
Total Recoverable Zinc	mg/kg dry wt	42	45
BTEX in Soil by Headspace GC-MS			
Benzene	mg/kg dry wt	< 0.07	< 0.05
Toluene	mg/kg dry wt	< 0.07	0.06
Ethylbenzene	mg/kg dry wt	< 0.07	< 0.05
m&p Xylene	mg/kg dry wt	< 0.14	0.11
o Xylene	mg/kg dry wt	< 0.07	< 0.05
Polycyclic Aromatic Hydrocarbons Screening in Soil			
Acenaphthene	mg/kg dry wt	< 0.04	< 0.03
Acenaphthylene	mg/kg dry wt	< 0.04	< 0.03
Anthracene	mg/kg dry wt	< 0.04	< 0.03
Benzo[a]anthracene	mg/kg dry wt	< 0.04	< 0.03
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.04	< 0.03
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.04	< 0.03
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.04	< 0.03
Benzo[k]fluoranthene	mg/kg dry wt	< 0.04	< 0.03
Chrysene	mg/kg dry wt	< 0.04	< 0.03
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.04	< 0.03
Fluoranthene	mg/kg dry wt	0.04	0.11
Fluorene	mg/kg dry wt	0.09	0.06
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.04	< 0.03



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

Sample Name:					
		Waitui	Cheal - C		
		29-Sep-2011 1:00 pm	29-Sep-2011 1:00 pm		
Lab Number:					
		939069.3	939069.4		
Polycyclic Aromatic Hydrocarbons Screening in Soil					
Naphthalene	mg/kg dry wt	< 0.19	< 0.13	-	-
Phenanthrene	mg/kg dry wt	0.15	0.16	-	-
Pyrene	mg/kg dry wt	0.06	0.24	-	-
Total Petroleum Hydrocarbons in Soil					
C7 - C9	mg/kg dry wt	< 12	< 8	-	-
C10 - C14	mg/kg dry wt	770	134	-	-
C15 - C36	mg/kg dry wt	2,500	6,400	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	3,300	6,600	-	-
Sample Name:					
		Mangahewa - A	Mangahewa - C		
		29-Sep-2011 9:00 am	29-Sep-2011 9:00 am		
Lab Number:					
		939069.1	939069.2		
Individual Tests					
Dry Matter	g/100g as recd	33	27	-	-
Density*	g/mL at 20°C	1.33	1.31	-	-
Total Recoverable Barium	mg/kg dry wt	58	57	-	-
Total Recoverable Potassium*	mg/kg dry wt	1,680	1,670	-	-
Total Recoverable Sodium	mg/kg dry wt	820	810	-	-
Chloride*	mg/kg dry wt	36	37	-	-
pH*	pH Units	9.2	9.0	-	-
Total Nitrogen*	g/100g dry wt	< 0.05	0.06	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg					
Total Recoverable Arsenic	mg/kg dry wt	5	5	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	-	-
Total Recoverable Chromium	mg/kg dry wt	20	21	-	-
Total Recoverable Copper	mg/kg dry wt	28	26	-	-
Total Recoverable Lead	mg/kg dry wt	12.9	12.2	-	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	< 0.10	-	-
Total Recoverable Nickel	mg/kg dry wt	21	22	-	-
Total Recoverable Zinc	mg/kg dry wt	67	64	-	-
BTEX in Soil by Headspace GC-MS					
Benzene	mg/kg dry wt	< 0.18	< 0.3	-	-
Toluene	mg/kg dry wt	< 0.18	< 0.3	-	-
Ethylbenzene	mg/kg dry wt	< 0.18	< 0.3	-	-
m&p-Xylene	mg/kg dry wt	< 0.4	< 0.5	-	-
o-Xylene	mg/kg dry wt	< 0.18	< 0.3	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil					
Acenaphthene	mg/kg dry wt	< 0.14	< 0.17	-	-
Acenaphthylene	mg/kg dry wt	< 0.14	< 0.17	-	-
Anthracene	mg/kg dry wt	< 0.14	< 0.17	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.14	< 0.17	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.14	< 0.17	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.14	< 0.17	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.14	< 0.17	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.14	< 0.17	-	-
Chrysene	mg/kg dry wt	< 0.14	< 0.17	-	-
Dibenz[a,h]anthracene	mg/kg dry wt	< 0.14	< 0.17	-	-
Fluoranthene	mg/kg dry wt	< 0.14	< 0.17	-	-
Fluorene	mg/kg dry wt	< 0.14	< 0.17	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.14	< 0.17	-	-
Naphthalene	mg/kg dry wt	< 0.7	< 0.9	-	-
Phenanthrene	mg/kg dry wt	< 0.14	< 0.17	-	-

Sample Type: Sludge					
Sample Name:		Mangahewa - A	Mangahewa - C		
		29-Sep-2011 9:00 am	29-Sep-2011 9:00 am		
Lab Number:		939069.1	939069.2		
Polycyclic Aromatic Hydrocarbons Screening in Soil					
Pyrene	mg/kg dry wt	< 0.14	< 0.17	-	-
Total Petroleum Hydrocarbons in Soil					
C7 - C9	mg/kg dry wt	< 50	< 50	-	-
C10 - C14	mg/kg dry wt	101	< 100	-	-
C15 - C36	mg/kg dry wt	< 170	< 200	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 300	< 400	-	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

Appendix No.2 - Total Petroleum Hydrocarbon Chromatograms

SUMMARY OF METHODS

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

Sample Type: Sludge			
Test	Method Description	Default Detection Limit	Samples
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-4
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	1-4
Heavy metals, screen As, Cd, Cr, Cu, Ni, Pb, Zn, Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	1-4
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample	-	1-4
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample.	-	1-4
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM. Silica cleanup. GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample	-	1-4
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) . gravimetry. US EPA 3550.	0.10 g/100g as rcvd	1-4
estCexin*	Potassium phosphate extraction for Ion Chromatography. In House.	-	1-4
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-4
Density*	Calculation: weight of sample / volume of sample at 20°C. Gravimetric determination.	0.02 g/mL at 20°C	1-2
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1-4
Total Recoverable Potassium*	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1-4
Total Recoverable Sodium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1-4
Chloride*	Ion Chromatography determination of es potassium phosphate extraction.	3 mg/kg dry wt	1-4
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH.	0.1 pH Units	1-4
Total Nitrogen*	Catalytic Combustion (900°C, O ₂), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1-4

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

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

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A handwritten signature in blue ink, appearing to be 'Ara Heron', with a stylized, overlapping loop structure.

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



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ANALYSIS REPORT

Page 1 of 3

Client:	BTW Company Ltd	Lab No:	968225	SPv1
Contact:	D Riley	Date Registered:	13-Jan-2012	
	C/- BTW Company Ltd	Date Reported:	26-Jan-2012	
	PO Box 551	Quote No:	45045	
	NEW PLYMOUTH 4340	Order No:		
		Client Reference:	Tank Water	
		Submitted By:	D Riley	

Sample Type: Aqueous					
Sample Name:		Cheal 12-Jan-2012 1:00 pm			
Lab Number:		968225.1			
Individual Tests					
pH	pH Units	8.1	-	-	-
Electrical Conductivity (EC)	mS/m	913	-	-	-
Total Dissolved Solids (TDS)	g/m³	5,500	-	-	-
Specific Gravity*	20°C/20°C	1.00	-	-	-
Total Potassium	g/m³	1,950	-	-	-
Total Sodium	g/m³	350	-	-	-
Chloride	g/m³	2,400	-	-	-
Total Nitrogen	g/m³	5.9	-	-	-
Nitrate-N + Nitrite-N	g/m³	< 0.002	-	-	-
Total Kjeldahl Nitrogen (TKN)	g/m³	5.8	-	-	-
Heavy metals, totals, trace As, Cd, Cr, Cu, Ni, Pb, Zn					
Total Arsenic	g/m³	< 0.011	-	-	-
Total Cadmium	g/m³	< 0.00053	-	-	-
Total Chromium	g/m³	< 0.0053	-	-	-
Total Copper	g/m³	0.0099	-	-	-
Total Lead	g/m³	< 0.0011	-	-	-
Total Nickel	g/m³	0.0057	-	-	-
Total Zinc	g/m³	< 0.011	-	-	-
BTEX in Water by Headspace GC-MS					
Benzene	g/m³	0.0094	-	-	-
Toluene	g/m³	0.0119	-	-	-
Ethylbenzene	g/m³	0.0015	-	-	-
m&p-Xylene	g/m³	0.009	-	-	-
o-Xylene	g/m³	0.0034	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq					
Acenaphthene	g/m³	< 0.00010	-	-	-
Acenaphthylene	g/m³	< 0.00010	-	-	-
Anthracene	g/m³	< 0.00010	-	-	-
Benzo[a]anthracene	g/m³	< 0.00010	-	-	-
Benzo[a]pyrene (BAP)	g/m³	< 0.00010	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m³	< 0.00010	-	-	-
Benzo[g,h,i]perylene	g/m³	< 0.00010	-	-	-
Benzo[k]fluoranthene	g/m³	< 0.00010	-	-	-
Chrysene	g/m³	< 0.00010	-	-	-
Dibenzo[a,h]anthracene	g/m³	< 0.00010	-	-	-
Fluoranthene	g/m³	< 0.00010	-	-	-



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Sample Type: Aqueous					
Sample Name:		Cheal 12-Jan-2012 1:00 pm			
Lab Number:		968225.1			
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq					
Fluorene	g/m ³	< 0.0002	-	-	-
Indeno(1,2,3-c,d)pyrene	g/m ³	< 0.00010	-	-	-
Naphthalene	g/m ³	< 0.0005	-	-	-
Phenanthrene	g/m ³	< 0.0004	-	-	-
Pyrene	g/m ³	< 0.0002	-	-	-
Total Petroleum Hydrocarbons in Water					
C7 - C9	g/m ³	< 0.10	-	-	-
C10 - C14	g/m ³	< 0.2	-	-	-
C15 - C36	g/m ³	1.1	-	-	-
Total hydrocarbons (C7 - C36)	g/m ³	1.1	-	-	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

SUMMARY OF METHODS


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

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Samples
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, trace level	-	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B	-	1
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq	Liquid / liquid extraction, SPE (if required), GC-MS SIM analysis	-	1
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines	-	1
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total Digestion	Boiling nitric acid digestion, APHA 3030 E 21 st ed. 2005.	-	1
Total Kjeldahl Digestion	Sulphuric acid digestion with copper sulphate catalyst.	-	1
pH	pH meter, APHA 4500-H ⁺ B 21 st ed. 2005.	0.1 pH Units	1
Electrical Conductivity (EC)	Conductivity meter, 25°C, APHA 2510 B 21 st ed. 2005.	0.1 mS/m	1
Total Dissolved Solids (TDS)	Filtration through GF/C (1.2 µm), gravimetric, APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 21 st ed. 2005.	10 g/m ³	1
Specific Gravity*	Calculation: weight of sample / weight of equivalent volume of water at 20°C. Gravimetric determination.	0.01 20°C/20°C	1
Total Potassium	Nitric acid digestion, ICP-MS, trace level, APHA 3125 B 21 st ed. 2005.	0.053 g/m ³	1
Total Sodium	Nitric acid digestion, ICP-MS, trace level, APHA 3125 B 21 st ed. 2005.	0.021 g/m ³	1
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser, APHA 4500 Cl ⁻ E (modified from continuous flow analysis) 21 st ed. 2005.	0.5 g/m ³	1
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N.	0.05 g/m ³	1
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser, APHA 4500-NO ₃ ⁻ I (Modified) 21 st ed. 2005.	0.002 g/m ³	1
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser, APHA 4500-N _{org} C. (modified) 4500 NH ₃ F (modified) 21 st ed. 2005.	0.10 g/m ³	1

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

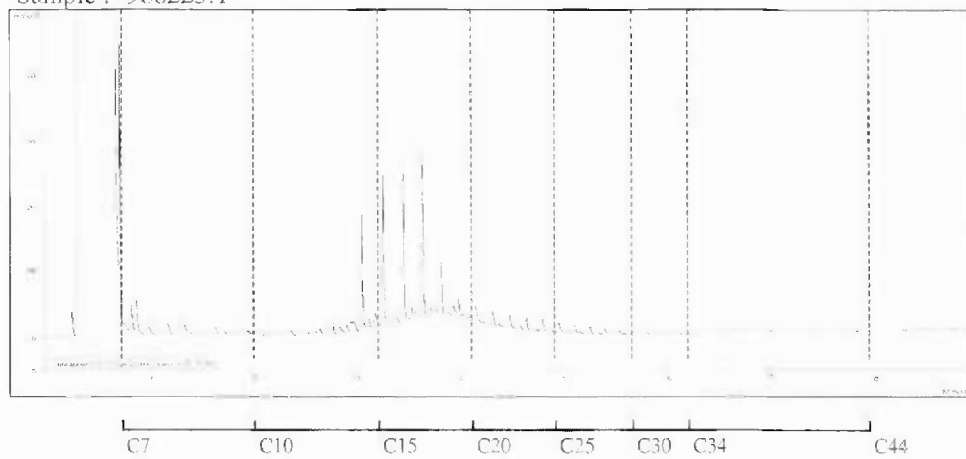
Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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A handwritten signature in dark ink, appearing to read 'Carole Rodgers-Carroll', written in a cursive style.

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

Sample : 968225.1





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Web www.hill-labs.co.nz

ANALYSIS REPORT

Page 1 of 3

Client:	BTW Company Ltd	Lab No:	988451	SPV1
Contact:	D Riley	Date Registered:	16-Mar-2012	
	C/- BTW Company Ltd	Date Reported:	29-Mar-2012	
	PO Box 551	Quote No:	32966	
	NEW PLYMOUTH 4340	Order No:		
		Client Reference:	Predisposal Sample	
		Submitted By:	D Riley	

Sample Type: I					
Sample Name:		Cheal C Cs	Man A SBM		
		15-Mar-2012 9:30 am	15-Mar-2012 11:00 am		
Lab Number:		988451.1	988451.2		
Individual Tests					
Dry Matter	g/100g as rcwd	95	84	-	-
Density*	g/mL at 20°C	1.64	1.96	-	-
Total Recoverable Barium	mg/kg dry wt	870	2,300	-	-
Total Recoverable Potassium*	mg/kg dry wt	500	2,500	-	-
Total Recoverable Sodium	mg/kg dry wt	1,440	1,050	-	-
Chloride*	mg/kg dry wt	177	390	-	-
pH*	pH Units	8.3	9.3	-	-
Total Nitrogen*	g/100g dry wt	< 0.05	0.31	-	-
Heavy metals: screen As, Cd, Cr, Cu, Ni, Pb, Zn, Hg					
Total Recoverable Arsenic	mg/kg dry wt	< 2	6	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	-	-
Total Recoverable Chromium	mg/kg dry wt	4	21	-	-
Total Recoverable Copper	mg/kg dry wt	41	17	-	-
Total Recoverable Lead	mg/kg dry wt	5.9	19.5	-	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	< 0.10	-	-
Total Recoverable Nickel	mg/kg dry wt	3	24	-	-
Total Recoverable Zinc	mg/kg dry wt	47	68	-	-
BTEX in Soil by Headspace GC-MS					
Benzene	mg/kg dry wt	< 0.05	< 0.05	-	-
Toluene	mg/kg dry wt	< 0.05	< 0.05	-	-
Ethylbenzene	mg/kg dry wt	< 0.05	< 0.05	-	-
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.10	-	-
o-Xylene	mg/kg dry wt	< 0.05	< 0.05	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil					
Acenaphthene	mg/kg dry wt	< 0.03	< 0.03	-	-
Acenaphthylene	mg/kg dry wt	< 0.03	< 0.03	-	-
Anthracene	mg/kg dry wt	< 0.03	0.03	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.03	0.17	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.03	0.12	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.03	0.21	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.03	0.09	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.03	0.10	-	-
Chrysene	mg/kg dry wt	< 0.03	0.17	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.03	< 0.03	-	-
Fluoranthene	mg/kg dry wt	< 0.03	0.40	-	-
Fluorene	mg/kg dry wt	< 0.03	< 0.03	-	-



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

Sample Name:		Cheal C Cs	Man A SBM
		15-Mar-2012 9:30 am	15-Mar-2012 11:00 am
Lab Number:		988451.1	988451.2
Polycyclic Aromatic Hydrocarbons Screening in Soil			
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.03	0.09
Naphthalene	mg/kg dry wt	< 0.12	< 0.15
Phenanthrene	mg/kg dry wt	< 0.03	0.30
Pyrene	mg/kg dry wt	< 0.03	0.36
Total Petroleum Hydrocarbons in Soil			
C7 - C9	mg/kg dry wt	< 8	174
C10 - C14	mg/kg dry wt	44	57,000
C15 - C36	mg/kg dry wt	1,900	113,000
Total hydrocarbons (C7 - C36)	mg/kg dry wt	1,950	171,000

Analyst's Comments

Appendix No. 1 - Total Petroleum Hydrocarbon Chromatograms

SUMMARY OF METHODS

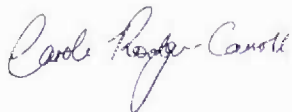
The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix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

Test	Method Description	Default Detection Limit	Samples
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-2
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	1-2
Heavy metals, screen As, Cd, Cr, Cu, Ni, Pb, Zn, Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	1-2
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample	-	1-2
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample.	-	1-2
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MFE Petroleum Industry Guidelines. Tested on as received sample	-	1-2
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry), gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1-2
esiCextn*	Potassium phosphate extraction for Ion Chromatography. In House.	-	1-2
Total Recoverable digestion	Nitric / hydrochloric acid digestion, US EPA 200.2.	-	1-2
Density*	Calculation: weight of sample / volume of sample at 20°C. Gravimetric determination.	0.02 g/mL at 20°C	1-2
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1-2
Total Recoverable Potassium*	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1-2
Total Recoverable Sodium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1-2
Chloride*	Ion Chromatography determination of es potassium phosphate extraction.	3 mg/kg dry wt	1-2
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH.	0.1 pH Units	1-2
Total Nitrogen*	Catalytic Combustion (900°C, O ₂), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1-2

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

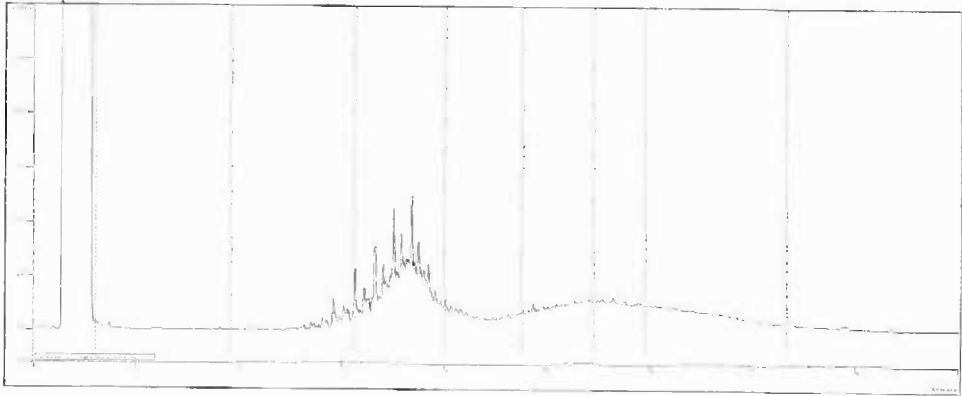
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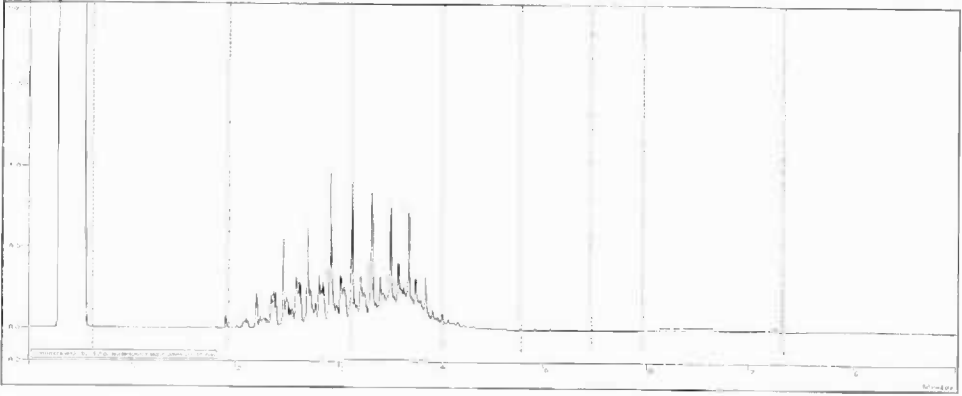
A handwritten signature in dark ink, appearing to read 'Carole Rodgers-Carroll', is written above the printed name.

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

Sample: 988451.1



Sample: 988451.2



C7 C10 C15 C20 C25 C30 C34 C44



ANALYSIS REPORT

Page 1 of 4

Client:	BTW Company Ltd	Lab No:	1036407	SPv1
Contact:	Michael Collins	Date Registered:	16-Aug-2012	
	C/- BTW Company Ltd	Date Reported:	29-Aug-2012	
	PO Box 551	Quote No:	32966	
	NEW PLYMOUTH 4340	Order No:		
		Client Reference:	Predisposal Sample	
		Submitted By:	Michael Collins	

Interim Report

This is an interim report, prepared before all test results are completed. As all final Q.C. checks may not have been possible, it is not regarded as an official laboratory report. The final, official report will be issued upon completion of all tests.

Sample Type: Oil					
Sample Name:		Wards P4 (oil methods)	Wards P8 (oil methods)		
Lab Number:		1036407.9	1036407.10		
Individual Tests					
Total Arsenic	mg/kg as rcvd	< 1.0	< 1.0	-	-
Total Barium	mg/kg as rcvd	40	14.2	-	-
Total Cadmium	mg/kg as rcvd	< 0.05	0.06	-	-
Total Chromium	mg/kg as rcvd	2.1	8.8	-	-
Total Copper	mg/kg as rcvd	3.1	10.7	-	-
Total Lead	mg/kg as rcvd	1.0	1.5	-	-
Total Nickel	mg/kg as rcvd	1.4	4.6	-	-
Total Potassium	mg/kg as rcvd	1,100	1,490	-	-
Total Sodium	mg/kg as rcvd	175	620	-	-
Total Zinc	mg/kg as rcvd	In Progress	In Progress	-	-
Chloride	mg/kg as rcvd	In Progress	In Progress	-	-
Total Nitrogen	g/100g as rcvd	< 0.09	< 0.13	-	-

Sample Type: Soil						
Sample Name:		Wards P1	Wards P2	Wards P3	Wards P4	Wards P5
		14-Aug-2012	14-Aug-2012	14-Aug-2012	14-Aug-2012	14-Aug-2012
Lab Number:		1036407.1	1036407.2	1036407.3	1036407.4	1036407.5
Individual Tests						
Dry Matter	g/100g as rcvd	46	59	65	31	76
Density	g/mL at 20 °C	1.80	1.70	1.23	1.01	1.58
Total Recoverable Barium	mg/kg dry wt	92	69	138	-	80
Total Recoverable Potassium	mg/kg dry wt	7,300	12,900	3,500	-	10,800
Total Recoverable Sodium	mg/kg dry wt	520	1,330	880	-	1,360
Chloride	mg/kg dry wt	2,300	9,900	1,700	-	8,400
pH	pH Units	8.1	10.0	7.7	-	10.2
Total Nitrogen	g/100g dry wt	0.08	< 0.05	0.11	-	< 0.05
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	8	4	5	-	5
Total Recoverable Cadmium	mg/kg dry wt	0.12	< 0.10	1.06	-	< 0.10
Total Recoverable Chromium	mg/kg dry wt	27	24	22	-	28
Total Recoverable Copper	mg/kg dry wt	24	26	33	-	17
Total Recoverable Lead	mg/kg dry wt	15.8	8.8	25	-	12.1
Total Recoverable Mercury	mg/kg dry wt	< 0.10	< 0.10	< 0.10	-	< 0.10
Total Recoverable Nickel	mg/kg dry wt	22	18	15	-	17
Total Recoverable Zinc	mg/kg dry wt	82	57	98	-	51
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.12	< 0.09	155	49	< 0.06
Toluene	mg/kg dry wt	0.13	< 0.09	1,300	550	< 0.06

Sample Name:						
Lab Number:						
BTEX in Soil by Headspace GC-MS						
Ethylbenzene	mg/kg dry wt	< 0.12	< 0.09	290	199	< 0.06
m&p-Xylene	mg/kg dry wt	0.3	< 0.17	1,800	1,640	< 0.12
o-Xylene	mg/kg dry wt	< 0.12	< 0.09	560	830	< 0.06
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.06	< 0.05	12	58	< 0.03
Acenaphthylene	mg/kg dry wt	< 0.06	< 0.05	6	22	< 0.03
Anthracene	mg/kg dry wt	< 0.06	< 0.05	< 4	< 8	< 0.03
Benzo[a]anthracene	mg/kg dry wt	< 0.06	< 0.05	< 4	< 8	< 0.03
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.06	< 0.05	< 4	< 8	< 0.03
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.06	< 0.05	< 4	< 8	< 0.03
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.06	< 0.05	< 4	< 8	< 0.03
Benzo[k]fluoranthene	mg/kg dry wt	< 0.06	< 0.05	< 4	< 8	< 0.03
Chrysene	mg/kg dry wt	< 0.06	< 0.05	< 4	14	< 0.03
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.06	< 0.05	< 4	< 8	< 0.03
Fluoranthene	mg/kg dry wt	< 0.06	< 0.05	5	31	< 0.03
Fluorene	mg/kg dry wt	< 0.06	< 0.05	34	280	0.05
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.06	< 0.05	< 4	< 8	< 0.03
Naphthalene	mg/kg dry wt	< 0.3	< 0.3	260	910	< 0.15
Phenanthrene	mg/kg dry wt	0.11	< 0.05	56	500	0.13
Pyrene	mg/kg dry wt	< 0.06	< 0.05	4	24	< 0.03
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 17	< 13	14,200	1,200	< 9
C10 - C14	mg/kg dry wt	44	< 30	36,000	46,000	< 20
C15 - C36	mg/kg dry wt	181	< 50	141,000	200,000	< 40
Total hydrocarbons (C7 - C36)	mg/kg dry wt	220	< 90	191,000	250,000	< 70
Sample Name:						
Lab Number:						
Individual Tests						
Dry Matter	g/100g as rcvd	70	72	71	-	-
Density	g/mL at 20 °C	1.86	1.82	2.14	-	-
Total Recoverable Barium	mg/kg dry wt	68	350	-	-	-
Total Recoverable Potassium	mg/kg dry wt	10,800	9,500	-	-	-
Total Recoverable Sodium	mg/kg dry wt	1,280	1,150	-	-	-
Chloride	mg/kg dry wt	7,900	6,000	-	-	-
pH	pH Units	9.5	10.2	-	-	-
Total Nitrogen	g/100g dry wt	< 0.05	< 0.05	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	6	5	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	0.10	-	-	-
Total Recoverable Chromium	mg/kg dry wt	34	25	-	-	-
Total Recoverable Copper	mg/kg dry wt	18	23	-	-	-
Total Recoverable Lead	mg/kg dry wt	11.6	17.5	-	-	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	< 0.10	-	-	-
Total Recoverable Nickel	mg/kg dry wt	21	19	-	-	-
Total Recoverable Zinc	mg/kg dry wt	61	72	-	-	-
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.07	< 0.06	3.1	-	-
Toluene	mg/kg dry wt	< 0.07	< 0.06	36	-	-
Ethylbenzene	mg/kg dry wt	< 0.07	< 0.06	13.4	-	-
m&p-Xylene	mg/kg dry wt	< 0.13	0.14	95	-	-
o-Xylene	mg/kg dry wt	< 0.07	< 0.06	44	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.04	< 0.04	12.3	-	-

Sample Name:		Wards P6 14-Aug-2012	Wards P7 14-Aug-2012	Wards P8 14-Aug-2012		
Lab Number:		1036407.6	1036407.7	1036407.8		
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthylene	mg/kg dry wt	< 0.04	< 0.04	5.4	-	-
Anthracene	mg/kg dry wt	< 0.04	< 0.04	< 0.7	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.04	< 0.04	1.5	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.04	< 0.04	< 0.7	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.04	< 0.04	0.8	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.04	< 0.04	< 0.7	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.04	< 0.04	< 0.7	-	-
Chrysene	mg/kg dry wt	< 0.04	< 0.04	2.7	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.04	< 0.04	< 0.7	-	-
Fluoranthene	mg/kg dry wt	< 0.04	< 0.04	6.7	-	-
Fluorene	mg/kg dry wt	< 0.04	< 0.04	58	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.04	< 0.04	< 0.7	-	-
Naphthalene	mg/kg dry wt	< 0.17	< 0.16	260	-	-
Phenanthrene	mg/kg dry wt	< 0.04	< 0.04	102	-	-
Pyrene	mg/kg dry wt	< 0.04	< 0.04	5.5	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 10	< 10	1,230	-	-
C10 - C14	mg/kg dry wt	< 20	< 20	12,900	-	-
C15 - C36	mg/kg dry wt	< 40	96	46,000	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	96	61,000	-	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

Appendix No.2 - Total Petroleum Hydrocarbon Chromatograms

SUMMARY OF METHODS

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

Test	Method Description	Default Detection Limit	Samples
Ashing and Aqua Regia digest	Ashing in Muffle furnace, Aqua Regia (HNO ₃ /HCl) digestion.	-	9-10
Total Arsenic	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	9-10
Total Barium	Aqua Regia Digestion, ICP-MS.	0.2 mg/kg as rcvd	9-10
Total Cadmium	Aqua Regia Digestion, ICP-MS.	0.05 mg/kg as rcvd	9-10
Total Chromium	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	9-10
Total Copper	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	9-10
Total Lead	Aqua Regia Digestion, ICP-MS.	0.2 mg/kg as rcvd	9-10
Total Nickel	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	9-10
Total Potassium	Aqua Regia Digestion, ICP-MS.	50 mg/kg as rcvd	9-10
Total Sodium	Aqua Regia Digestion, ICP-MS.	20 mg/kg as rcvd	9-10
Total Zinc	Aqua Regia Digestion, ICP-MS.	2 mg/kg as rcvd	9-10
Total Chloride in Oil	Determination using Titration-c, used oil quantification kit.	50 mg/kg as rcvd	9-10
Total Nitrogen	Catalytic Combustion (900°C, O ₂), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g as rcvd	9-10

Test	Method Description	Default Detection Limit	Samples
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-3, 5-7
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	1-3, 5-7
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	1-3, 5-7
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample	-	1-8

Sample Type: Soil			
Test	Method Description	Default Detection Limit	Samples
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample.	-	1-8
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MFE Petroleum Industry Guidelines. Tested on as received sample	-	1-8
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1-8
eslCextrn	Potassium phosphate extraction for Ion Chromatography. In House.	-	1-3, 5-7
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-3, 5-7
Density	Calculation: weight of sample / volume of sample at 20 °C. Gravimetric determination.	0.02 g/mL at 20 °C	1-8
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1-3, 5-7
Total Recoverable Potassium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1-3, 5-7
Total Recoverable Sodium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1-3, 5-7
Chloride	Ion Chromatography determination of es potassium phosphate extraction.	3 mg/kg dry wt	1-3, 5-7
pH	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH.	0.1 pH Units	1-3, 5-7
Total Nitrogen	Catalytic Combustion (900 °C, O ₂), separation. Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1-3, 5-7

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

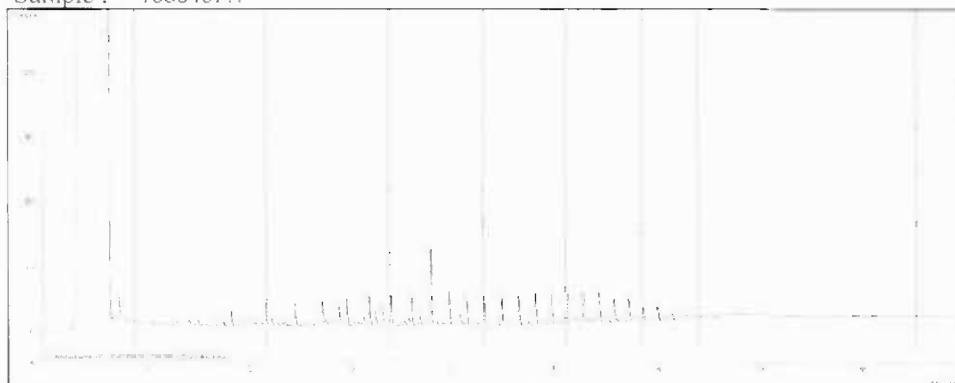
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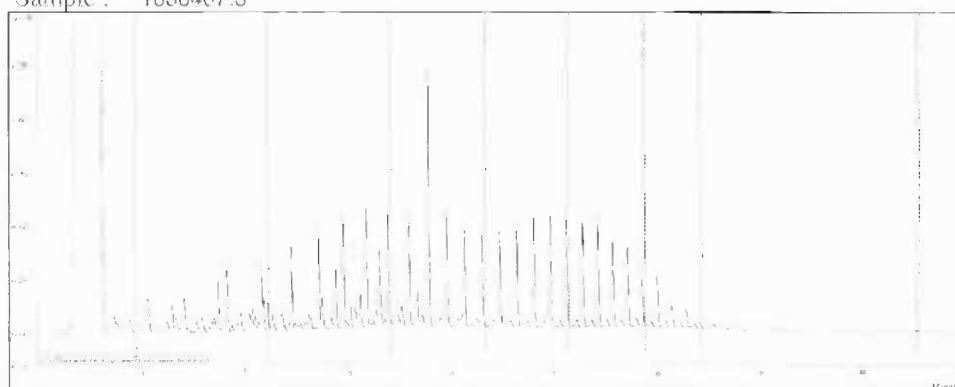


Martin Cowell - BSc (Chem)
Client Services Manager - Environmental Division

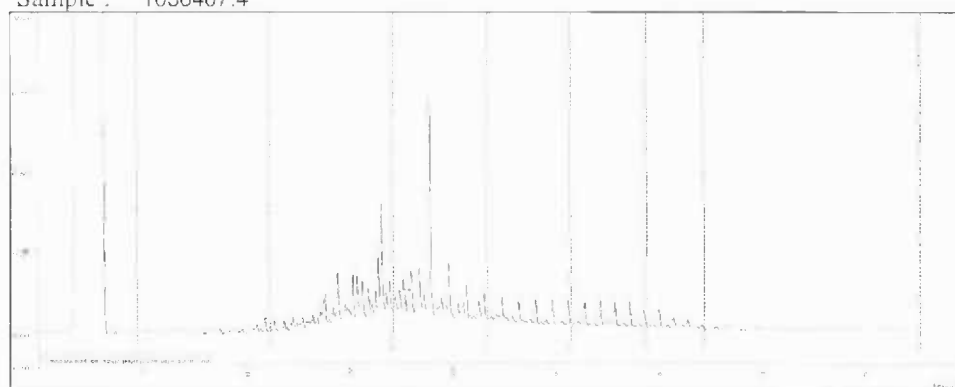
Sample : 1036407.1



Sample : 1036407.3

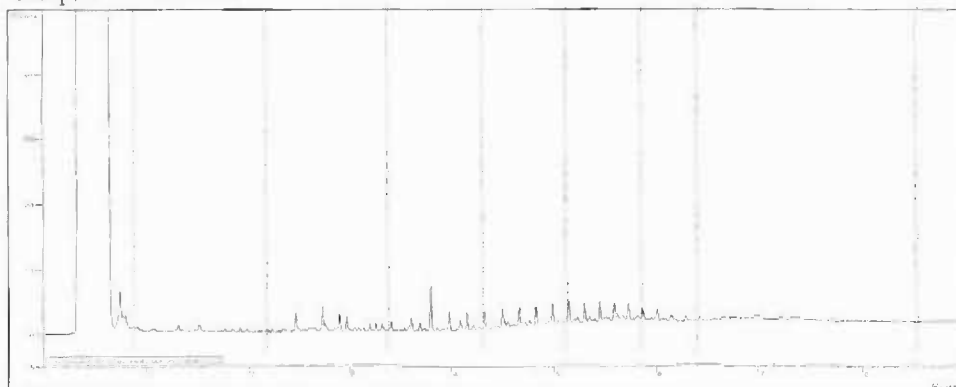


Sample : 1036407.4

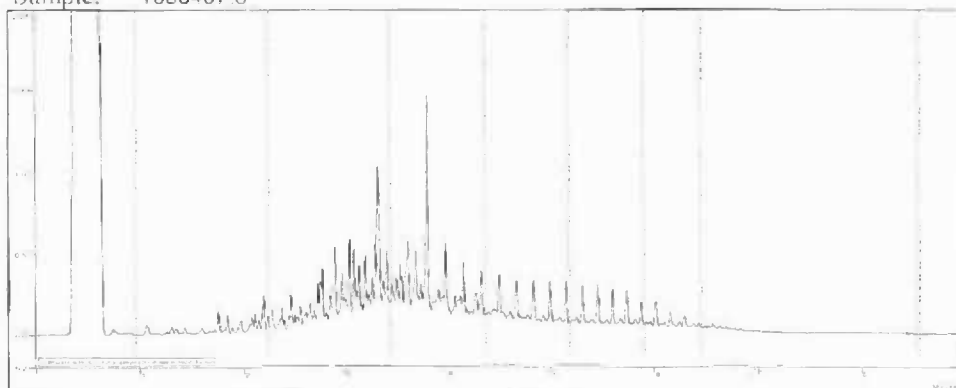


C7 C10 C15 C20 C25 C30 C34 C44

Sample: 1036407.7



Sample: 1036407.8



C7 C10 C15 C20 C25 C30 C34 C44



ANALYSIS REPORT

Page 1 of 2

Client:	BTW Company Ltd	Lab No:	1038960	SPV1
Contact:	Michael Collins	Date Registered:	24-Aug-2012	
	C/- BTW Company Ltd	Date Reported:	30-Aug-2012	
	PO Box 551	Quote No:	32956	
	NEW PLYMOUTH 4340	Order No:		
		Client Reference:	Predisposal Sample	
		Submitted By:	Michael Collins	

Interim Report

This is an interim report, prepared before all test results are completed. As all final Q.C. checks may not have been possible, it is not regarded as an official laboratory report. The final official report will be issued upon completion of all tests.

Sample Type: Oil				
Sample Name:		Cheal Oil Waste		
		14-Aug-2012		
Lab Number:		1038960.1		
Individual Tests				
Dry Matter	g/100g as rcvd	72	-	-
Total Arsenic	mg/kg as rcvd	< 1.0	-	-
Total Barium	mg/kg as rcvd	15.1	-	-
Total Cadmium	mg/kg as rcvd	0.06	-	-
Total Chromium	mg/kg as rcvd	< 1.0	-	-
Total Copper	mg/kg as rcvd	5.5	-	-
Total Lead	mg/kg as rcvd	3.7	-	-
Total Nickel	mg/kg as rcvd	1.7	-	-
Total Polassium	mg/kg as rcvd	< 50	-	-
Total Sodium	mg/kg as rcvd	< 20	-	-
Total Zinc	mg/kg as rcvd	26	-	-
Chloride	mg/kg as rcvd	In Progress	-	-
Total Nitrogen	g/100g as rcvd	< 0.09	-	-
BTEX in Soil by Headspace GC-MS				
Benzene	mg/kg dry wt	51	-	-
Toluene	mg/kg dry wt	650	-	-
Ethylbenzene	mg/kg dry wt	177	-	-
m&p-Xylene	mg/kg dry wt	1,250	-	-
o-Xylene	mg/kg dry wt	410	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil				
Acenaphthene	mg/kg dry wt	In Progress	-	-
Acenaphthylene	mg/kg dry wt	In Progress	-	-
Anthracene	mg/kg dry wt	In Progress	-	-
Benzo[a]anthracene	mg/kg dry wt	In Progress	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	In Progress	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	In Progress	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	In Progress	-	-
Benzo[k]fluoranthene	mg/kg dry wt	In Progress	-	-
Chrysene	mg/kg dry wt	In Progress	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	In Progress	-	-
Fluoranthene	mg/kg dry wt	In Progress	-	-
Fluorene	mg/kg dry wt	In Progress	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	In Progress	-	-
Naphthalene	mg/kg dry wt	In Progress	-	-
Phenanthrene	mg/kg dry wt	In Progress	-	-
Pyrene	mg/kg dry wt	In Progress	-	-

Sample Type: Oil		Sample Name: Cheal Oily Waste			
		Lab Number: 1038960.1			
Total Petroleum Hydrocarbons in Soil					
C7 - C9	mg/kg dry wt	31,000	-	-	-
C10 - C14	mg/kg dry wt	138,000	-	-	-
C15 - C36	mg/kg dry wt	740,000	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	910,000	-	-	-

Analyst's Comments

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

SUMMARY OF METHODS

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

Sample Type: Oil			
Test	Method Description	Default Detection Limit	Samples
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample	-	1
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample.	-	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample	-	1
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) . gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1
Ashing and Aqua Regia digest	Ashing in Muffle furnace. Aqua Regia (HNO ₃ /HCl) digestion.	-	1
Total Arsenic	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	1
Total Barium	Aqua Regia Digestion, ICP-MS.	0.2 mg/kg as rcvd	1
Total Cadmium	Aqua Regia Digestion, ICP-MS.	0.05 mg/kg as rcvd	1
Total Chromium	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	1
Total Copper	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	1
Total Lead	Aqua Regia Digestion, ICP-MS.	0.2 mg/kg as rcvd	1
Total Nickel	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	1
Total Potassium	Aqua Regia Digestion, ICP-MS.	50 mg/kg as rcvd	1
Total Sodium	Aqua Regia Digestion, ICP-MS.	20 mg/kg as rcvd	1
Total Zinc	Aqua Regia Digestion, ICP-MS.	2 mg/kg as rcvd	1
Total Chloride in Oil	Determination using Titration-c, used oil quantification kit	50 mg/kg as rcvd	1
Total Nitrogen	Catalytic Combustion (900°C, O ₂), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g as rcvd	1

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

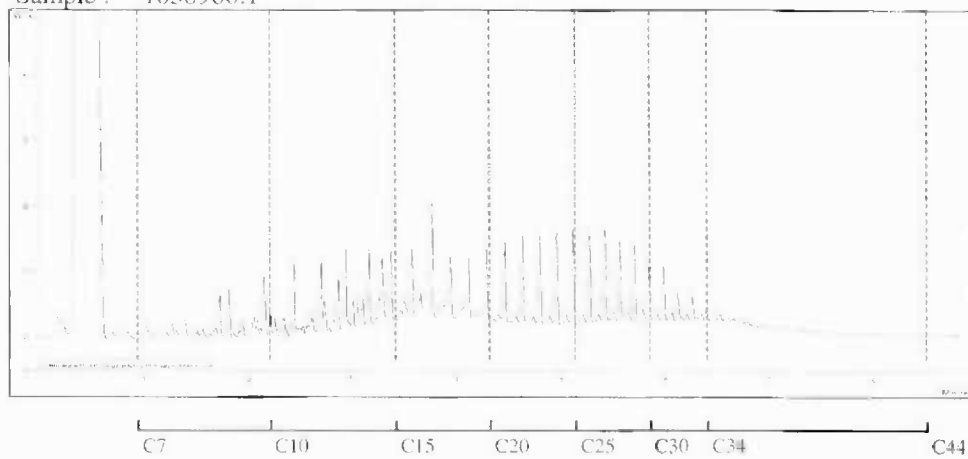
Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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

Sample : 1038960.1





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Hamilton 3240, New Zealand

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Web www.hill-labs.co.nz

ANALYSIS REPORT

Page 1 of 3

Client:	BTW Company Ltd	Lab No:	1039412	SPV1
Contact:	Michael Collins	Date Registered:	25-Aug-2012	
	C/- BTW Company Ltd	Date Reported:	03-Sep-2012	
	PO Box 551	Quote No:	32966	
	NEW PLYMOUTH 4340	Order No:		
		Client Reference:		
		Submitted By:	Michael Collins	

Sample Type: Soil					
Sample Name:		Cheal Flare Pit 24-Aug-2012 7:00 am			
Lab Number:		1039412.1			
Individual Tests					
Dry Matter	g/100g as rcvd	70	-	-	-
Density*	g/mL at 20°C	2.07	-	-	-
Total Recoverable Barium	mg/kg dry wt	6,100	-	-	-
Total Recoverable Potassium*	mg/kg dry wt	2,400	-	-	-
Total Recoverable Sodium	mg/kg dry wt	690	-	-	-
Chloride*	mg/kg dry wt	470	-	-	-
pH*	pH Units	8.1	-	-	-
Total Nitrogen*	g/100g dry wt	< 0.05	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg					
Total Recoverable Arsenic	mg/kg dry wt	18	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	0.17	-	-	-
Total Recoverable Chromium	mg/kg dry wt	16	-	-	-
Total Recoverable Copper	mg/kg dry wt	115	-	-	-
Total Recoverable Lead	mg/kg dry wt	1,410	-	-	-
Total Recoverable Mercury	mg/kg dry wt	1.50	-	-	-
Total Recoverable Nickel	mg/kg dry wt	3	-	-	-
Total Recoverable Zinc	mg/kg dry wt	113	-	-	-
BTEX in Soil by Headspace GC-MS					
Benzene	mg/kg dry wt	0.24	-	-	-
Toluene	mg/kg dry wt	6.9	-	-	-
Ethylbenzene	mg/kg dry wt	3.2	-	-	-
m,p-Xylene	mg/kg dry wt	32	-	-	-
o-Xylene	mg/kg dry wt	2.4	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil					
Acenaphthene	mg/kg dry wt	< 0.04	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.04	-	-	-
Anthracene	mg/kg dry wt	< 0.04	-	-	-
Benzo[a]anthracene	mg/kg dry wt	0.24	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.12	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	0.40	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	0.15	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	0.06	-	-	-
Chrysene	mg/kg dry wt	0.68	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	0.04	-	-	-
Fluoranthene	mg/kg dry wt	0.88	-	-	-
Fluorene	mg/kg dry wt	< 0.04	-	-	-



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

Sample Name:		Cheal Flare Pit 24-Aug-2012 7:00 am			
Lab Number:		1039412.1			
Polycyclic Aromatic Hydrocarbons Screening in Soil					
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	0.10	-	-	-
Naphthalene	mg/kg dry wt	5.3	-	-	-
Phenanthrene	mg/kg dry wt	3.9	-	-	-
Pyrene	mg/kg dry wt	1.49	-	-	-
Total Petroleum Hydrocarbons in Soil					
C7 - C9	mg/kg dry wt	178	-	-	-
C10 - C14	mg/kg dry wt	1,560	-	-	-
C15 - C36	mg/kg dry wt	9,700	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	11,400	-	-	-

Analyst's Comments

Appendix No. 1 - Total Petroleum Hydrocarbon Chromatograms

SUMMARY OF METHODS

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

Sample Type: Soil			
Test	Method Description	Default Detection Limit	Samples
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1
Soil Prep Dry & Sieve for Agriculture	Air dried at 35°C and sieved, <2mm fraction.	-	1
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	1
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample	-	1
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample.	-	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample	-	1
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1
esiCexln*	Potassium phosphate extraction for Ion Chromatography. In House.	-	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1
Density*	Calculation: weight of sample / volume of sample at 20°C. Gravimetric determination.	0.02 g/mL at 20°C	1
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1
Total Recoverable Potassium*	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Total Recoverable Sodium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	1
Chloride*	Ion Chromatography determination of es potassium phosphate extraction.	3 mg/kg dry wt	1
pH*	1:2 (v/v) soil : water slurry followed by potentiometric determination of pH.	0.1 pH Units	1
Total Nitrogen*	Catalytic Combustion (900°C, O ₂), separation. Thermal Conductivity Detector [Elemental Analyser].	0.05 g/100g dry wt	1

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

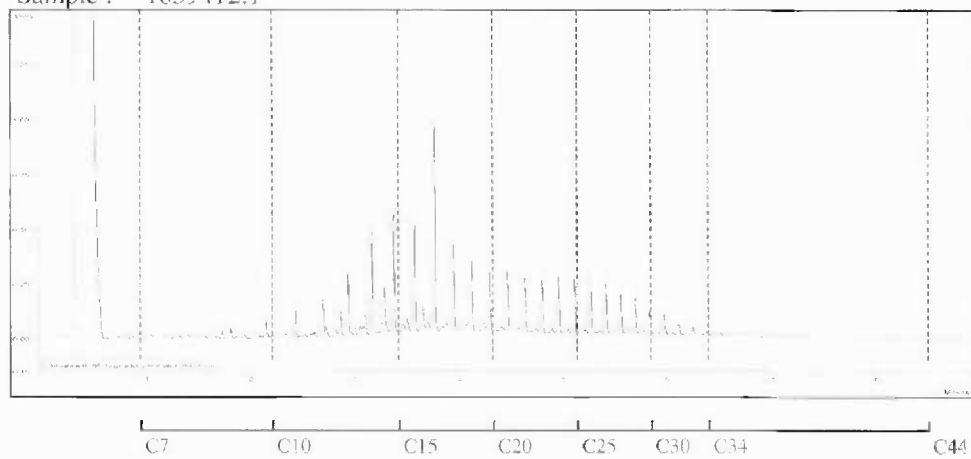
Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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A handwritten signature in black ink, appearing to read 'Graham Corban', written in a cursive style.

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

Sample : 1039412.1





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Web www.hill-labs.co.nz

ANALYSIS REPORT

Page 1 of 2

Client:	BTW Company Ltd	Lab No:	1038960	SPV2
Contact:	Michael Collins	Date Registered:	24-Aug-2012	
	C/- BTW Company Ltd	Date Reported:	07-Sep-2012	
	PO Box 551	Quote No:	32966	
	NEW PLYMOUTH 4340	Order No:		
		Client Reference:	Predisposal Sample	
		Submitted By:	Michael Collins	

Sample Type: Oil					
Sample Name:		Cheal Oily Waste			
		14-Aug-2012			
Lab Number:		1038960.1			
Individual Tests					
Dry Matter	g/100g as rcvd	72	-	-	-
Total Arsenic*	mg/kg as rcvd	< 1.0	-	-	-
Total Barium*	mg/kg as rcvd	15.1	-	-	-
Total Cadmium*	mg/kg as rcvd	0.06	-	-	-
Total Chromium*	mg/kg as rcvd	< 1.0	-	-	-
Total Copper*	mg/kg as rcvd	5.5	-	-	-
Total Lead*	mg/kg as rcvd	3.7	-	-	-
Total Nickel*	mg/kg as rcvd	1.7	-	-	-
Total Potassium*	mg/kg as rcvd	< 50	-	-	-
Total Sodium*	mg/kg as rcvd	< 20	-	-	-
Total Zinc*	mg/kg as rcvd	26	-	-	-
Chloride*	mg/kg as rcvd	< 3 #1	-	-	-
Total Nitrogen*	g/100g as rcvd	< 0.09	-	-	-
BTEX in Soil by Headspace GC-MS					
Benzene	mg/kg dry wt	51	-	-	-
Toluene	mg/kg dry wt	650	-	-	-
Ethylbenzene	mg/kg dry wt	177	-	-	-
m&p-Xylene	mg/kg dry wt	1,250	-	-	-
o-Xylene	mg/kg dry wt	410	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil					
Acenaphthene	mg/kg dry wt	< 4	-	-	-
Acenaphthylene	mg/kg dry wt	< 4	-	-	-
Anthracene	mg/kg dry wt	< 4	-	-	-
Benzo[a]anthracene	mg/kg dry wt	5	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 4	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	6	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 4	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 4	-	-	-
Chrysene	mg/kg dry wt	12	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 4	-	-	-
Fluoranthene	mg/kg dry wt	19	-	-	-
Fluorene	mg/kg dry wt	< 4	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 4	-	-	-
Naphthalene	mg/kg dry wt	1,320	-	-	-
Phenanthrene	mg/kg dry wt	230	-	-	-
Pyrene	mg/kg dry wt	31	-	-	-



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

Sample Name: Cheal Oily Waste		14-Aug-2012
Lab Number: 1038960.1		
Total Petroleum Hydrocarbons in Soil		
C7 - C9	mg/kg dry wt	31,000
C10 - C14	mg/kg dry wt	138,000
C15 - C36	mg/kg dry wt	740,000
Total hydrocarbons (C7 - C36)	mg/kg dry wt	910,000

Analyst's Comments

#1 The chloride testing was sub-contracted to IPL, due to the delay of the test kits required for Hill Laboratories to perform this analysis.

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

Appendix No.2 - Chloride result from IPL

SUMMARY OF METHODS

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

Test	Method Description	Default Detection Limit	Samples
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample	-	1
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample.	-	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MPE Petroleum Industry Guidelines. Tested on as received sample	-	1
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry), gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1
Ashing and Aqua Regia digest	Ashing in Muffle furnace, Aqua Regia (HNO ₃ /HCl) digestion.	-	1
Total Arsenic*	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	1
Total Barium*	Aqua Regia Digestion, ICP-MS.	0.2 mg/kg as rcvd	1
Total Cadmium*	Aqua Regia Digestion, ICP-MS.	0.05 mg/kg as rcvd	1
Total Chromium*	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	1
Total Copper*	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	1
Total Lead*	Aqua Regia Digestion, ICP-MS.	0.2 mg/kg as rcvd	1
Total Nickel*	Aqua Regia Digestion, ICP-MS.	1.0 mg/kg as rcvd	1
Total Potassium*	Aqua Regia Digestion, ICP-MS.	50 mg/kg as rcvd	1
Total Sodium*	Aqua Regia Digestion, ICP-MS.	20 mg/kg as rcvd	1
Total Zinc*	Aqua Regia Digestion, ICP-MS.	2 mg/kg as rcvd	1
Total Chloride in Oil*	Determination using Titration-c, used oil quantification kit.	50 mg/kg as rcvd	1
Total Nitrogen*	Catalytic Combustion (900°C, O ₂), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g as rcvd	1

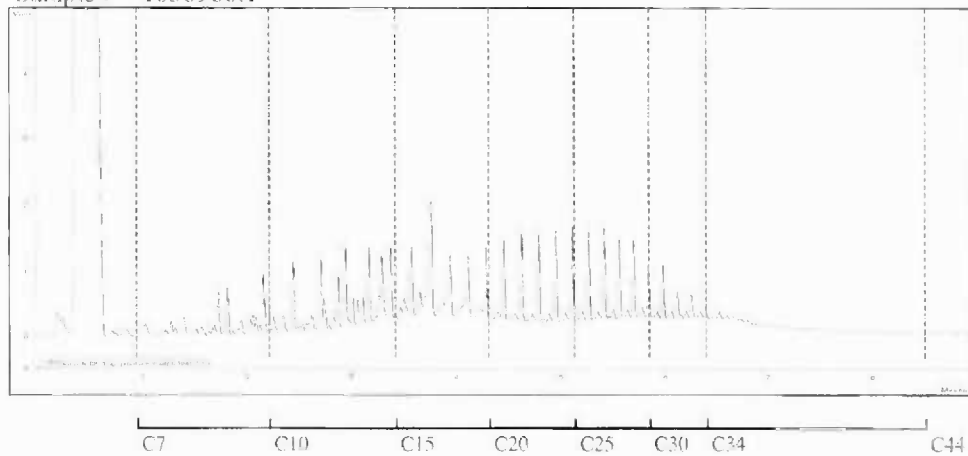
These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

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

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

Sample : 1038960.1





INDEPENDENT PETROLEUM LABORATORY LTD

Specialists in Fuels and Environmental Analysis

Laboratory Test Report

Customer: Hills Laboratories

Copy to: Environmental

Address: Private Bag 3205
Hamilton East

Customer Reference: Oil

Report Ref: 414532

Location

Product: Miscellaneous

Source: Various as below

SAMPLES RECEIVED/WORK REQUIRED

Samples were ashed prior to analysis as requested. Sample matrix is outside scope of chloride method.

Method	Notes	Properties	Units	Miscellaneous	Miscellaneous	Miscellaneous	Miscellaneous
SMS369-89		Chlorides	mg/kg	<3	<3	<3	<3

Sample Type	Miscellaneous	Miscellaneous	Miscellaneous	Miscellaneous
Site Name	1036407/10	1036407/9	1038960-1	1039555/3
Sample Point Name	Oil	Oil	Oil	Oil
Sample ID	414536	414535	414534	414532

DISCUSSION

Reported By: M. Adams (Martin Adams)

Date: 05 September 2012

Checked By: B. Adams (Approved Signatory)

Date: 05 September 2012

This report relates specifically to the samples as received.

The latest issue of the relevant test methods was used unless otherwise stated.

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Web www.hill-labs.co.nz

ANALYSIS REPORT

Page 1 of 2

Client:	Origin Energy Resources New Zealand Ltd	Lab No:	920548	SPV1
Contact:	Mike Reid	Date Registered:	06-Aug-2011	
	C/- Origin Energy Resources New Zealand Ltd	Date Reported:	12-Aug-2011	
	Private Bag 2022	Quote No:		
	NEW PLYMOUTH 4342	Order No:		
		Client Reference:	Oily Waste Pre-disposal	
		Submitted By:	Mike Reid	

Sample Type: Aqueous				
Sample Name:		Steam Cleaning Water		
		05-Aug-2011		
		12:00 pm		
Lab Number:		920548.1		
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn				
Total Arsenic	g/m³	< 1.1	-	-
Total Cadmium	g/m³	< 0.053	-	-
Total Chromium	g/m³	< 0.53	-	-
Total Copper	g/m³	1.53	-	-
Total Lead	g/m³	0.95	-	-
Total Nickel	g/m³	< 0.53	-	-
Total Zinc	g/m³	5.4	-	-
BTEX in Water by Headspace GC-MS				
Benzene	g/m³	55	-	-
Toluene	g/m³	85	-	-
Ethylbenzene	g/m³	18.5	-	-
m&p-Xylene	g/m³	85	-	-
o-Xylene	g/m³	33	-	-
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq				
Acenaphthene	g/m³	0.42	-	-
Acenaphthylene	g/m³	0.39	-	-
Anthracene	g/m³	0.39	-	-
Benzo[a]anthracene	g/m³	0.194	-	-
Benzo[a]pyrene (BAP)	g/m³	0.012	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m³	0.050	-	-
Benzo[g,h,i]perylene	g/m³	< 0.008	-	-
Benzo[k]fluoranthene	g/m³	0.009	-	-
Chrysene	g/m³	0.41	-	-
Dibenzo[a,h]anthracene	g/m³	< 0.008	-	-
Fluoranthene	g/m³	0.60	-	-
Fluorene	g/m³	4.4	-	-
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.008	-	-
Naphthalene	g/m³	27	-	-
Phenanthrene	g/m³	11.3	-	-
Pyrene	g/m³	0.58	-	-
Total Petroleum Hydrocarbons in Water				
C7 - C9	g/m³	1,480	-	-
C10 - C14	g/m³	1,470	-	-
C15 - C36	g/m³	2,300	-	-
Total hydrocarbons (C7 - C36)	g/m³	5,300	-	-



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Analyst's Comments

The matrix of sample 920548.1 has affected some the System Monitoring Compounds in the PAH analysis, whereby the recovery ranged between 8% and 98%. Therefore the results may be underestimated for compounds like Benzo[a]pyrene and Dibenzo[a,h]anthracene.

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms

SUMMARY OF METHODS

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

Sample 191 - Aqueous			
Test	Method Description	Default Detection Limit	Samples
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, screen level	-	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B	-	1
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq	Liquid / liquid extraction, SPE (if required), GC-MS SIM analysis	-	1
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines	-	1
Total Digestion	Boiling nitric acid digestion, APHA 3030 E 21 st ed, 2005.	-	1

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

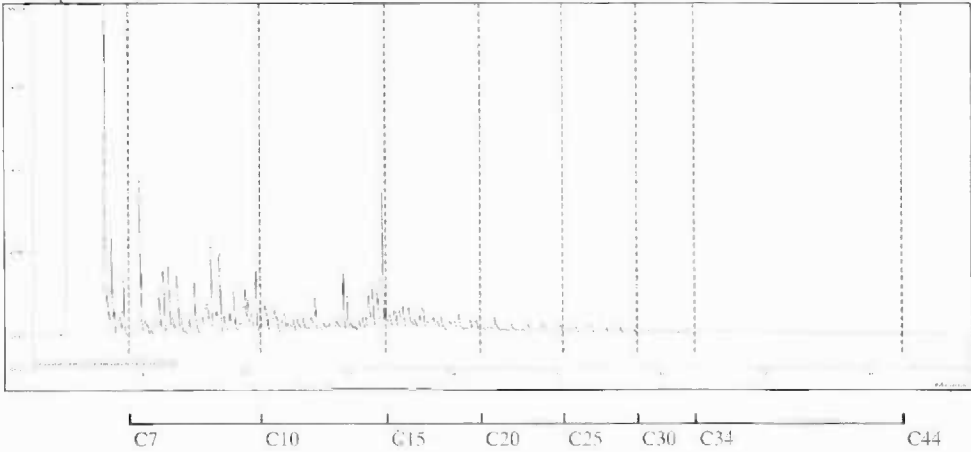
Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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

Sample : 920548.1





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Web www.hill-labs.co.nz

ANALYSIS REPORT

Page 1 of 2

Client:	Kea Petroleum Holdings Ltd	Lab No:	1147691	S/PV1
Contact:	Michael Collins	Date Registered:	20-Jun-2013	
	C/- Kea Petroleum Holdings Ltd	Date Reported:	28-Jun-2013	
	PO Box 8310	Quote No:	53195	
	NEW PLYMOUTH 4310	Order No:		
		Client Reference:	Pre-Disposal Water	
		Submitted By:	Michael Collins	

Sample Type Aqueous					
Sample Name:		Puku Conductor			
Lab Number:		1147691.1			
Individual Tests					
pH	pH Units	7.1	-	-	-
Electrical Conductivity (EC)	mS/m	1.076	-	-	-
Total Dissolved Solids (TDS)	g/m³	5.700	-	-	-
Total Potassium	g/m³	930	-	-	-
Total Sodium	g/m³	1,290	-	-	-
Chloride	g/m³	3,300	-	-	-
Total Nitrogen	g/m³	25	-	-	-
Nitrate-N + Nitrite-N	g/m³	0.035	-	-	-
Total Kjeldahl Nitrogen (TKN)	g/m³	25	-	-	-
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn					
Total Arsenic	g/m³	0.058	-	-	-
Total Cadmium	g/m³	0.00057	-	-	-
Total Chromium	g/m³	0.0142	-	-	-
Total Copper	g/m³	0.122	-	-	-
Total Lead	g/m³	0.051	-	-	-
Total Nickel	g/m³	0.034	-	-	-
Total Zinc	g/m³	5.5	-	-	-
BTEX in Water by Headspace GC-MS					
Benzene	g/m³	7.1	-	-	-
Toluene	g/m³	9.1	-	-	-
Ethylbenzene	g/m³	0.59	-	-	-
m&p-Xylene	g/m³	4.2	-	-	-
o-Xylene	g/m³	1.45	-	-	-
Total Petroleum Hydrocarbons in Water					
C7 - C9	g/m³	11.0	-	-	-
C10 - C14	g/m³	30	-	-	-
C15 - C36	g/m³	72	-	-	-
Total hydrocarbons (C7 - C36)	g/m³	113	-	-	-

Analyst's Comments

The specific gravity could not be performed due to insufficient sample supplied.

Appendix No.1 - Total Petroleum Hydrocarbon Chromatograms



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

SUMMARY OF METHODS

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

Test	Method Description	Default Detection Limit	Samples
Heavy metals, totals, trace As, Cd, Cr, Cu, Ni, Pb, Zn	Nitric acid digestion, ICP-MS, trace level	-	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26587,3629]	-	1
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis US EPA 8015B/MFE Petroleum Industry Guidelines [KBIs:2803,10734]	-	1
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total Digestion	Boiling nitric acid digestion, APHA 3030 E 22 nd ed. 2012 (modified).	-	1
Total Kjeldahl Digestion	Sulphuric acid digestion with copper sulphate catalyst.	-	1
pH	pH meter, APHA 4500-H ⁺ B 21 st ed. 2005.	0.1 pH Units	1
Electrical Conductivity (EC)	Conductivity meter, 25°C, APHA 2510 B 21 st ed. 2005.	0.1 mS/m	1
Total Dissolved Solids (TDS)	Filtration through GF/C (1.2 µm), gravimetric, APHA 2540 C (modified: drying temperature of 103 - 105°C used rather than 180 ± 2°C) 21 st ed. 2005.	10 g/m ³	1
Total Potassium	Nitric acid digestion, ICP-MS, trace level, APHA 3125 B 21 st ed. 2005.	0.053 g/m ³	1
Total Sodium	Nitric acid digestion, ICP-MS, trace level, APHA 3125 B 21 st ed. 2005.	0.021 g/m ³	1
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser, APHA 4500 Cl ⁻ E (modified from continuous flow analysis) 21 st ed. 2005.	0.5 g/m ³	1
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N.	0.05 g/m ³	1
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser, APHA 4500-NO ₃ ⁻ I 21 st ed. 2005.	0.002 g/m ³	1
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser, APHA 4500-N _{org} D. (modified) 4500 NH ₃ F (modified) 21 st ed. 2005.	0.10 g/m ³	1

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

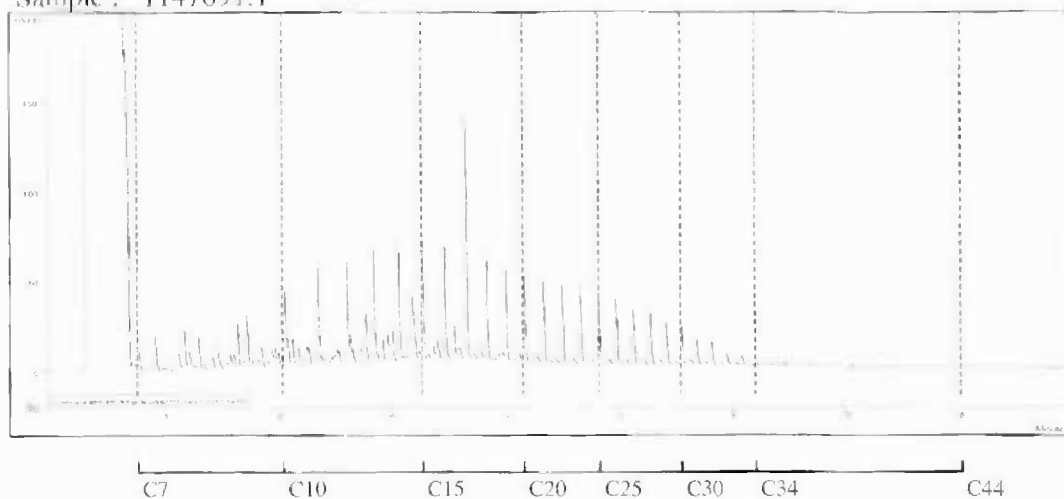
Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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

Sample : 1147691.1



Appendix 7

Monitoring Results & Compliance Table

Sample Type: Soil

Site Name:		15-Jan-12	30-Jan-12	30-Jan-13	19-7-July-13	
Waikaikai		Pre-Disposal	Pre-Disposal	Receiving Environment F1	Receiving Environment F1	Consent Limits
Lab Number:		1091551.3	1095817.1	1095949.1	1154516.1	
Dry Matter	g/100g as rcvd	17.7	36	91	86	
Density	g/mL at 20°C	0	1.24	1.91	43	
Total Recoverable Barium	mg/kg dry wt	0	81	196	< 20	
Total Recoverable Potassium	mg/kg dry wt	0	98,000	5,300	172	
Total Recoverable Sodium	mg/kg dry wt	0	7,800	2,100	24	460
Chloride	mg/kg dry wt	0	95,000	930	0.14	700
pH	pH Units	0	12.1	7.2		
Total Nitrogen	g/100g dry wt	0	< 0.05	0.12		
Heavy Metals						
Total Recoverable Arsenic	mg/kg dry wt	0	6	< 2	< 2	17
Total Recoverable Cadmium	mg/kg dry wt	0	< 0.10	< 0.10	< 0.10	0.8
Total Recoverable Chromium	mg/kg dry wt	0	36	14	13	290
Total Recoverable Copper	mg/kg dry wt	0	11	11	10	100
Total Recoverable Lead	mg/kg dry wt	0	16.3	3.4	1.3	160
Total Recoverable Mercury	mg/kg dry wt	0	< 0.10	< 0.10	< 0.10	1
Total Recoverable Nickel	mg/kg dry wt	0	14	6	6	60
Total Recoverable Zinc	mg/kg dry wt	0	64	63	60	300
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	<0.6	< 0.15	< 0.05	< 0.05	1.1
Toluene	mg/kg dry wt	<0.6	< 0.15	< 0.05	< 0.05	68
Ethylbenzene	mg/kg dry wt	<0.6	< 0.15	< 0.05	< 0.05	53
m&p-Xylene	mg/kg dry wt	<1.1	< 0.3	< 0.10	< 0.10	48
o-Xylene	mg/kg dry wt	<0.6	< 0.15	< 0.05	< 0.05	48
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	<0.14	< 0.07	< 0.03	< 0.03	
Acenaphthylene	mg/kg dry wt	<0.14	< 0.07	< 0.03	< 0.03	
Anthracene	mg/kg dry wt	<0.14	< 0.07	< 0.03	< 0.03	
Benzo[a]anthracene	mg/kg dry wt	<0.14	< 0.07	< 0.03	< 0.03	
Benzo[a]pyrene (BAP)	mg/kg dry wt	<0.14	< 0.07	< 0.03	< 0.03	0.027
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	<0.14	< 0.07	< 0.03	< 0.03	
Benzo[g,h,i]perylene	mg/kg dry wt	<0.14	< 0.07	< 0.03	< 0.03	
Benzo[k]fluoranthene	mg/kg dry wt	<0.14	< 0.07	< 0.03	< 0.03	
Chrysene	mg/kg dry wt	<0.14	< 0.07	< 0.03	< 0.03	
Dibenzo[a,h]anthracene	mg/kg dry wt	<0.14	< 0.07	< 0.03	< 0.03	
Fluoranthene	mg/kg dry wt	<0.14	< 0.07	< 0.03	< 0.03	
Fluorene	mg/kg dry wt	<0.14	< 0.07	< 0.03	< 0.03	
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	<0.14	< 0.07	< 0.03	< 0.03	
Naphthalene	mg/kg dry wt	<0.7	< 0.4	< 0.12	< 0.14	7.2
Phenanthrene	mg/kg dry wt	<0.14	< 0.07	< 0.03	< 0.03	
Pyrene	mg/kg dry wt	<0.14	< 0.07	< 0.03	< 0.03	
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	<40	< 19	< 8	< 8	
C10 - C14	mg/kg dry wt	<80	< 40	< 20	< 20	
C15 - C36	mg/kg dry wt	<160	< 80	< 40	< 40	
Total hydrocarbons (C7 - C36)	mg/kg dry wt	<300	< 140	< 70	< 70	4000



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Web www.hill-labs.co.nz

ANALYSIS REPORT

Page 1 of 2

Client:	Waikakai Farms	Lab No:	1095949	SPV1
Contact:	Waikakai Farms	Date Registered:	02-Feb-2013	
	C/- P Wards	Date Reported:	13-Feb-2013	
	78 Lower Manutahi Road	Quote No:	53112	
	RD 2	Order No:		
	PATEA 4598	Client Reference:	Receiving Soil	
		Submitted By:	Waikakai Farms	

Sample Type: Soil					
Sample Name:		Receiving Soil 1			
		30-Jan-2013			
		10:30 am			
Lab Number:		1095949.1			
Individual Tests					
Dry Matter	g/100g as recd	91	-	-	-
Density*	g/mL at 20°C	1.91	-	-	-
Total Recoverable Barium	mg/kg dry wt	196	-	-	-
Total Recoverable Calcium	mg/kg dry wt	5,300	-	-	-
Total Recoverable Magnesium	mg/kg dry wt	2,100	-	-	-
Chloride*	mg/kg dry wt	930	-	-	-
pH*	pH Units	7.2	-	-	-
Total Nitrogen*	g/100g dry wt	0.12	-	-	-
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg					
Total Recoverable Arsenic	mg/kg dry wt	< 2	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	-	-	-
Total Recoverable Chromium	mg/kg dry wt	14	-	-	-
Total Recoverable Copper	mg/kg dry wt	11	-	-	-
Total Recoverable Lead	mg/kg dry wt	3.4	-	-	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	-	-	-
Total Recoverable Nickel	mg/kg dry wt	6	-	-	-
Total Recoverable Zinc	mg/kg dry wt	63	-	-	-
BTEX in Soil by Headspace GC-MS					
Benzene	mg/kg dry wt	< 0.05	-	-	-
Toluene	mg/kg dry wt	< 0.05	-	-	-
Ethylbenzene	mg/kg dry wt	< 0.05	-	-	-
m&p-Xylene	mg/kg dry wt	< 0.10	-	-	-
o-Xylene	mg/kg dry wt	< 0.05	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil					
Acenaphthene	mg/kg dry wt	< 0.03	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.03	-	-	-
Anthracene	mg/kg dry wt	< 0.03	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.03	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.03	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.03	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.03	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.03	-	-	-
Chrysene	mg/kg dry wt	< 0.03	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.03	-	-	-
Fluoranthene	mg/kg dry wt	< 0.03	-	-	-
Fluorene	mg/kg dry wt	< 0.03	-	-	-



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Sample Type: Soil					
Sample Name:		Receiving Soil 1 30-Jan-2013 10:30 am			
Lab Number:		1095949.1			
Polycyclic Aromatic Hydrocarbons Screening in Soil					
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.03	-	-	-
Naphthalene	mg/kg dry wt	< 0.12	-	-	-
Phenanthrene	mg/kg dry wt	< 0.03	-	-	-
Pyrene	mg/kg dry wt	< 0.03	-	-	-
Total Petroleum Hydrocarbons in Soil					
C7 - C9	mg/kg dry wt	< 8	-	-	-
C10 - C14	mg/kg dry wt	< 20	-	-	-
C15 - C36	mg/kg dry wt	< 40	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	-	-	-

SUMMARY OF METHODS

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

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

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

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

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Martin Cowell - BSc (Chem)
Client Services Manager - Environmental Division



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Web www.hill-labs.co.nz

ANALYSIS REPORT

Page 1 of 2

Client:	Kea Petroleum Holdings Ltd	Lab No:	1154516	SPv1
Contact:	Michael Collins	Date Registered:	10-Jul-2013	
	C/- Kea Petroleum Holdings Ltd	Date Reported:	19-Jul-2013	
	PO Box 8310	Quote No:	53196	
	NEW PLYMOUTH 4310	Order No:		
		Client Reference:		
		Submitted By:	Michael Collins	

Sample Type: **Soil**

Sample Name:	Waikakai Farms
	09-Jul-2013 4:00 pm
Lab Number:	1154516.1

Individual Tests

Dry Matter	g/100g as recvd	86	-	-	-	-
Total Recoverable Barium	mg/kg dry wt	43	-	-	-	-
Total Recoverable Boron	mg/kg dry wt	< 20	-	-	-	-
Total Recoverable Vanadium	mg/kg dry wt	172	-	-	-	-
Chloride*	mg/kg dry wt	24	-	-	-	-
Total Nitrogen*	g/100g dry wt	0.14	-	-	-	-

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

Total Recoverable Arsenic	mg/kg dry wt	< 2	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt	13	-	-	-	-
Total Recoverable Copper	mg/kg dry wt	10	-	-	-	-
Total Recoverable Lead	mg/kg dry wt	1.5	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt	6	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt	60	-	-	-	-

BTEX in Soil by Headspace GC-MS

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

Polycyclic Aromatic Hydrocarbons Screening in Soil

Acenaphthene	mg/kg dry wt	< 0.03	-	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.03	-	-	-	-
Anthracene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.03	-	-	-	-
Chrysene	mg/kg dry wt	< 0.03	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.03	-	-	-	-
Fluoranthene	mg/kg dry wt	< 0.03	-	-	-	-
Fluorene	mg/kg dry wt	< 0.03	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.03	-	-	-	-
Naphthalene	mg/kg dry wt	< 0.14	-	-	-	-



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Sample Name: Waikakai Farms					
09-Jul-2013 4:00 pm					
Lab Number: 1154516.1					
Polycyclic Aromatic Hydrocarbons Screening in Soil					
Phenanthrene	mg/kg dry wt	< 0.03	-	-	-
Pyrene	mg/kg dry wt	< 0.03	-	-	-
Total Petroleum Hydrocarbons in Soil					
C7 - C9	mg/kg dry wt	< 8	-	-	-
C10 - C14	mg/kg dry wt	< 20	-	-	-
C15 - C36	mg/kg dry wt	< 40	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	-	-	-

SUMMARY OF METHODS

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

Test	Method Description	Default Detection Limit	Samples
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1
Heavy metals, screen As, Cd, Cr, Cu, Ni, Pb, Zn, Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	1
BTEX in Soil by Headspace GC-MS	Solvent extraction. Headspace GC-MS analysis US EPA 8260B. Tested on as received sample [KBIs:5782,26687,3629]	-	1
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction. Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample. [KBIs:5786,2805,2695]	-	1
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MFE Petroleum Industry Guidelines. Tested on as received sample [KBIs:5786,2805,10734]	-	1
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry), gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rcvd	1
eslCextn*	Potassium phosphate extraction for Ion Chromatography. In House.	-	1
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1
Total Recoverable Barium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1
Total Recoverable Boron	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	20 mg/kg dry wt	1
Total Recoverable Vanadium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	100 mg/kg dry wt	1
Chloride*	Ion Chromatography determination of es potassium phosphate extraction.	3 mg/kg dry wt	1
Total Nitrogen*	Catalytic Combustion, separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	1

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

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

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



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

	Name	Waikakai				
	Date	13/11/2012				
	Sample number	GND2290	GND2291	GND2292	GND2293	GND2294
	Lab Number:	1069937.1	1069937.2	1069937.3	1069937	1069938
BTEX in Water						
Benzene	g/m3	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Toluene	g/m3	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Ethylbenzene	g/m3	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
m&p-Xylene	g/m3	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
o-Xylene	g/m3	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
TPH in Water						
C7 - C9	g/m3	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14	g/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36	g/m3	< 0.4	< 0.4	< 0.4	< 0.4	0.6
Total hydrocarbons	g/m3	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7



Hill Laboratories
BETTER TESTING BETTER RESULTS

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

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

ANALYSIS REPORT

Page 1 of 1

Client:	Taranaki Regional Council	Lab No:	1069937	SPv1
Contact:	David Olson	Date Registered:	15-Nov-2012	
	C/- Taranaki Regional Council	Date Reported:	20-Nov-2012	
	Private Bag 713	Quote No:		
	STRATFORD 4352	Order No:		
		Client Reference:	Waikakai Landfarm GW	
		Submitted By:	David Olson	

Sample Type: Water					
Sample Name:	GND2290	GND2291	GND2292	GND2293	GND2294
	13-Nov-2012 1:25 pm	13-Nov-2012 12:15 pm	13-Nov-2012 1:05 pm	13-Nov-2012 3:00 pm	13-Nov-2012 1:50 pm
Lab Number:	1069937.1	1069937.2	1069937.3	1069937.4	1069937.5
BTEX in Water by Headspace GC-MS					
Benzene	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Toluene	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Ethylbenzene	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010
m&p-Xylene	g/m ³	< 0.002	< 0.002	< 0.002	< 0.002
o-Xylene	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Total Petroleum Hydrocarbons in Water					
C7 - C9	g/m ³	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14	g/m ³	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36	g/m ³	< 0.4	< 0.4	< 0.4	0.6
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	< 0.7	< 0.7	< 0.7

SUMMARY OF METHODS

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

Test	Method Description	Default Detection Limit	Samples
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B	-	1-5
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines	-	1-5

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

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

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

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



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

Appendix 8

TRC Inspection Notices

No. 11875

Document: 1103575

**ABATEMENT NOTICE UNDER SECTIONS 322 & 324 OF THE
RESOURCE MANAGEMENT ACT 1991**

To: Peter Ward
Waikaikai Farms Limited
78 Lower Manutahi Road
RD 2 Patea 4598

Taranaki Regional Council gives notice that you must take the following action:

1. Ensure no further drilling mud waste is taken in the pre-existing pit area to ensure compliance with Resource Consent 5956-1.
2. Ensure groundwater bores are installed and sampled prior to the landfarming of existing drilling muds to ensure compliance with Resource Consent 5956-1.
3. Ensure the oily waste portion of the drilling mud is separated and discharged into the oily waste pit for later disposal to ensure compliance with Resource Consent 5956-1.
4. Upon completion of the required actions listed above, ensure the materials currently within the pit area are landfarmed as soon as practicable to ensure compliance with Resource Consent 5956-1.

The location to which this abatement notice applies is:

46-78 MANUTAHU RD MANUTAHU
LOTS 1 2 & 4 DP 7139 LOTS 2 & 12 DP 14551 & SEC 742 PATEA DIST BLK I CARLYLESD

You must comply with this abatement notice within the following period:

02 December 2012.

You must continue to comply with this abatement notice after that date.

This notice is issued under:

Section 322(1)(b)(ii) of the Resource Management Act 1991, which states that:

- (1) An abatement notice may be served on any person by an enforcement officer—
 - (b) Requiring that person to do something that, in the opinion of the enforcement officer, is necessary to ensure compliance by or on behalf of that person with this Act, any regulations, a rule in a plan or a proposed plan, or a resource consent, and also necessary to avoid, remedy, or mitigate any actual or likely adverse effect on the environment—
 - (ii) Relating to any land of which the person is the owner or occupier.

The reasons for this notice are:

5. Scientific Officer, David Olson visited the property on 29 August 2012 and found that:
 - The best practicable option for the storage and disposal of drilling muds had not been adopted.
6. Special condition 3 of Resource Consent 5956-1 states:
 3. *The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.*
7. At the time of inspection special condition 3 of Resource Consent 5956-1 was being contravened.
8. Section 15(1)(b) of the Resource Management Act 1991 prohibits the discharge of contaminants onto or into land in circumstances which may result in that contaminant entering water unless the discharge is expressly allowed by a national environmental standard or other regulations, a rule in a regional plan, or a resource consent.
9. The discharge of drilling mud, discovered on 29 August 2012 was not allowed by Resource Consent 5956-1 and therefore contravened section 15(1)(b) of the Resource Management Act 1991.
10. Contravention of section 15(1)(b) of the Resource Management Act 1991 is an offence under section 338(1)(a) of the Resource Management Act 1991.
11. This notice has been issued to you to require you to take the action as set out in clauses 1 to 4 because in the opinion of the enforcement officer that issued this notice, this action is necessary to ensure compliance by you/on your behalf with section 15(1)(b) of the Resource Management Act 1991/regulations/a rule in a plan/a proposed plan/a resource consent and also necessary to avoid/remedy/mitigate any actual/likely adverse effect on the environment relating to any land of which you are the owner/occupier.

If you do not comply with this notice, you may be prosecuted under section 338 of the Resource Management Act 1991 (unless you appeal and the notice is stayed as explained below), or an infringement notice may be served on you under section 343C of the Resource Management Act 1991.

You have the right to appeal to the Environment Court against the whole or any part of this notice. If you wish to appeal, you must lodge a notice of appeal in form 49 with the Environment Court within 15 working days of being served with this notice.

An appeal does not automatically stay the notice and so you must continue to comply with it unless you also apply for a stay from an Environment Judge under section 325(3A) of the Resource Management Act 1991 (see form 50). To obtain a stay, you must lodge both an appeal and a stay with the Environment Court.

You also have the right to apply in writing to Taranaki Regional Council to change or cancel this notice in accordance with section 325A of the Resource Management Act 1991.

The Taranaki Regional Council authorised the enforcement officer who issued this notice. Its address is:

Taranaki Regional Council
Private Bag 713
Stratford 4352

Phone: (06) 765 7127
Facsimile: (06) 765 5097

The enforcement officer is acting under the following authorisation:

A warrant of authority issued by the Taranaki Regional Council, pursuant to section 38 of the Resource Management Act 1991, authorising the officer to carry out specified functions and powers as an enforcement officer under the Resource Management Act 1991 including issue of abatement notices.

.....
John Cooper
Enforcement Officer
Taranaki Regional Council
Warrant No. 174

02 October 2012

Inspection Notice

(under section 332 of the Resource Management Act 1991)



Name: Waikaikai Farms Limited
Postal Address: 78 Lower Manutahi Road, R D 2, PATEA 4598
Inspection Number: B293841076
Inspection Officer: John Cooper
Inspection Date/Time: 17 January 2013 11:24am
Inspection Type: Compliance Monitoring Insp.
Catchment: Mangaroa
Location in respect of notice: Lower Manutahi Road, Manutahi

Type of Works: Laandfarm
Weather Conditions: Fine & Windy

Consents:	Expiry	Inspection Result	Purpose
56-1	1-Jun-2016	Complies	To discharge drilling wastes from hydrocarbon exploration and production activities, and oily wastes from wellsites, onto and into land via landfarming

The following was found to be occurring: Wind west, speed 4, no objectionable odours were found during the inspection. Two lined pits at the site contain waste materials, the main mud pit had plenty of freeboard and was free of surface oils, the oily waste pit contained turbid liquid with a very small amount of windblown surface oil and blackened vegetation around the fringes. The area where muds have been spread were inspected, very little mud was found within the soil profile in the majority of areas inspected, some small areas have had poor pasture strike and more mud was present in these areas. It was outlined by the consent holder that no materials have been received recently and no clients are currently 'on the books' to utilise the disposal area.

The following action is to be taken:

Further Action: Nil
Occupier Present: Yes
Notice Delivered To: By Mail

Signed:

Warrant No. 174

Inspection Notice

(under section 332 of the Resource Management Act 1991)



Name: Waikaikai Farms Limited
Postal Address: 78 Lower Manutahi Road, R D 2, PATEA 4598
Inspection Number: B301453682
Inspection Officer: John Cooper
Inspection Date/Time: 2 April 2013 12:00pm
Inspection Type: Compliance Monitoring Insp.
Catchment: Mangaroa
Location in respect of notice: 156 Manawapou Road, Manutahi

Type of Works: Landfarm
Whether Conditions: Fine

Consents:		Expiry	Inspection Result	Purpose
5956-1	1 Jun-2016	Complies	To discharge drilling wastes from hydrocarbon exploration and production activities, and oily wastes from well sites, onto and into land via landfarming	

The following was found to be occurring: Wind North, speed 2-3, no objectionable odours were found beyond the site boundary, all pits containing material were lined and found to have plenty of freeboard available, the liquid inside all of the pits was found to be dark with very little visible surface oiling. The area where muds have previously been applied had good pasture cover. No recent disposal has occurred at the site and no sources of mud have as yet been arranged.

The following action is to be taken:

Further Action: Nil
Occupier Present: Yes
Notice Delivered To: By Mail

Signed: _____

Warrant No. 174

Inspection Notice

(under section 332 of the Resource Management Act 1991)



Name: Waikaikai Farms Limited
Postal Address: 78 Lower Manutahi Road, R D 2, PATEA 4598
Inspection Number: B311038718
Inspection Officer: John Cooper
Inspection Date/Time: 8 July 2013 10:45am
Inspection Type: Compliance Monitoring Insp.
Catchment: Mangaroa
Location in respect of notice: Lower Manutahi Road, Manutahi

Type of Works: Land farm
Weather Conditions: Fine & Windy

Consents:	Expiry:	Inspection Result	Purpose
59566-1	1-Jun-2016	Complies	To discharge drilling wastes from hydrocarbon exploration and production activities, and oily wastes from well sites, onto and into land via landfarming

The following was found to be occurring: Wind west, speed 4, no objectionable odours or visible emissions were found during the inspection, hydrocarbon odours noted down-wind of pits. Two lined pits at the site contain materials, liners appeared in good repair, surface crude/waxy oils present in both pits, the oily portion of the material was transferred from the larger pit into the smaller one using a digger bucket and the liquid portion was pumped back into the larger pit. Discussions held with site owner with regard to notification and sampling requirements, it was outlined that a representative sample was taken when the material was delivered, approximately 14 cubic metres were stockpiled at the site. Requirements of spreading activities discussed, condition relating to spreading of materials within one year of being brought onto site, as very little mud is present it may be necessary to delay spreading until more mud has been stockpiled to mix with the liquids. Areas where muds have been applied were inspected, pasture appeared healthy, limited regrowth in a few small areas, some muds identified within the soil profile and some migrating to the surface, no animals have grazed the area as yet but it has been previously mowed, chicken shed fertiliser has been added to the area also. Discussions being held with a company who may be utilising the disposal site, also discussing the possibility of transferring the resource consent into their names, it was re-iterated to Peter that in the interim it is essential that all required notifications and sampling occur.

The following action is to be taken:

Further Action: Nil
Occupier Present: Yes
Notice Delivered To: By Mail

Signed: _____

Warrant No. 174

Appendix III

Abatement and Infringement notices

INFRINGEMENT OFFENCE REMINDER NOTICE

Section 343C(4), Resource Management Act 1991

NOTICE NUMBER: 275

ENFORCEMENT AUTHORITY

Taranaki Regional Council

47 Cloten Road, Stratford OR

Private Bag 713, Stratford

ENFORCEMENT OFFICER IDENTIFICATION

131

TO: Waikaikai Farms Limited of 78 Lower Manutahi Road, RD 2, Patea 4598

You are alleged to have committed an infringement offence against the Resource Management Act 1991, as follows:

Details of alleged infringement offence

Section of Resource Management Act 1991 contravened: Section 9(2)(a)

Nature of infringement: Use of land, namely the discharge of drilling wastes onto land, in a manner that contravenes a regional rule, when the use was not expressly allowed by a resource consent.

Location: Lower Manutahi Road, Manutahi

Date: 18 April 2012

Approximate time: 2.00pm

THE FEE FOR THIS INFRINGEMENT IS \$300.00

Payment of infringement fee

The infringement fee was payable to the enforcement authority within 28 days after 25 May 2012.

The infringement fee remains payable to the enforcement authority at Taranaki Regional Council, 47 Cloten Road, Stratford, Private Bag 713, Stratford.

The contact details of the enforcement authority are as follows: Taranaki Regional Council, 47 Cloten Road, Stratford, Private Bag 713, Stratford. Phone: 06 765 7127 Fax: 06 765 5097.

Payments by cheque should be crossed "Not Transferable".

.....
Signature of enforcement officer

Service details

(To be provided for filing in court)

Infringement notice served by _____ on _____

Reminder notice served by _____ at _____ on _____

IMPORTANT

Please read the summary of rights printed on the next page

Document No: 1050379

INFRINGEMENT NOTICE**NOTICE NUMBER 275**

*(Issued under the authority of section 343C of the
Resource Management Act 1991)*

ENFORCEMENT AUTHORITY**ENFORCEMENT OFFICER
IDENTIFICATION****Taranaki Regional Council****131**

47 Cloten Road, Stratford

Private Bag 713, Stratford

Phone: 06 765 7127

Fax: 06 765 5097

TO: Waikaikai Farms Limited of
78 Lower Manutahi Road, RD 2, Patea 4598

You are alleged to have committed an infringement offence against the Resource Management Act 1991, as follows:

Details of Alleged Infringement Offence

Section of Resource Management Act 1991 contravened: Section 9(2)(a)

Nature of infringement:

Use of land, namely the discharge of drilling wastes onto land, in a manner that contravenes a regional rule, when the use was not expressly allowed by a resource consent.

Location: Lower Manutahi Road, Manutahi

Date: 18 April 2012

Approximate time: 2.00pm

THE FEE FOR THIS INFRINGEMENT IS \$300.00**Payment of Infringement Fee**

The infringement fee is payable to the enforcement authority within 28 days after 25 May 2012.

The infringement fee is payable to the enforcement authority at: **47 Cloten Road, Stratford, or Private Bag 713, Stratford**

The contact details of the Taranaki Regional Council are as follows: 47 Cloten Road, Stratford. Private Bag 713, Stratford. Phone: 06 765 7127 Fax: 06 765 5097.

Payments by cheque should be crossed "Not Transferable".

.....
Signature of Enforcement Officer

IMPORTANT**PLEASE READ SUMMARY OF RIGHTS PRINTED OVERLEAF**

Document No: 1050359

SUMMARY OF RIGHTS

Note: If, after reading this summary, you do not understand anything in it, you should consult a lawyer immediately.

Payment

- 1 If you pay the infringement fee within 28 days after the service of this notice, no further action will be taken against you in respect of this infringement offence. Payments should be made to the enforcement authority at the address shown on the front of this notice.

Note: If, under section 21(3A) or (3C)(a) of the Summary Proceedings Act 1957, you enter or have entered into a time to pay arrangement with an informant in respect of an infringement fee payable by you, paragraphs 3 and 4 below do not apply and you are not entitled either to request a hearing to deny liability or to ask the Court to consider any submissions (as to penalty or otherwise) in respect of the infringement.

Further Action

- 2 If you wish to raise any matter relating to circumstances of the alleged offence, you should do so by writing a letter and delivering it to the enforcement authority at the address shown on the front of this notice within 28 days after the service of a reminder notice in respect of the offence.
- 3 If you deny liability and wish to request a hearing in the District Court in respect of the alleged offence, you must, within 28 days after the service of a reminder notice in respect of the offence, deliver to the enforcement authority at the address shown on the front page of this notice a letter requesting a Court hearing in respect of the offence. The enforcement authority will then, if it decides to commence court proceedings in respect of the offence, serve you with a notice of hearing setting out the place and time at which the matter will be heard by the Court.

Note: If the Court finds you guilty of the offence, costs will be imposed in addition to any penalty.

- 4 If you admit liability in respect of the alleged offence but wish to have the Court consider submissions as to penalty or otherwise, you must, within 28 days after the service of a reminder notice in respect of the offence, deliver to the enforcement authority at the address shown on the front page of this notice a letter requesting a hearing in respect of the offence AND in the same letter admit liability in respect of the offence AND set out the submissions that you would wish to be considered by the Court. The enforcement authority will then, if it decides to commence court proceedings in respect of the offence, file your letter with the Court. There is no provision for an oral hearing before the Court if you follow this course of action.

Note: Costs will be imposed in addition to any penalty.

Non-payment of Fee

- 5 If you do not pay the infringement fee and do not deliver a letter requesting a hearing within 28 days after the service of this notice, you will be served with a reminder notice (unless the enforcement authority decides otherwise).
- 6 If you do not pay the infringement fee and do not deliver a letter requesting a hearing in respect of the alleged infringement offence within 28 days after the service of the reminder notice, you will become liable to pay COSTS IN ADDITION TO THE INFRINGEMENT FEE (unless the enforcement authority decides not to commence court proceedings against you).

Defence

- 7 You will have a complete defence against proceedings relating to the alleged offence if the infringement fee is paid to the enforcement authority at the address

shown on the front page of this notice within 28 days after the service of a reminder notice in respect of the offence. Late payment or payment made to any other address will not constitute a defence to proceedings in respect of the alleged offence.

- 8
- (1) This paragraph describes a defence additional to the one described in paragraph 7. This defence is available if you are charged with an infringement offence against any of sections 9, 12, 13, 14, and 15 of the Resource Management Act 1991.
 - (2) You must prove either of the following to have the defence:
 - (a) that—
 - (i) the action or event to which the infringement notice relates was necessary for the purposes of saving or protecting life or health, or preventing serious damage to property, or avoiding an actual or likely adverse effect on the environment; and
 - (ii) your conduct was reasonable in the circumstances; and
 - (iii) you adequately mitigated or remedied the effects of the action or event after it occurred; or
 - (b) that—
 - (i) the action or event to which the infringement notice relates was due to an event beyond your control, including natural disaster, mechanical failure, or sabotage; and
 - (ii) you could not reasonably have foreseen or provided against the action or event; and
 - (iii) you adequately mitigated or remedied the effects of the action or event after it occurred.
 - (3) Subparagraph (2) does not apply unless—
 - (a) you deliver a written notice to the enforcement agency; and
 - (b) in the notice, you—
 - (i) state that you intend to rely on subparagraph (2)(a) or (b); and
 - (ii) specify the facts that support your reliance on subparagraph (2)(a) or (b); and
 - (c) you deliver the notice—
 - (i) within 7 days after you receive the infringement notice; or
 - (ii) within a longer period allowed by a District Court.
 - (4) If you do not comply with subparagraph (3), you may ask the District Court to give you leave to rely on subparagraph (2)(a) or (b).
- 8A
- (1) This paragraph describes a defence additional to those described in paragraphs 7 and 8. This defence is available if—
 - (a) you are—
 - (i) a principal; or
 - (ii) an employer; or
 - (iii) the owner of a ship; and

- (b) you may be liable for an offence alleged to have been committed by—
 - (i) your agent; or
 - (ii) your employee; or
 - (iii) the person in charge of your ship.
 - (2) If you are a natural person, including a partner in a firm, you must prove either of the following to have the defence:
 - (a) that you—
 - (i) did not know, and could not reasonably be expected to have known, that the offence was to be, or was being, committed; and
 - (ii) took all reasonable steps to remedy any effects of the act or omission giving rise to the offence; or
 - (b) that you took all reasonable steps to—
 - (i) prevent the commission of the offence; and
 - (ii) remedy any effects of the act or omission giving rise to the offence.
 - (3) If you are not a natural person (for example, you are a body corporate), you must prove either of the following to have the defence:
 - (a) that—
 - (i) neither the directors (if any) nor any person involved in your management knew, or could reasonably be expected to have known, that the offence was to be, or was being, committed; and
 - (ii) you took all reasonable steps to remedy any effects of the act or omission giving rise to the offence; or
 - (b) that you took all reasonable steps to—
 - (i) prevent the commission of the offence; and
 - (ii) remedy any effects of the act or omission giving rise to the offence.
- 8B
- (1) This paragraph describes a defence additional to the defences described in paragraphs 7, 8, and 8A. This defence is available if you are charged with an infringement offence against section 15A(1)(a) of the Resource Management Act 1991 (relating to dumping waste or other matter in the coastal marine area from a ship, aircraft, or offshore installation).
 - (2) In order to have the defence, you must prove all of the following in relation to the act or omission that is alleged to constitute the offence:
 - (a) that the act or omission was necessary—
 - (i) to save or prevent danger to human life; or
 - (ii) to avert a serious threat to any ship, aircraft, or offshore installation; or
 - (iii) in the case of *force majeure* caused by stress of weather, to secure the safety of any ship, aircraft, or offshore installation; and

- (b) that the act or omission was a reasonable step to take in all the circumstances; and
 - (c) that the act or omission was likely to result in less damage than would otherwise have occurred; and
 - (d) that the act or omission was taken or omitted in such a way that the likelihood of damage to human or marine life was minimised.
- 8C (1) This paragraph describes a defence additional to the defences described in paragraphs 7, 8, 8A, and 8B. This defence is available if you are charged with an infringement offence against section 15B(1) or (2) of the Resource Management Act 1991 (relating to certain discharges of a harmful substance, a contaminant, or water in the coastal marine area from a ship or offshore installation).
- (2) You must prove either of the following to have the defence:
- (a) that the harmful substance, contaminant, or water was discharged for the purpose of securing the safety of a ship or an offshore installation, or for the purpose of saving life and that the discharge was a reasonable step to effect that purpose; or
 - (b) that the harmful substance, contaminant, or water escaped as a consequence of damage to a ship or its equipment or to an offshore installation or its equipment, and—
 - (i) such damage occurred without your negligence or deliberate act; and
 - (ii) as soon as practicable after that damage occurred, all reasonable steps were taken to prevent the escape of the harmful substance, contaminant, or water or, if any such escape could not be prevented, to minimise any escape.

Queries/Correspondence

- 9 When writing or making payment of an infringement fee, please indicate—
- (a) The date of the infringement offence; AND
 - (b) The infringement notice number; AND
 - (c) The identifying number of each alleged offence and the course of action you are taking in respect of it (if this notice sets out more than 1 offence and you are not paying all the infringement fees for all the alleged offences); AND
 - (d) Your full address for replies (if you are not paying all the infringement fees for all the alleged offences).

FULL DETAILS OF YOUR RIGHTS AND OBLIGATIONS ARE SET OUT IN SECTIONS 340 TO 343D OF THE RESOURCE MANAGEMENT ACT 1991 AND SECTION 21 OF THE SUMMARY PROCEEDINGS ACT 1957.

NOTE: ALL PAYMENTS, ALL QUERIES, AND ALL CORRESPONDENCE REGARDING THIS INFRINGEMENT MUST BE DIRECTED TO THE ENFORCEMENT AUTHORITY AT THE ADDRESS SHOWN.

No. 11875

Document: 1103575

**ABATEMENT NOTICE UNDER SECTIONS 322 & 324 OF THE
RESOURCE MANAGEMENT ACT 1991**

To: Peter Ward
Waikaikai Farms Limited
78 Lower Manutahi Road
RD 2 Patea 4598

Taranaki Regional Council gives notice that you must take the following action:

1. Ensure no further drilling mud waste is taken in the pre-existing pit area to ensure compliance with Resource Consent 5956-1.
2. Ensure groundwater bores are installed and sampled prior to the landfarming of existing drilling muds to ensure compliance with Resource Consent 5956-1.
3. Ensure the oily waste portion of the drilling mud is separated and discharged into the oily waste pit for later disposal to ensure compliance with Resource Consent 5956-1.
4. Upon completion of the required actions listed above, ensure the materials currently within the pit area are landfarmed as soon as practicable to ensure compliance with Resource Consent 5956-1.

The location to which this abatement notice applies is:

46-78 MANUTAHU RD MANUTAHU
LOTS 1 2 & 4 DP 7139 LOTS 2 & 12 DP 14551 & SEC 742 PATEA DIST BLK I CARLYLESD

You must comply with this abatement notice within the following period:

02 December 2012.

You must continue to comply with this abatement notice after that date.

This notice is issued under:

Section 322(1)(b)(ii) of the Resource Management Act 1991, which states that:

- (1) An abatement notice may be served on any person by an enforcement officer—
 - (b) Requiring that person to do something that, in the opinion of the enforcement officer, is necessary to ensure compliance by or on behalf of that person with this Act, any regulations, a rule in a plan or a proposed plan, or a resource consent, and also necessary to avoid, remedy, or mitigate any actual or likely adverse effect on the environment—
 - (ii) Relating to any land of which the person is the owner or occupier.

The reasons for this notice are:

5. Scientific Officer, David Olson visited the property on 29 August 2012 and found that:
 - The best practicable option for the storage and disposal of drilling muds had not been adopted.
6. Special condition 3 of Resource Consent 5956-1 states:
 3. *The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.*
7. At the time of inspection special condition 3 of Resource Consent 5956-1 was being contravened.
8. Section 15(1)(b) of the Resource Management Act 1991 prohibits the discharge of contaminants onto or into land in circumstances which may result in that contaminant entering water unless the discharge is expressly allowed by a national environmental standard or other regulations, a rule in a regional plan, or a resource consent.
9. The discharge of drilling mud, discovered on 29 August 2012 was not allowed by Resource Consent 5956-1 and therefore contravened section 15(1)(b) of the Resource Management Act 1991.
10. Contravention of section 15(1)(b) of the Resource Management Act 1991 is an offence under section 338(1)(a) of the Resource Management Act 1991.
11. This notice has been issued to you to require you to take the action as set out in clauses 1 to 4 because in the opinion of the enforcement officer that issued this notice, this action is necessary to ensure compliance by you/on your behalf with section 15(1)(b) of the Resource Management Act 1991/regulations/a rule in a plan/a proposed plan/a resource consent and also necessary to avoid/remedy/mitigate any actual/likely adverse effect on the environment relating to any land of which you are the owner/occupier.

If you do not comply with this notice, you may be prosecuted under section 338 of the Resource Management Act 1991 (unless you appeal and the notice is stayed as explained below), or an infringement notice may be served on you under section 343C of the Resource Management Act 1991.

You have the right to appeal to the Environment Court against the whole or any part of this notice. If you wish to appeal, you must lodge a notice of appeal in form 49 with the Environment Court within 15 working days of being served with this notice.

An appeal does not automatically stay the notice and so you must continue to comply with it unless you also apply for a stay from an Environment Judge under section 325(3A) of the Resource Management Act 1991 (see form 50). To obtain a stay, you must lodge both an appeal and a stay with the Environment Court.

You also have the right to apply in writing to Taranaki Regional Council to change or cancel this notice in accordance with section 325A of the Resource Management Act 1991.

The Taranaki Regional Council authorised the enforcement officer who issued this notice. Its address is:

Taranaki Regional Council
Private Bag 713
Stratford 4352

Phone: (06) 765 7127
Facsimile: (06) 765 5097

The enforcement officer is acting under the following authorisation:

A warrant of authority issued by the Taranaki Regional Council, pursuant to section 38 of the Resource Management Act 1991, authorising the officer to carry out specified functions and powers as an enforcement officer under the Resource Management Act 1991 including issue of abatement notices.

.....
John Cooper
Enforcement Officer
Taranaki Regional Council
Warrant No. 174

02 October 2012

Appendix IV

Monitoring well schematics

Peter Wards Lower Manutahi Land Farm

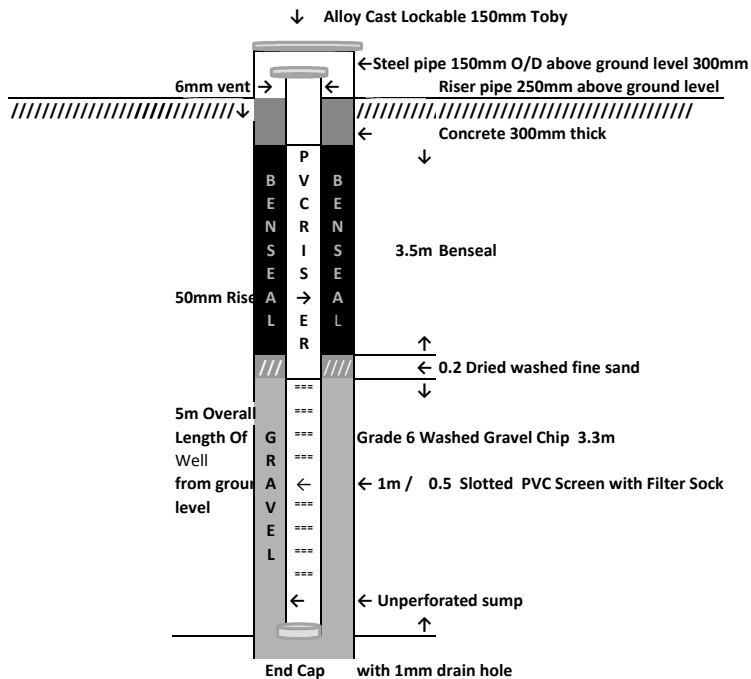
Construction Diagram Of Monitoring Well GND2290

Date: 22-09-2012

Hole Drilled With Tractor Rig From 0 to 10m with 100mm auger - Installed casing
150mm dia & cleaned out lower bottom of hole with truck mounted rig & pressure pump

Drilled to 15m into wet sands and no formation change at TD

Note: BTW to survey in ground elevations & GPS well locations



Monitoring Wells Installed By Strata Drilling Services Ltd 23/09/2012

Drilling Formations

0 to 15m loose Soft Fine Sands

Tagged bottom of screen 5.6 top of riser pipe

Water Table @ 3.0m dipped by Strata on 25-10-2012

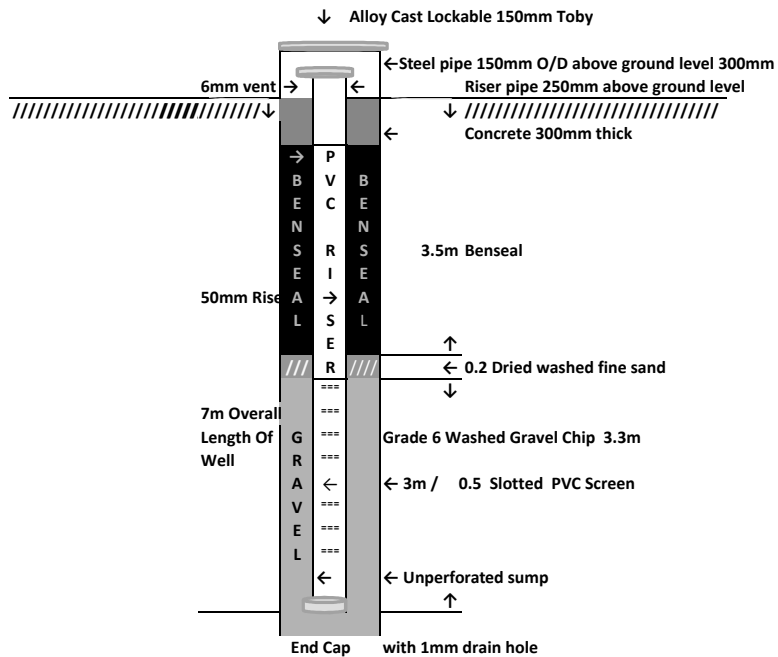
Peter Wards Lower Manutahi Land Farm

Construction Diagram Of Monitoring Wells GND2291

Date: 22-09-2012

Hole Drilled With Tractor Rig From 0 to 10m with 100mm auger

Note: BTW to survey in ground elevations & GPS well locations



Monitoring Wells Installed By Strata Drilling Services Ltd 25/09/2012

Drilling Formations

0 -1.3m Sand

1.3m to 6.5m Clay

6.5m to 10m Soft Peat

Tagged bottom of screen 7.870 top of riser pipe

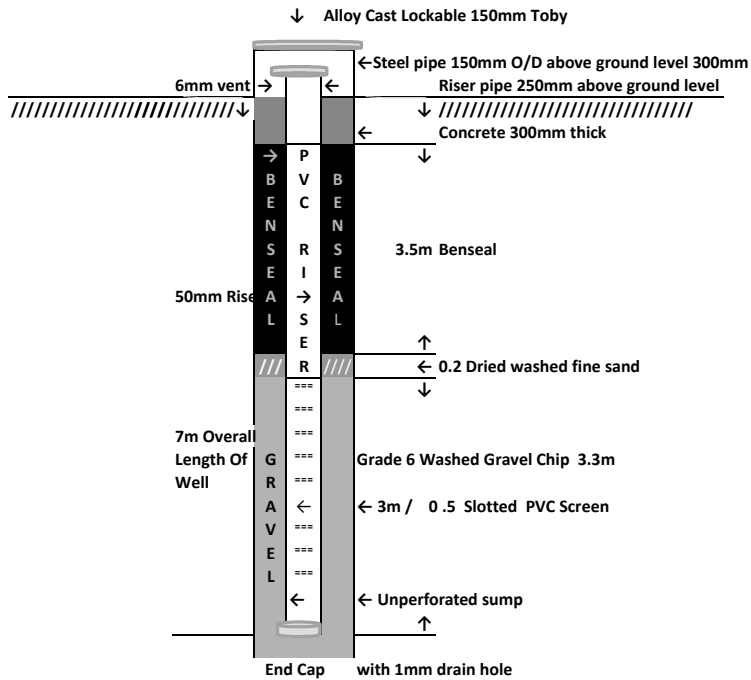
Water Table @ 4.7m dipped by Strata on 26-10-2012

Peter Wards Lower Manutahi Land Farm

Construction Diagram Of Monitoring Wells GND2292

Date: 6-06-2012

Hole Drilled With Tractor Rig From 0 to 8m with 100mm auger - Installed casing
150mm dia & cleaned out lower bottom of hole with truck mounted rig & pressure pump
Note: BTW to survey in ground elevations & GPS well locations



Monitoring Wells Installed By Strata Drilling Services Ltd 22/09/2012

Drilling Formations

0 -1.3m Sand

1.3m to 8m Clay Soft Sandy Clay

Tagged bottom of screen 7.350 top of riser pipe

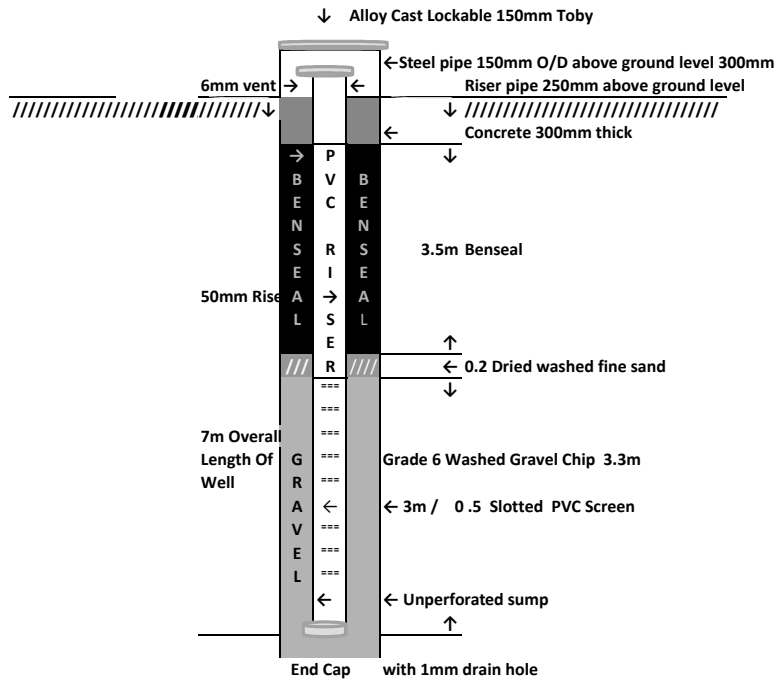
Water Table @ 4.775m dipped by Strata on 26-10-2012

Peter Wards Lower Manutahi Land Farm

Construction Diagram Of Monitoring Wells GND2293

Date: 26-09-2012

Hole Drilled With Tractor Rig From 0 to 10m with 100mm auger - Installed casing
150mm dia & cleaned out lower bottom of hole with truck mounted rig & pressure pump
Note: BTW to survey in ground elevations & GPS well locations



Monitoring Wells Installed By Strata Drilling Services Ltd 17/04/2012

Drilling Formations

0-7.5 Sand

7.5m to 10m Silty Mudstone

Tagged bottom of screen 1.610 top of riser pipe

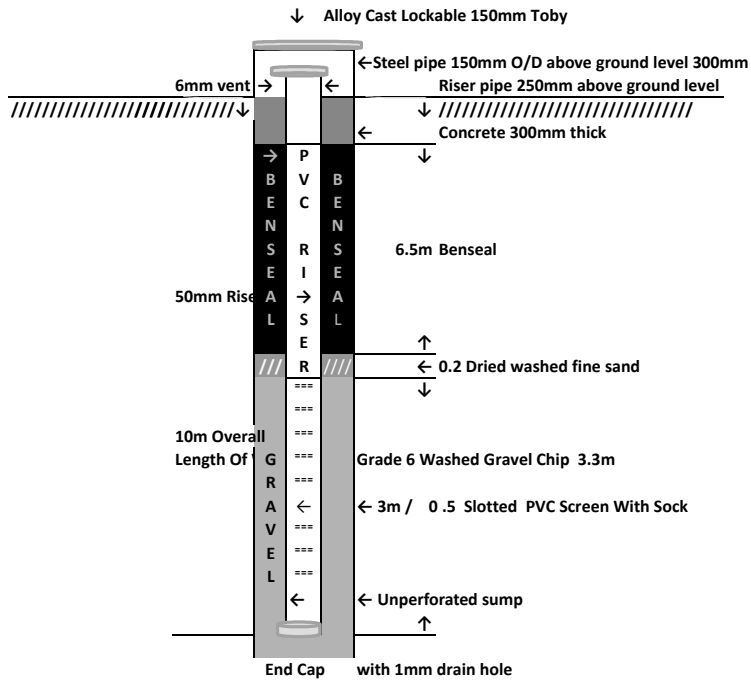
Water Table @ 5.930 dipped by Strata on 26-10-2012

Peter Wards Lower Manutahi Land Farm

Construction Diagram Of Monitoring Wells GND2294

Date: 27-09-2012

Hole Drilled With Tractor Rig From 0 to 10m with 100mm auger - Installed casing
150mm dia & cleaned out lower bottom of hole with truck mounted rig & pressure pump
Note: BTW to survey in ground elevations & GPS well locations



Monitoring Wells Installed By Strata Drilling Services Ltd

17/04/2012

Drilling Formations

0- 4.5 Sand
4.5m to 4.85 Layer Of Peat
4.85 To 7m Sand
7m To 8m Silty Mudstone
8m To 9.8m Soft Clay
9.8m To 10m Sand

Tagged bottom of screen 10.2 top of riser pipe
Water Table @ 1.920 dipped by Strata on 26-10-2012

Appendix V

AgKnowledge landfarm review report

The Taranaki Landfarms are they

“Fit for Purpose”

A report

Commissioned by Taranaki Regional Council

Undertaken by

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

September 2013

EXECUTIVE SUMMARY

1. Waste products (rock cuttings and drilling muds) from the oil exploration industry in Taranaki are being incorporated into re-contoured formed sand dunes and re-sown back to pasture (a process referred to as Landfarming). This process is controlled by resource consents issued by the Taranaki Regional Council. Three Landfarms have been completed to date and are now being farmed commercially (2 under irrigation).
2. The drilling muds contain potential contaminants: petrochemical residues, barium, heavy metals and salts. The question arises: are these reformed soils 'fit-for-purpose' - in this case pastoral farming and especially dairy farming.
3. As required by the consents regular soil samples were collected and analysed during the disposal process. These results were summarised and examined relative to the permitted limits for the various potential contaminants.
4. The completed sites were visited and the pasture and soils inspected. Soil and pasture samples were collected and analysed for all potential contaminants. These results were compared to the properties of normal New Zealand pastoral soils.
5. It is concluded from this body of evidence that these modified soils are 'fit-for-purpose'. The concentrations of: nutrients (macro and micro), heavy metals and soluble salts in these soils and pasture are similar to normal New Zealand soils. The form of barium present is as environmentally benign barite, and there is no evidence of accumulation of petrochemical residues.
6. The process of Landfarming these otherwise very poor soils, together with appropriate management (irrigation, fertiliser and improved pastures) has increased the agronomic value of the land from about \$3-5000/ha to \$30-40,000/ha.

BRIEF

1. The Taranaki Regional Council (TRC) has consented several oil exploration companies to dispose of 'drilling muds' at several sites on coastal sands around the region.
2. The drilling muds are initially stored at the sites and, after the sand dunes have been levelled, this material is applied to the surface (at < 100mm thick) and then incorporated into the re-contoured sandy soils (at a minimum depth of 250mm depth). Once this process is completed the modified soils are fertilised (not more than 200 kg N/ha) and sown down to clover-based pasture. This whole process is controlled by criteria set out in resource consents.
3. Three sites (referred to as landfarms) have been completed to date and are currently being used for pastoral farming. One site (Browns, commenced 2006, completed 2011) is not irrigated and runs dry stock. The other 2 sites (Schridder, commenced 2004, completed 2010, and Geary, commenced 2001, completed 2006) are under pivot irrigation and used for dairy farming. Note there is a small area at the Geary site, which is not irrigated.
4. The TRC has retained agKnowledge Ltd to determine whether these landfarms are "fit for purpose", in this case fit for pastoral farming and in particular dairying.
5. Specifically this brief excludes any consideration as to the off-site effects of the landfarms (possible movement of contaminants via runoff or leaching) and does not consider whether the compliance criteria set out in the consents were met or otherwise.

METHODOLOGY

6. Drilling muds consist of a) the cuttings (mainly solid) of the underlying strata of rocks from the drill bit b) drilling fluids (mud and slurry used to either lubricate the drilling process or to control the in-well pressure. This includes barium sulphate which is used as a wetting and weighing agent and c) drilling wastes (liquid) containing well water and petrochemical residues. There are 3 classes of drilling fluids: water-based, (WBM), oil based (OBM) and synthetic (SBM) (Taranaki Regional Council, undated, ref: PCDOCS\FRODO\98943\1).
7. Given the general composition of the drilling muds, this report investigates the following aspects of the completed landfarms:
 - a. What is the current soil fertility of the modified soils with respect to growing clover-based pasture for ruminants and in particular dairy cows?

- b. What are the heavy metal and barium concentrations in the soils and pastures and are there any implications for soil, pasture and animal health and production?
 - c. Are there any petrochemical residues in the soils and pasture, which may affect soil, plant and animal health?
8. Two sites, Geary and Schrider, were visited on July 4 2013 and soils samples (0-75mm – the standard depth for determining soil fertility) and mixed-pasture samples were collected for an initial investigation, using the standard sampling protocols.
9. The 3 completed landfarms were visited on 5 August 2013 and on this occasion two sets of soil (0-75mm) and mixed pasture samples were collected from the following sites: Schrider (irrigated), Geary (irrigated and non-irrigated) and Brown (non-irrigated). One set were sealed in clip-tight plastic bags for analysis of petroleum hydrocarbon (PCH) residues and the other set were used to determine the concentrations of the full suite of elements including the macro, micro and heavy metals plus barium.
10. The TRC provided the full records of the soil tests (0-250mm) undertaken as per the consents, during the process of disposal of the drilling muds, at each site. This data was summarized.
11. Throughout this report the criteria for the safe disposal of heavy metals, barium and petroleum hydrocarbons (as set down by a number of authorities) are used as part (other matters are also considered) of the assessment process. In applying these criteria it is assumed that they have been set at levels to ensure the protection of soil, pasture, animal and human health.

RESULTS

Pasture Assessment

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

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

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

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

Soil Properties

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

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

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

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

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

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

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

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

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

Sodium	13	481	600	310	460 g/m ³	7
Chloride	36	28	356	4	700 g/m ³	0

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

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

Soil Property	No. samples	Average	Max	Min	Limit ¹ & units	No. over limit
Conductivity (disposal)		No given			400 mS/m	0
Conductivity (expiry)		No given			290 mS/m	0
Soluble salts	5	all < 0.05	<0.05	-	0.25 %	0
SAR	17	2.4	18	0.3	18	0
Sodium	17	80	530	7	460 g/m ³	7?
Chloride	31	98	550	5.9	700 g/m ³	0

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

The soil property which most frequently exceeded the limit was the soil Na concentrations. The limit of 460 gm/m³ soil, is (assuming a soil bulk density of about 1) equivalent to a MAF soil Na reading of about 20. Thus, while some elevated soil Na levels were recorded during the disposal process the current levels (0-75 mm) are normal (Table 2). This is also apparent in the SAR levels. The likely reason for this is that Na (and the same applies to chloride) are very mobile and will readily leach out of soils, especially sandy soils with a good rainfall and under irrigation, noting that in the New Zealand situation Na and Cl are environmentally benign.

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

Soil Fertility

Soils

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

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

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

Brown	6.6	22	2	8	4	13
<i>Optimal¹</i>	<i>5.8-6.0</i>	<i>35-40</i>	<i>7-10</i>	<i>10-12</i>	<i>10-12</i>	<i>8-10</i>

Notes 1) assuming a high producing dairy farm

Pasture

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

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

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

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

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

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

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

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

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

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

Heavy Metals

Soil (Routine Sampling 0-250mm)

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

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

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

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

Note 1) from the Ministry for the Environment 2003

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

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

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

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

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

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

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

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

Soil (normal pastoral soil levels)

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

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

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

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

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

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

Pasture (normal levels)

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

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

Site	Pasture heavy metal and barium concentrations (ppm)						
	As	Cd	Hg	Pb	Cr	Ni	Ba
Schrider	<0.1 (<0.1)	0.022 (0.033)	0.013 (0.028)	0.039 (0.079)	0.460 (<0.1)	<1 (<1)	42 (33)
Geary Irrigated	<0.1	0.011	<0.01	0.072	0.750	<1	74
Geary non-irrigated	<0.1 (<0.10)	0.025 (0.027)	0.011 (0.029)	0.102 (0.112)	0.600 (0.160)	<1 (<1)	>100 (97)
Brown	<0.1	0.073	0.011	0.104	0.520	<1	71
Typical¹	<i>0.07-0.24</i>	<i>0.03-0.29</i>	<i>na</i>	<i>0.10-1.8</i>	<i>0.31-0.49</i>	<i>0.10-0.20</i>	<i>na</i>

Note 1) see Appendix 2

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

Barium

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

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

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

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

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

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

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

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

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

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

Petroleum Hydrocarbons

Soils

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Pasture

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

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

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

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

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

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

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

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

CONCLUSIONS

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

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

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

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

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

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

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

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

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

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

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

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

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

