

TAG Oil (NZ) Limited  
Vanner Landfarm  
Monitoring Programme  
Annual Report  
2013-2014

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## **Executive summary**

BTW Company Ltd (on behalf of the consent holder TAG Oil (NZ) Limited) operates a drilling waste disposal site located on Lower Ball Road at Kakaramea, in the Mangaroa catchment. The site is actively used to dispose of rock cuttings and drilling muds to land via the process of landfarming. During the 2013-2014 monitoring period, the resource consent was transferred from BTW Company Ltd to TAG Oil (NZ) Ltd. BTW have continued to manage the site, but only waste material from TAG operations is now disposed of at the site.

This report for the period July 2013 – June 2014 describes the monitoring programme implemented by the Taranaki Regional Council to assess the Company's environmental performance during the period under review, and the results and environmental effects of the Company's activities.

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

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

The monitoring showed that the site was being operated to a high level and no adverse environmental effects were detected. As in the previous year, the monitoring indicated soil and water resources were not being significantly impacted by site activities, and house keeping and record keeping and reporting were all to a high standard. There were no Unauthorised Incidents (UIs) recording non-compliance in respect of this consent holder during the period under review.

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

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

This report includes recommendation for the 2014-2015 year.



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# **1. Introduction**

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

### **1.1.1 Introduction**

This report is the Annual Report for the period July 2013 - June 2014 by the Taranaki Regional Council describing the monitoring programme associated with a resource consent held by TAG Oil (NZ) Limited (TAG). BTW Company Ltd (on behalf of TAG) operates a drilling waste landfarm situated on Lower Ball Road at Kakaramea (Vanner Landfarm).

The Vanner site became operational during the previous monitoring period, when there was a single disposal of 1390 m<sup>3</sup> of primarily water/synthetic based cuttings and fluids, with smaller quantities of contaminated water and soil. The waste spread in 2012-2013 was sourced from the Mangahewa C and D, Sidewinder, Puka and KA-1 wellsites and Cheal production station. On 30 July 2013 consent 7942-1 was transferred from BTW Company Ltd to TAG Oil (NZ) Limited and the site began exclusively disposing of TAG cuttings and mud. The site remains under BTW management and has continued to stockpile and landfarm muds and cuttings for the remainder of the monitoring period.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consent held by TAG Oil (NZ) Limited, to discharge drilling waste onto and into land via landfarming. This is the second Annual Report to be prepared by the Taranaki Regional Council to cover discharges to land and their effects at the Vanner site.

### **1.1.2 Structure of this report**

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

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

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

Section 4 presents recommendations to be implemented in the 2014-2015 monitoring year.

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

### 1.1.3 The Resource Management Act 1991 and monitoring

The *Resource Management Act 1991* (RMA) primarily addresses environmental 'effects' which are defined as positive or adverse, temporary or permanent, past, present or future, or cumulative. Effects may arise in relation to:

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

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

### 1.1.4 Evaluation of environmental and consent performance

Besides discussing the various details of the performance and extent of compliance by the consent holder/s during the period under review, this report also assigns 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 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 2013-2014 year, 60% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 29% demonstrated a good level of environmental performance and compliance with their consents.

## 1.2 Process descriptions

### 1.2.1 Drilling waste

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

#### **Drilling fluids**

Oil and gas wells may be drilled with either synthetic based mud (SBM) or water based mud (WBM). As the names suggest, these are fluids with either water (fresh or saline) or synthetic oil as a base material, to which further compounds are added to modify the physical characteristics of the mud (for example mud weight or viscosity). More than one type of fluid may be used to drill an individual well. In the past, oil based muds (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 avoid polycyclic aromatic hydrocarbons, reduce the potential for bioaccumulation, and accelerate biodegradation compared with OBM.

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

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

### **Cuttings**

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

## **1.2.2 Landfarming**

The landfarming process has typically been used in the Taranaki region to assist the 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).

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

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

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

### 1.3 Site location and description

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

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

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

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

#### Site data

##### Location

Word descriptor:	Lower Ball Road, Kakaramea, Taranaki
Map reference:	E 1720685
(NZTM)	N 5602731
Mean annual rainfall:	1043 mm
Mean annual soil temperature:	~15.1°C
Mean annual soil moisture:	~32.9%
Elevation:	~25 m asl
Geomorphic position:	Cliffed / dune backslope
Erosion / deposition:	Erosion
Vegetation:	Pasture, dune grasses
Parent material:	Aeolian deposit
Drainage class:	Free / well draining
Land use:	Active disposal



**Figure 1** TAG Vanner landfarm location map with regional location (inset)

## 1.4 Resource consent

TAG holds discharge permit 7942-1 to discharge drilling wastes [consisting of drilling cuttings and drilling fluids from drilling operations with water based muds and synthetic based muds] onto and into land via landfarming. This permit was issued by the Taranaki Regional Council on 21 October 2011 to BTW Company Ltd, as a resource consent under Section 87(e) of the Resource Management Act. It was transferred to TAG on 30 July 2013. This resource consent is due to expire on 1 June 2028.

Condition 1 sets out definitions.

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

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

Condition 8 stipulates the discharge area.

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

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

Conditions 14 and 15 specify further site management requirements.

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

Condition 24 concerns archaeological remains.

Conditions 25 and 26 concern lapse provisions and consent reviews.

The permit is attached to this report in Appendix I.

## **1.5 Monitoring programme**

### **1.5.1 Introduction**

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

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

The monitoring programme for the Vanner 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 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 five scheduled inspections were made of the site during the monitoring period, with regard to the consents for the discharge of drilling waste. Five further inspections were conducted at the site during chemical sampling runs. Inspections focussed on the following aspects:

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

#### **1.5.4 Chemical sampling**

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

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

The Mangaroa Stream was sampled twice at two sites (upstream and downstream) for standard surface water quality parameters and hydrocarbons.

#### **1.5.5 Review of analytical results**

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

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

Receiving environment soil samples were also tested for electrical conductivity, sodium absorption ratio (SAR) and total soluble salts (TSS).

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

## **2. Results**

### **2.1 Inspections**

#### **19 July 2013**

The following was found to be occurring: No objectionable odours or visible emissions were found at the site boundary during the inspection, but strong hydrocarbon/mud odours were noted when downwind of the pits. Three lined pits were in use at the site to receive muds and a further two liquid receiving pits were present. The integrity of the liners appeared satisfactory and there was plenty of space available in all of the pits. The load-in area was tidy. The initial spreading area showed good pasture strike across the entire area and very little mud was visible within the soil profiles. The area where muds were most recently applied looked good. This area had yet to be sown. Some stockpiled topsoil was present at the site and this material appeared stable. The culvert constructed over the Mangaroa Stream appeared to be coping with site activities.

#### **7 November 2013**

The following was found to be occurring: A moderate southeast wind was blowing and no objectionable odours or visible emissions were detected during the inspection. All pits at the site contained materials and had liners in place, but it was noted that the pit B liner had a large tear on the southern wall. Discussions were held with the site operator regarding the state of the liner. It was outlined that the pit had been emptied and the liner was ripped by strong winds, however, the operator suspected there may have been a small hole caused by loading/unloading of cuttings in the pit. The pit wall behind the liner appeared free of drilling wastes indicating nothing had discharged. The operator outlined that the pit was to be completely emptied when weather allowed and the liner was to be replaced. Fencing was in place around the pit to prevent any materials being introduced. All other pits were found to be satisfactory. The liquid in the seaward pits was dark with surface hydrocarbons present. No spreading activities were occurring due to poor weather, the access tracks were being harrowed to improve the area and reduce ponding. The culvert over the waterway looked good and appeared to be coping with flood events. The area where muds were originally spread had pasture establishing. The area where muds were most recently being applied had good contouring and bunding across three sides. Some muds had migrated to the soil surface through natural processes; these muds were found to be weathering and broke apart easily when handled. Ponded water around the spreading area from recent rain was free of hydrocarbons. Signage and site security was in place.

#### **6 January 2014**

A site inspection was conducted in conjunction with sampling. All storage pits appeared in good order and an additional/replacement liner was noted on site. Spreading areas F7 and F8 were being applied with mud fluids. Pasture was establishing well in spreading areas F1 through to F5.





**Photo 1** Pasture establishment, spreading areas F1-F5, Vanner Landfarm January 2014

#### **15 January 2014**

An inspection was conducted in conjunction with groundwater, surface water and soil sampling. At the time of inspection spreading of mud fluids was occurring on area F8. No significant ponding was observed. The pit area looked good. Drilling mud odours were observed near the current spreading operation, but not at the site boundaries. The Mangaroa Stream looked unaffected by site activities and buffer zone conditions were being complied with. Pasture cover was slightly patchy through areas F3 and F4. Areas F1, F2 and F5 looked good. No significant issues were noted.

#### **10 February 2014**

The following was found to be occurring: There was a strong southwest wind and no objectionable odours or visible emissions were detected at the site boundary. All lined pits contained waste material and the liners appeared in good repair. Pasture strike in previously spread areas looked generally good, with only some small patches where grass had failed to grow. Recently spread material was well blended and weathering effectively. Small amounts of mud were migrating to the surface through natural processes. The area on the northern side of the culvert has been prepared to receive muds. The contouring looked good and bund walls were in place around the prepared spreading area, but some of the stockpiled topsoil was starting to mobilise due to the higher winds.

#### **4 March 2014**

A site inspection was conducted in conjunction with scheduled groundwater and surface water sampling. The storage pits appeared in good order. Area F9 had been recently spread and fenced off. Areas F6 - F8 were yet to be sown. Areas F1 - F5 had



been previously sown and pasture establishment was generally good, but some barren/wind blown patches were observed.

#### **1 April 2014**

An inspection of the site was conducted in conjunction with groundwater and soil sampling. Areas F1 - F2 had good pasture establishment, F3 - F6 had patchy to minimal pasture cover. Areas F7 and F8 had not yet been sown and area F9 had been spread and was still awaiting topsoil application. The site generally looked good, and new fencing had been established around the entire perimeter areas of F1 - F8.

#### **9 April 2014**

The following was found to be occurring: No objectionable odours or visible emissions were found during the inspection. All pit liners appeared in good repair, very little surface oils were present in any of the pits, and all pits had plenty of freeboard available. Mud fluids had been recently spread within the spreading area immediately south of the pits. There was grey ponded water around the most recently spread area from recent rain, but no hydrocarbons were observed. The muds from pit B were scheduled to be spread within that area when weather permitted. Previous application areas were showing good pasture cover which appeared healthy. No ponded water was observed in these older areas. There were small quantities of muds present at surface, but these appeared to be weathering well.

#### **8 May 2014**

An inspection was conducted in conjunction with routine groundwater sampling. Some of the spreading areas had been recently re-sown. Initial pasture strike in area F8 was observed. Areas F1 to F4 looked good, with other areas still relatively barren.

#### **28 May 2014**

The following was found to be occurring: The wind was from the north and no objectionable odours or visible emissions were detected. All pit levels were found to be low, the balance pits contained essentially stormwater, and two mud pits contained only residual materials that were beyond the reach of the earthworks machinery. All liners appeared in good repair. Recent mud application looked good, with material spread thinly and due to be incorporated shortly. No run-off or significant ponding was observed from the recently spread area. All previous application areas were inspected and found to be satisfactory, there were essentially two stages of pasture growth and it was obvious that the entire area has been recently re-sown.

## **2.2 Results of discharge monitoring**

There were eight disposals during the monitoring period of approximately 3450 m<sup>3</sup> of waste. This material consisted of predominantly water based muds and cuttings from the TAG, Cheal C, E and G wellsites, and the Ngapaeruru-1 exploration well drilled near Dannevirke, as well as cuttings and fluids from Mangahewa C and KA19-20 wellsites (stockpiled from the previous monitoring year). The waste was spread at the 100 mm rate over an area of approximately 4.656 Ha (areas F2-F9, Figure 2).

The Company is required to track and record all discharges under the resource consent and provide this data as part of their annual report for Council review. Further details regarding discharges at the site are provided in the supplied report, attached in Appendix II.

### 2.3 Results of receiving environment monitoring

During the monitoring year, six composite soil samples were collected by sub-sampling along transects at 10 m intervals to a depth of 250mm in completed spreading areas F2 to F5 and F7 to F8 (Figure 3) . The results are presented below in Table 1.



**Figure 3** Council soil sampling transect locations, areas F1 to F8

**Table 1** Council soil sample results, Vanner Landfarm 2013-2014

Parameter	Unit	F2	F5	F3	F4	F7	F8
Calcium	mg/kg	11.2	112	146	184	124	87.0
Chloride	mg/kg DW	24.3	225	299	839	920	642
Conductivity	mS/m@20C	15.8	148	211	425	459	276
Total Hydrocarbons	mg/kg DW	140	200	1200	410	220	1450
Moisture factor	-	1.007	1.005	1.003	1.004	1.005	1.006
Magnesium	mg/kg	3.8	15.4	9.4	13.8	18.4	14.2
Sodium	mg/kg	18.4	53.3	55.9	129	136	98.1
pH	pH	6.4	7.6	8.0	8.3	7.5	7.2
SAR	-	1.2	1.3	1.2	2.5	3.0	2.6
TSS	mg/kg	123.7	1158.2	1651.3	3326.0	3592.1	2160.0

The Council soil sample results show compliance with all consent limits for all areas sampled, with the exception of slightly exceedances of the soil conductivity application limit of 400 mS/m. These exceedances of the conductivity limit are minor and would be unlikely to adversely affect soil quality or structure. These slight elevations are likely due to salt loading from the water based muds disposed of at the site. Chloride and sodium concentrations are relatively low, as are the sodium adsorption ratios. Total soluble salt concentrations are elevated in areas F4 and F7 to above consent surrender limits, but as the consent holder is not looking to surrender the consent, this presents no issue. No adverse environmental effects are anticipated regarding the receiving soils based on the results presented in Table 1.



There are relatively low hydrocarbon concentrations in all areas sampled and it is anticipated surrender limits will be relatively quickly achieved in these spreading areas.

### 2.3.2 Council groundwater results

During the monitoring quarterly groundwater sampling was conducted from two monitoring bores at the Vanner site, located as shown in Figure 4, below. The results for each of the bores are presented in Tables 2 and 3 respectively.



**Figure 4** Groundwater and surface water sampling sites, Vanner landfarm

**Table 2** Groundwater monitoring results from bore GND2316, Vanner landfarm during 2013-2014 monitoring period

Parameter	Unit	15 Jan 2014	04 Mar 2014	01 Apr 2014	15 May 2014
Static water level	m	10.42	9.023	9.830	8.953
Temperature	Deg.C	17.3	14.9	14.8	14.6
pH	pH	6.7	6.7	6.6	6.5
Conductivity	mS/m@20C	53.5	57.0	54.8	58.0
Total dissolved solids	g/m <sup>3</sup>	413.9	441.0	424.0	448.8
Chloride	g/m <sup>3</sup>	93.4	101	93.8	111
Sodium	g/m <sup>3</sup>	-	-	54.9	62.9
Barium	g/m <sup>3</sup>	-	-	0.14	0.08
Benzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Toluene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Meta – xylene	g/m <sup>3</sup>	<0.002	<0.002	<0.002	<0.002
Ortho – xylene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbon (TPH)	g/m <sup>3</sup>	<0.7	<0.7	<0.7	<0.7
HC C7-C9	g/m <sup>3</sup>	<0.10	<0.10	<0.10	<0.10
HC C10-C14	g/m <sup>3</sup>	<0.2	<0.2	<0.2	<0.2
HC C15-C36	g/m <sup>3</sup>	<0.4	<0.4	<0.4	<0.4

**Table 3** Groundwater monitoring results from bore GND2317, Vanner landfarm during 2013-2014 monitoring period

Parameter	Unit	15 Jan 2014	04 Mar 2014	01 Apr 2014	08 May 2014
Static water level	m	7.522	7.516	7.650	7.404
Temperature	Deg.C	16.3	16.0	15.0	15.2
pH	pH	6.8	6.8	6.6	6.4
Conductivity	mS/m@20C	50.4	58.9	68.4	80.9
Total dissolved solids	g/m <sup>3</sup>	389.9	455.7	529.2	625.9
Chloride	g/m <sup>3</sup>	104	128	160	224
Sodium	g/m <sup>3</sup>	-	-	63.9	68.7
Barium	g/m <sup>3</sup>	-	-	0.15	0.18
Benzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Toluene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Meta – xylene	g/m <sup>3</sup>	<0.002	<0.002	<0.002	<0.002
Ortho – xylene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbon (TPH)	g/m <sup>3</sup>	<0.7	<0.7	<0.7	<0.7
HC C7-C9	g/m <sup>3</sup>	<0.10	<0.10	<0.10	<0.10
HC C10-C14	g/m <sup>3</sup>	<0.2	<0.2	<0.2	<0.2
HC C15-C36	g/m <sup>3</sup>	<0.4	<0.4	<0.4	<0.4

Groundwater results from the monitoring period show effectively no impact from the landfarming and stockpiling activities conducted at the Vanner landfarm. Measured salinity parameters are well within the normal range for coastal groundwater in Taranaki. These results are consistent with the previous monitoring period results. No hydrocarbons have been detected at any stage in either bore.

### 2.3.3 Council surface water results

The Mangaroa Stream was sampled twice during the monitoring period at two sampling sites, one upstream (MAN000020) and one downstream (MAN000010) of the stockpiling and spreading areas. Sampling sites are identified in Figure 4. Samples were analysed for similar parameters to the groundwater samples. Results are presented in Table 4, below.

**Table 4** Surface water samples, Mangaroa Stream, Vanner landfarm 2013-2014 monitoring period

Parameter	Unit	MAN000020		MAN000010	
		15 Jan 2014	04 Mar 2014	15 Jan 2014	04 Mar 2014
Temperature	Deg.C	18.0	14.6	19.3	15.0
pH	pH	7.4	7.5	7.7	7.6
Conductivity	mS/m@20C	41.2	41.9	41.1	42.5
Total dissolved solids	g/m <sup>3</sup>	318.8	324.2	318.0	328.8
Chloride	g/m <sup>3</sup>	74.8	71.2	72.9	75.8
Benzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Toluene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Meta – xylene	g/m <sup>3</sup>	<0.002	<0.002	<0.002	<0.002
Ortho – xylene	g/m <sup>3</sup>	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbon (TPH)	g/m <sup>3</sup>	<0.7	<0.7	<0.7	<0.7
HC C7-C9	g/m <sup>3</sup>	<0.10	<0.10	<0.10	<0.10
HC C10-C14	g/m <sup>3</sup>	<0.2	<0.2	<0.2	<0.2

Parameter	Unit	MAN000020		MAN000010	
		15 Jan 2014	04 Mar 2014	15 Jan 2014	04 Mar 2014
HC C15-C36	g/m <sup>3</sup>	<0.4	<0.4	<0.4	<0.4

The surface water results for the Mangaroa Stream indicate there have been no adverse environmental effects on this body of water from activities conducted at the adjacent Vanner landfarm site. No hydrocarbons have been detected in any of the samples, and the other water quality parameters measured are within typical ranges for coastal streams in Taranaki. On both sampling occasions upstream and downstream samples have been shown very similar results for salinity and other water quality parameters.

## 2.4 Review of analytical results

BTW (acting on behalf of TAG) supplied receiving environment soil results throughout the monitoring year, and as a summary table in their supplied annual report (Appendix II).

BTW collected a total of 22 composite samples from all areas F1-F9 during the monitoring period, using the methodology detailed in Section 3 of the TAG supplied annual report. BTW's soil results are included in Table 4.1, Section 4 of the TAG supplied annual report, Appendix II.

The supplied soil sample results are similar to those from the Council soil sampling, with some initial salinity related results (conductivity and total soluble salts) which were outside of consent limits. Repeat sampling has indicated that these areas are now compliant with all limits.

Hydrocarbon concentrations in the supplied results already show compliance with surrender criteria, and have been consistently low in all soil sampling undertaken thus far. No significant polycyclic or monocyclic aromatic hydrocarbons or heavy metals have been detected in any of the samples in the current or previous monitoring period.

BTW also sampled the Mangaroa Stream on two occasions, 13 February 2014 and 15 May 2014. These results are presented in Appendix C of the BTW supplied report, included in Appendix II. The results are similar to the Council surface water results. No hydrocarbons or significant metals have been detected in either sample; all other measured parameters are typical of the coastal reaches of a small stream in a Taranaki dairy catchment.

## 2.5 Investigations, interventions, and incidents

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

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

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

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

In the 2013-2014 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with TAG's conditions in resource consents or provisions in Regional Plans.

### **3. Discussion**

#### **3.1 Discussion of site performance**

Operations at the Vanner disposal site (including during the current monitoring period) to this date have been to a high standard. Earlier in the monitoring year resource consent 7942-1 was transferred from BTW to TAG and began to exclusively dispose of TAG water based mud and cuttings. BTW have continued to operate the site on behalf of TAG, and the site has remained active for most of the monitoring period under review.

BTW have done a very good job of managing this site. Their notification, mapping, sampling and record supply have been to a very high standard. They have learnt from the issues encountered at their Brown Road and Oeo sites in the previous monitoring period, and have implemented these learnings effectively in the operation of the Vanner site.

The earthworks contractors have also performed well, under close BTW supervision to achieve good results with the mechanical/operational aspects of site activity, and site house keeping has been good throughout the monitoring period.

BTW and TAG have effectively implemented several site improvements during the monitoring period including adding additional lining on the pit loading side of storage pits, reviewing their sampling procedures, lining the truck washing facilities, and increasing signage and pit area security.

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

No significant adverse environmental effects have been detected in any of the monitoring undertaken by either the Company or the Council at the Vanner disposal site during the 2013-2014 monitoring period. This is consistent with the findings of the previous monitoring period, which was when activity commenced at the site.

Contaminant concentrations in the soils have been relatively low in all areas sampled in both the Council and Company soil samples. There were two breaches of the conductivity limit in the Council soil samples, and some initial high results for conductivity and total soluble salts in the supplied results, which reduced to within consent limits in subsequent samples.

Groundwater and surface water at the site have, to this point, appeared un-impacted by stockpiling and landfarming activities. When the site was established, there was initial concern about the Mangaroa Stream, which runs through part of the site. However, the Company and their contractors have effectively used buffer distances and bunding when spreading, and storage pit integrity appears to have been sufficient to prevent any significant leaching of contaminants into groundwater and/or surface water.

There was some concern raised by third parties about waste sourced from Dannevirke's Ngapaeruru-1 well. 300 m<sup>3</sup> of cuttings and water based mud was disposed of in areas F2 and F3, alongside material from other TAG wells. The receiving soil results for areas F2 and F3 were similar to those from all other areas, and review of



the predisposal results showed the wastes to have levels of contaminants consistent with water based mud used in Taranaki. There was nothing to indicate these waste streams were significantly physically different to the material sourced from the Cheal wellsites.

No effects were detected off-site in the immediate neighbourhood. Odour effects were generally localised, and no significant dust effects were observed in relation to earthworks or spreading.

### 3.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Table 5.

**Table 5** Summary of performance for Consent **7942-1** to discharge drilling wastes [consisting of drilling cuttings and drilling fluids from drilling operations with water based muds and synthetic based muds] onto and into land via landfarming

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Definitions which apply to the consent	Not applicable	N/A
2. Best practicable option to be adopted	Inspection and liaison with consent holder	Yes
3. Notify TRC 48 hrs prior to stockpiling	Notifications received	Yes
4. Notify TRC 48 hrs prior to landfarming	Notifications received	Yes
5. The consent holder shall sample for the following: a. Total Petroleum Hydrocarbons b. Benzene, toluene, ethylbenzene, xylenes c. Polycyclic aromatic hydrocarbons d. Chloride, nitrogen, pH, potassium, sodium	Sampling	Yes
6. Keep records relating to wastes, areas, compositions, volumes, dates, treatments and monitoring	Company records	Yes
7. Report on records in condition 6 to Council by 31 August each year	Report received 18 August 2014	Yes
8. Discharges made only within area as specified by submitted application 6903	Inspection	Yes
9. No discharge within 25m of a water body or property boundary	Inspection	Yes
10. Discharge depth limited to 100mm for waste with hydrocarbons <5%, or 50mm for waste with hydrocarbons >5%	Company records and inspection	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
11. Incorporation into soil as soon as practicable to a depth of at least 250mm	Inspection and sampling	Yes
12. Hydrocarbon concentrations in soil shall not exceed 50,000 mg/ kg dry weight	Sampling	Yes
13. Landfarming areas to be used in accordance with conditions 10 and 11 and shall not be used for any subsequent discharges of drilling wastes	Inspection	N/A
14. All material to be landfarmed as soon as practicable and no later than 12 months	Company records and inspections	Yes
15. Re-vegetate landfarmed areas as soon as practicable	Company records and inspections	Yes
16. Total dissolved salts in any fresh water body shall not exceed 2500 g/m <sup>3</sup>	Sampling	Yes
17. Disposal of waste shall not lead to contaminants entering surface water or ground water exceeding background concentrations	Sampling	Yes
18. Disposal of waste shall not result in any significant adverse environmental effects on the Mangaroa Stream	Inspection and sampling	Yes
19. Soil conductivity must be less than 400 mS/m. If background conductivity exceeds 400 mS/m, then increase shall not exceed 100 mS/m	Sampling	Not in all samples
20. Sodium absorption ratio [SAR] must be less than 18.0, if background SAR exceeds 18.0 then increase shall not exceed 1.0	Sampling	Yes
21. Concentrations of heavy metals in the soil shall at all times comply with MfE guidelines	Sampling	Yes
22. Prior to expiry/cancellation of consent these levels must not be exceeded: a. conductivity, 400 mS/m b. chloride, 700 g/m <sup>3</sup> c. dissolved salts, 2500 g/m <sup>3</sup> d. sodium, 460 g/m <sup>3</sup> e. PAHs, MAHs and TPH, Tables 4.12 and 4.15, Guidelines for assessing and managing petroleum hydrocarbon contaminated sites in New Zealand (MfE 1999)	Sampling prior to surrender	N/A

Condition requirement	Means of monitoring during period under review	Compliance achieved?
23. If condition 22 not met, consent cannot be surrendered	Sampling	N/A
24. Notification of discovery of archaeological remains	None found	N/A
25. Lapse condition	Inspection for evidence of exercise	N/A
26. Optional review provision re environmental effects	Next optional review June 2016	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>High</b>

During the year, the Company demonstrated a high level of environmental performance and compliance with the resource consent as defined in Section 1.1.4. The site was very well managed and no adverse environmental effects were detected. The occasional non-compliance with the conductivity limit was inconsequential.

### 3.4 Recommendation from the 2012-2013 Annual Report

In the 2012-2013 Annual Report, it was recommended:

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

This recommendation was implemented.

### 3.5 Alterations to monitoring programmes for 2014-2015

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

It is proposed that for 2014-2015, the programme remains unchanged from that implemented in 2013-2014. A recommendation to this effect is attached to this report.

#### **4. Recommendation**

1. THAT monitoring of consented activities at Vanner landfarm in the 2014-2015 year continue at the same level as in 2013-2014.

## Glossary of common terms and abbreviations

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

Al*	Aluminium.
As*	Arsenic.
Biomonitoring	Assessing the health of the environment using aquatic organisms.
BTEX	MAH's benzene, toluene, ethylbenzene and xylene.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODF	Biochemical oxygen demand of a filtered sample.
Bund	A wall around a tank to contain its contents in the case of a leak.
CBOD	Carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate.
cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
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 <sup>3</sup> s <sup>-1</sup> ).
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
E.coli	Escherichia coli, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Ent	Enterococci, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre of sample.
F	Fluoride.
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
g/m <sup>3</sup>	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.

Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
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 <sub>4</sub>	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH <sub>3</sub>	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO <sub>3</sub>	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
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 <sub>10</sub>	Relatively fine airborne particles (less than 10 micrometre diameter).
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	<i>Resource Management Act</i> 1991 and including all subsequent amendments.
SBM	Synthetic based mud.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.

UI	Unauthorised Incident.
UIR	Unauthorised Incident Register – contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
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**

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

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

Taranaki Regional Council (2014): BTW Company Limited Vanner Landfarm Monitoring Programme Annual Report 2012-2013. Technical Report 2013-58.



## **Appendix I**

**Resource consent held by  
TAG Oil (NZ) 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: TAG Oil (NZ) Limited  
P O Box 402  
NEW PLYMOUTH 4340

Decision Date: 21 October 2011

Commencement Date: 21 October 2011

**Conditions of Consent**

Consent Granted: To discharge drilling wastes [consisting of drilling cuttings and drilling fluids from drilling operations with water based muds and synthetic based muds] onto and into land via landfarming

Expiry Date: 1 June 2028

Review Date(s): June 2016, June 2022

Site Location: Lower Ball Road, Kakaramea  
[Property owner: GJ & WJ Vanner]

Legal Description: Lot 1 DP 8481 Sub 2 & 3 Blk II Carlyle SD [Discharge site]

Grid Reference (NZTM) 1720685E-5602731N

Catchment: Mangaroa

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

### **General condition**

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

### **Special conditions**

1. For the purposes of this consent the following definitions shall apply:
  - a) stockpiling means a discharge of drilling wastes from vehicles, tanks, or other containers onto land for the purpose of interim storage prior to landfarming, but without subsequently spreading onto, or incorporating the discharged material into the soil within 48 hours; and
  - b) landfarming means the discharge of drilling wastes onto land, subsequent spreading and incorporation into the soil, for the purpose of attenuation of hydrocarbon and/or other contaminants, and includes any stripping and relaying of topsoil.
2. The consent holder shall adopt the best practicable option [as defined section 2 of the Resource Management Act 1991] to prevent or minimise any actual or potential effects on the environment arising from the discharge.

### **Notifications, monitoring and reporting**

3. The consent holder shall notify the Chief Executive, Taranaki Regional Council, [by emailing [worknotification@trc.govt.nz](mailto:worknotification@trc.govt.nz)] at least 48 hours prior to permitting drilling wastes onto the site for stockpiling, from each well drilled. Notification shall include the following information:
  - a) the consent number;
  - b) the name of the well[s] from which the waste was generated;
  - c) the type of waste to be stockpiled; and
  - d) the volume of waste to be stockpiled.
4. The consent holder shall notify the Chief Executive, Taranaki Regional Council, [by emailing [worknotification@trc.govt.nz](mailto:worknotification@trc.govt.nz)] at least 48 hours prior to landfarming stockpiled material, or material brought onto the site for landfarming within 48 hours. Notification shall include the following information:
  - a) the consent number;
  - b) the name of the well[s] from which the waste was generated;
  - c) the type of waste to be landfarmed;
  - d) the volume and weight [or density] of the waste to be landfarmed;
  - e) the concentration of chlorides, nitrogen and hydrocarbons in the waste; and
  - f) the specific location and area over which the waste will be landfarmed.

5. The consent holder shall take a representative sample of each type of waste, from each individual source, and have it analysed for the following:
  - a) total petroleum hydrocarbons [ $C_6$ - $C_9$ ,  $C_{10}$ - $C_{14}$ ,  $C_{15}$ - $C_{36}$ ];
  - b) benzene, toluene, ethylbenzene, and xylenes;
  - c) polycyclic aromatic hydrocarbons screening; and
  - d) chloride, nitrogen, pH, potassium, and sodium.
6. The consent holder shall keep records of the following:
  - a) wastes from each individual well;
  - b) composition of wastes [in accordance with condition 5];
  - c) stockpiling area[s];
  - d) volumes of material stockpiled;
  - e) landfarming area[s], including a map showing individual disposal areas with GPS co-ordinates;
  - f) volumes and weights of wastes landfarmed;
  - g) dates of commencement and completion of stockpiling and landfarming events;
  - h) dates of sowing landfarmed areas;
  - i) treatments applied; and
  - j) details of monitoring, including sampling locations, sampling methods and the results of analysis;

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

### **Discharge limits**

8. The discharge area shall be as shown in Drawing No. 10321-101-GIS submitted with application 6903.
9. Notwithstanding condition 8, there shall be no discharge within 25 metres of the Mangaroa Stream or property boundaries.
10. For the purposes of landfarming, drilling wastes shall be applied to land in a layer not exceeding:
  - a) 100 mm thick for wastes with a hydrocarbon concentration less than 50,000 mg/kg dry weight; or
  - b) 50 mm thick for wastes with a hydrocarbon concentration equal to or greater than 50,000 mg/kg dry weight; and
  - c) in a rate and manner such that no ponded liquids remain after one hour, for all wastes;

prior to incorporation into the soil.

11. As soon as practicable following the application of solid drilling wastes to land, the consent holder shall incorporate the wastes into the soil to a depth of at least 250 mm.
12. The hydrocarbon concentration in the soil over the landfarming area shall not exceed 50,000 mg/kg dry weight at any point where:
  - a) liquid waste has been discharged; or
  - b) solid waste has been discharged and incorporated into the soil.
13. An area of land used for the landfarming of drilling wastes in accordance with conditions 10 and 11 of this consent, shall not be used for any subsequent discharges of drilling waste.

### **Operational requirements**

14. All material must be landfarmed as soon as practicable, but no later than twelve months after being brought onto the site.
15. As soon as practicable following landfarming, areas shall be sown into pasture [or into crop]. The consent holder shall monitor revegetation and if adequate establishment is not achieved within two months of sowing, shall undertake appropriate land stabilisation measures to minimise wind and stormwater erosion.

### **Receiving environment limits - water**

16. The exercise of this consent shall not result in the concentration of total dissolved salts in any fresh water body exceeding 2500 g/m<sup>3</sup>.
17. Other than as provided for in condition 15, the exercise of this consent shall not result in any contaminant concentration, within surface water or groundwater, which after reasonable mixing, exceeds the background concentration for that particular contaminant.
18. The exercise of this consent shall not result in any of the following effects in the Mangaroa Stream:
  - a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
  - b) any conspicuous change in the colour or visual clarity;
  - c) any emission of objectionable odour;
  - d) the rendering of fresh water unsuitable for consumption by farm animals;
  - e) any significant adverse effects on aquatic life.

## Receiving environment limits - soil

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

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

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

<b>Constituent</b>	<b>Standard</b>
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 [C<sub>7</sub>-C<sub>9</sub>, C<sub>10</sub>-C<sub>14</sub>, C<sub>15</sub>-C<sub>36</sub>]

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

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

### **Archaeological remains**

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

### **Lapse and review**

25. This consent shall lapse on 31 December 2016, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.
26. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2016 and/or June 2022, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 30 July 2013

For and on behalf of  
Taranaki Regional Council

---

**Director-Resource Management**



## **Appendix II**

### **Supplied annual report**

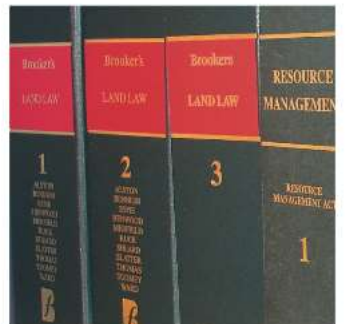


# *Annual Report*

Special Condition 7 - Monitoring and Reporting

TAG OIL (NZ) Limited Landfarm Annual Report - Consent 7942

by *BTW Company*



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# TAG OIL (NZ) Limited Landfarm Annual Report

## - Consent 7942

### Reviewed

**Report Author**

\_\_\_\_\_  
Dave Bolger

\_\_\_\_\_  
Date

**Reviewed by**

\_\_\_\_\_  
Cameron Twigley

\_\_\_\_\_  
Date

13314  
1/10/2014

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# 1 INTRODUCTION

## 1.1 Special Condition 7

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

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

This report therefore includes all information related to activities provided for under consent 7942-1 from 1 July 2013 to 30 June 2014 as well as monitoring required under SC 16-23.

## 1.2 July 2013 to June 2014 - Summary

During the annual monitoring year this resource consent (7942-1) was transferred from BTW Company to TAG Oil (NZ) Limited. The site has continued to be managed by BTW Company on behalf of TAG Oil (NZ) Limited.

The site has been very active over the monitoring year with a total area of 4.656ha landfarmed. The areas landfarmed have been divided into specific landfarm areas as per normal operating procedures. The areas landfarmed for this monitoring year are F2 to F9.

The site is consented for water based and synthetic based cuttings and fluids, however once the site became a TAG Oil only site, only water based cuttings and fluids have been disposed of at this site.

The soil sampling results for the year have concluded that all the individual areas landfarmed to date ( F1 to F9) now meet consent surrender requirements for the consent. This is an exceptional result considering some areas have only been landfarmed for 6 months.

Pasture strike has been excellent on the early landfarmed areas and all surface water results taken from the Mangaroa Stream have demonstrated no surface water contamination from the landfarming activity. In respect to the Mangaroa stream, very tight and effective management of the site activities have ensured strict buffers were adhered to and large earth bunds were constructed to ensure no surface water flow of any fluids towards the Mangaroa Stream.

The site has five lined pits, three fluid pits and two cutting pits and also has a designated lined wash down area that flows back into the large fluid pit.

The site has excellent environmental characteristics, which ensure this type of activity can be sustainable when effectively managed.

There have been no environmental issues arising during the monitoring year, the site has been fully compliant with this resource consent, and now all the areas landfarmed meet surrender criteria as stated in the conditions of the consent.

Overall this site has demonstrated a very positive result for this type of activity that is now heavily monitored and scrutinised. This site does provide evidence that if a landfarm is well managed and that specific environmental characteristics are present, landfarming is a sustainable solution using a natural process to break down any elevated levels of constituents.

### 1.3 Records required under Special Condition 7

*The consent holder shall keep records of the following:*

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

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

### 1.4 Report Overview

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

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

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

- A map of the site showing individual disposal areas, GPS co-ordinates and stockpiling areas is located in Appendix B displaying compliance with SC6 c), e) & g). This includes:
  - *stockpiling areas;*
  - *landfarming areas, including a map showing individual disposal area with GPS co-ordinates;*
  - *dates and commencement and completion of storage and landfarming events.*
- Section 2 provides the information related to the recording of details required within conditions d), f), h), and i) of SC6 which are listed below;
  - *volumes of material stored;*
  - *volumes and weights of wastes landfarmed;*
  - *dates of sowing landfarmed areas;*
  - *treatments applied.*

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

- Section 3 provides details of monitoring, including sampling locations and sampling methods as required by SC6, condition j.
- Section 4 provides the results of analysis as required also by SC6, condition j. Special Conditions 16-23 of Consent 7942-1 are also addressed in this section.

## 2 MATERIAL STORAGE AND TREATMENT

- The following section provides the information related to recording of details required within conditions d), f), h), and i) of SC6 which are listed below;
  - *volumes of material stored;*
  - *volumes and weights of wastes landfarmed;*
  - *dates of sowing landfarmed areas;*
  - *treatments applied.*

### 2.1 Material Volumes

The volume of material stored over the reporting year was 3450m<sup>3</sup>. This material has now been landfarmed into area F2 to F9. As can be seen in table 2.1 the area landfarmed is 4.656 hectares which is greater than the area required by the consent.

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

Table 2.1: Volumes of Material Landfarmed – July 2013 to June 2014

Location	Material Type	Date Landfarmed	Area of cover (m <sup>2</sup> )	Thickness of material (mm)	Volume landfarmed (m <sup>3</sup> )
F2	WBM	July 2013	0.405	100mm	285
F3	WBM	August 2013	0.652	100mm	382.6
F4	WBM	September 2013	0.755	100mm	644.4
F5	WBM	October 2013	0.646	100mm	633
F6	WBM	November 2013	0.411	100mm	249
F7	WBM	December 2013	0.592	100mm	507
F8	WBM	December 2013	0.675	100mm	263
F9	WBM	February 2014	0.520	100mm	486

### 2.2 Sowing and treatments

No treatments have been applied to materials landfarmed to date, however application of fertiliser is likely during the next monitoring period.

Areas F1 to F6 were initially sown in oaks, however now have been re-sown in permanent pasture. There is now great pasture strike in these areas. F7 and F8 have been sown twice in oaks, however due to the landfarming timing and very dry summer, pasture strike has been limited. It is intended to re-sow these areas in spring time to obtain a good pasture strike, however we note these areas are prone to very strong winds which make the establishment of pasture challenging. The F9 area has not been sown yet due to the landfarming only being completed in late June; therefore the window of opportunity for pasture strike was missed. This area will be sown in spring time, however there is some natural vegetation cover beginning to establish in this area.

Refer to figure 2.2 below and Appendix D for photographic evidence of good pasture strike at the site.





Figure 2.2: Pasture strike looking south 1/6/14

### 3 MONITORING INFORMATION

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

#### 3.1 Monitoring

A pre-disposal sample of all material is analysed for a variety of constituents before the material is stockpiled on site in lined pits. Testing takes place prior to stockpiling because on occasions it is added to other material already stored and therefore unable to be sampled separately once on-site. The material is tested by an independent accredited laboratory (Hill Laboratories), the analysis includes testing for hydrocarbons, including Total Petroleum Hydrocarbons, Polycyclic Aromatic Hydrocarbons, BTEX, Heavy Metals and individual tests such as for Barium, Potassium, Sodium, Chloride, Nitrogen and pH.

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

Monitoring of the landfarmed area begins within the first month of topsoil being re-applied to the landfarmed area. At this point, an entire suite of tests (both environmental and agricultural) is undertaken to assess the receiving environment against consent conditions.

For WBM material, monitoring is undertaken every six months for the first year following application, and then 6-monthly sampling continues until compliance with consent conditions is achieved. For SBM material, monitoring is undertaken every three months for the first year following application, and then 6-monthly until compliance is achieved. Within the first year, if results are compliant with surrender conditions, monitoring ceases. To ensure compliance best practice, all individual landfarmed areas must meet surrender criteria on two consecutive occasions, before sampling of an individual area ceases.

Monitoring results have been provided in a spread sheet form to assist with compliance and consent requirements for surrender (See Section 4).

The results demonstrate that all landfarmed areas to date meet surrender criteria for this consent. Surrender criteria data and analysis is discussed in section 4.

All receiving environment samples are tested by Hill Laboratories and sampling methodology is in accordance with the TRC procedure for soil sampling at landfarm sites. In addition BTW Company has its own sampling procedure which is strictly adhered to and adopts best current practices for specific sampling requirements.

Apart from the soil sampling, additional surface water sampling of the Mangaroa Stream has taken place on two occasions during the monitoring year. The results of the sampling are contained in Appendix C and demonstrate compliance with special condition 16, 17 and 18. The sampling results demonstrate background constituent levels have been consistent with results before the activity took place adjacent to the Mangaroa Stream. Therefore no effect on the surface water has been identified by water sampling.

### 3.2 Sampling Locations

Specific landfarmed areas are located through the use of a GPS navigational system. These co-ordinates are contained within the 'Vanner Disposal Site Sampling Plan' (Appendix E) which shows individual areas of disposal and is updated following landfarming events. A central point is located within each area and a composite sample is retrieved in a transect line from the central point. The transect line is approximately 60 meters and the extent of each transect line is defined by coordinates on the sampling plan. The line direction is dependent on the underlying orientation of the landfarmed material.

### 3.3 Methods

Soil sampling involves collecting a composite of 10 sub-samples along each individual transect line for each specific landfarm area. Typically, samples are retrieved to a maximum depth of 250mm but this can vary depending on the location of the drilling mud layer.

The samples are collected from a stainless steel core sampler and homogenised in a stainless steel bucket before a composite sample is collected into the appropriate container for analysis. All equipment is decontaminated with Triple S solution after each sampling transect is completed.

Strict chain of custody requirements are adhered to, for the laboratory to accept the sample and process for analysis.

### 3.4 Inspection Notices

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

### 3.5 Infringement Notice

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

### 3.6 Abatement Notices

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

### 3.7 Site Improvements

A collaborative approach from the consent holder and the TRC has seen improvements at the site, which include; all stockpiling pits being lined since the first load of material was stockpiled. Groundwater monitoring bores were installed before the site became operational. Background sampling of soil, surface water and groundwater has taken place by both the consent holder (initially BTW) and the TRC. Having this background data is paramount for the consent holder and the TRC to monitoring the site in relation to pre-existing background levels. It is an important set of baseline data that will provide the basis for surrendering the consent in the future.

Most of the improvements achieved for the year have been around administration and compliance monitoring of the actual landfarming area. A robust sampling methodology has been used and a separate sampling plan has been provided to assist the Council with the locations of the sampling, refer to Appendix E. A full suite of soil sampling has taken place to ensure full compliance with the consent and as demonstrated in figure 3.8 the soil sampling is comprehensive and goes well beyond consent requirements. This provides reassurance and greater data capture for future land use activities on the site. It is considered this is an important point, as the consent holder is not just doing the bare minimum to comply with consent conditions, instead they are testing for a range of constituents that could be considered to have adverse effects on the receiving environment at certain concentrations.

This significant data set supplied provides additional evidence to the Council that consent conditions have been met. This intensive monitoring by the applicant is vital to ensure applicable guideline standards are being met by the applicant during initial loading and meeting surrender criteria.

The site now has a designated wash down area that is lined and flows back into a liquid holding pit. It is considered that a designated wash down area is an essential requirement to ensure there is no uncontrolled discharge at the site. It is considered that this should be mandatory at all sites.

Generally at land farming sites there had been an issue in the past with the front of the liners ripping, due to the heavy impact during the disposing of muds into the pits. All pits now have an additional impact liner at the front of the pits where disposal takes place. See figure 3.7 below.



**Figure 3.7 New protective liner at front of pits.**

These additional impact liners are essential in the protection of the integrity of the primary liners, and obviously to ensure no uncontrolled discharge takes place from a ripped liner.

A sampling plan has been provided, showing the position of each sampling transect within each individual land farmed area. The plan gives coordinates not only for the central point, however from the extent of the transect. It also provides orientation and distance of the sampling transect line.

Extensive monitoring of the site has continued. BTW Company has actively maintained a presence on the site to ensure all disposal is well managed and no spills or unauthorised disposal takes place. Due to the nature of the activity site presence is paramount to ensure compliance with consent and that no adverse effects from the activity occur.

With BTW Company retaining the management of the site, there has been a continuation of best practices in terms of spreading area requirements. The management option of having larger areas than required under the resource consent has ensured no overloading of material into the receiving environment, and the results currently show this to be an effective management tool in meeting early surrender criteria and achieving background concentration in the soil matrix.





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BETTER TESTING BETTER RESULTS

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## ANALYSIS REPORT

Page 1 of 3

<b>Client:</b>	BTW Company Limited	<b>Lab No:</b>	1260970	SPV1
<b>Contact:</b>	Dave Bolger	<b>Date Registered:</b>	09-Apr-2014	
	C/- BTW Company Limited	<b>Date Reported:</b>	22-Apr-2014	
	PO Box 551	<b>Quote No:</b>	36604	
	NEW PLYMOUTH 4340	<b>Order No:</b>	13314	
		<b>Client Reference:</b>		
		<b>Submitted By:</b>	Dave Bolger	

Sample Type: Soil						
<b>Sample Name:</b>		F8 - Vanner				
		07-Apr-2014				
<b>Lab Number:</b>		1260970.1				
Individual Tests						
Dry Matter	g/100g as rcvd	97	-	-	-	-
Total Recoverable Barium	mg/kg dry wt	600	-	-	-	-
Total Recoverable Boron	mg/kg dry wt	< 20	-	-	-	-
Total Recoverable Vanadium	mg/kg dry wt	220	-	-	-	-
Chloride*	mg/kg dry wt	390	-	-	-	-
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	17	-	-	-	-
Total Recoverable Copper	mg/kg dry wt	11	-	-	-	-
Total Recoverable Lead	mg/kg dry wt	1.3	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt	7	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt	71	-	-	-	-
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	< 0.12	-	-	-	-



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:		F8 - Vanner				
		07-Apr-2014				
Lab Number:		1260970.1				
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	33	-	-	-	-
C15 - C36	mg/kg dry wt	240	-	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	270	-	-	-	-



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## ANALYSIS REPORT

Page 1 of 4

Client:	BTW Company Ltd	Lab No:	1204552	shpw1
Address:	PO Box 551 NEW PLYMOUTH 4340	Date Registered:	19-Nov-2013	
		Date Reported:	22-Nov-2013	
		Quote No:	36604	
		Order No:	13314	
		Client Reference:		
Phone:	06 759 5040	Submitted By:	Dave Bolger	

Sample Name: F2 - Vanner 18-Nov-2013				Lab Number: 1204552.1		
Sample Type: SOIL General, Outdoor (S10)						
Analysis		Level Found	Medium Range	Low	Medium	High
pH	pH Units	5.9	5.8 - 6.3			
Potassium	me/100g	0.37	0.50 - 0.80			
Calcium	me/100g	1.0	6.0 - 12.0			
Magnesium	me/100g	0.25	1.00 - 3.00			
Sodium	me/100g	0.07	0.20 - 0.50			
CEC	me/100g	4	12 - 25			
Total Base Saturation	%	40	50 - 85			
Volume Weight	g/mL	1.99	0.60 - 1.00			
Total Soluble Salts*	mg/L	548				
Electrical Conductivity (Sat Paste)*	mS/cm	0.8				
Nitrate-N (Sat Paste)*	mg/L	29				
Ammonium-N (Sat Paste)*	mg/L	5				
Phosphorus (Sat Paste)*	mg/L	2				
Potassium (Sat Paste)*	mg/L	102				
Calcium (Sat Paste)*	mg/L	31				
Magnesium (Sat Paste)*	mg/L	9				
Sodium (Sat Paste)*	mg/L	39				
Sodium Absorption Ratio*		1.6				
Lime Requirement (7.5cm)	tonne/ha	1.0				

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.

Figure 3.8 Soil Sampling Constituents testing regime

## 4 ANALYSIS OF RESULTS

The following Table 4.1 provides a summary of the soil monitoring results for areas F1 to F9 over the reporting period and beyond. Analysis of the results of monitoring are required by SC6, condition j. Special Conditions 16-23 of Consent 7942-1 are also addressed in this section.

Table 4.1 demonstrates that all the landfarmed areas now meet surrender criteria, as indicated by the fields coloured in green. Some areas initially had constituent levels above the surrender criteria thresholds; however during the year these areas have reduced to meet surrender limits. The surrender limits on the consent are based on the most current environmental guideline standards in New Zealand for managing petroleum hydrocarbons and the safe application of biosolids to land. These guidelines have been produced by the Ministry for the Environment.

As table 4.1 demonstrates the areas that have been landfarmed have responded well to the landfarming process. Testing has shown that with water based muds there are generally very low hydrocarbon levels and sometimes not even detectable limits. With the water based muds the main elevated constituents are salts such as chloride. However the high initial salt concentrations are leached through the soil during rain events and natural attenuation through the sandy soil matrix takes place. It is important to remember this is a coastal location and concentrations of salts are naturally higher at this location. Other constituents like hydrocarbons are generally held within the soil matrix and bio remediated, as microbes break down the hydrocarbon molecules by using oxygen.

As this site is coastal, consideration must be given to the baseline environment and surrounding environment. Coastal locations have naturally high levels of salts, and from background soil sampling a level of total soluble salts of 548 mg/L was recorded in the soil. Therefore it is considered that initial high applications of salt in this environment are likely to have minimal effect. Also when you include a natural buffer zone and significant depth to groundwater the effects are likely to be negligible and to date all the soil, surface water and groundwater results reflect this.

Also worth pointing out is that all the results demonstrate no elevated levels of heavy metals in the soil. All levels fall well below the biosolids guideline values set by the Ministry for the Environment to protect public health and the environment, plus to safeguard the life-supporting capacity of soils.

All landfarmed area from F1 to F9 meet surrender criteria as specified on this consent (7942-1).



		Meets TRC Surrender Criteria				Does not meet TRC Consent surrender criteria																				
	Date	Soil conductivity <290mS m-1 (see Consent if PD is greater than 400)	Sodium 460 mg/kg	SAR <18	Total Soluable salts <2500gm-3	Benzene <1.1(v)	Toulene <68(4m)	Ethylbenzene (53)(4.v)	Xylenes (48) (4.m)	Naphthalene (7.2) (p)	Non-carc. (Pyrene) (160) (4p)	Benzo(a)pyrene eq.(5) (0.027)(p)	Arsenic (20mg/kg)	Cadmium (1mg/kg)	Chromium (600mg/kg)	Copper (100mg/kg)	Lead (300mg/kg)	Mercury (1mg/kg)	Nickel (60mg/kg)	Zinc (300mg/kg)	C7-C9 120 (m)	C10-C14 58 (x)	C15-C36 (4000) (7,x)	nitrogen g/100g dry wt	Chloride 700 mg/kg	Material
F1	1/07/2013	220	126	2.8	1419	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	16	8	1.4	<0.10	7	60	8	220	620	0.12	70	SBM
	1/11/2013	90	82	3.2	581	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	18	10	1.2	<0.10	8	71	8	20	92	1	29	SBM
																										SBM
F2	1/08/2013	40	30	1.5	264	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	17	9	1.3	<0.10	7	67	8	20	<40	17	11	WBM
	11/02/2014	80	34	1.1	548	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	16	10	1.1	<0.10	7	61	8	27	71	0.07	33	WBM
																										WBM
F3	1/08/2013	520	162	2.6	3460	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	18	10	1.4	<0.10	7	69	8	350	1040	1	280	WBM
	11/02/2014	230	83	1.7	1544	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	16	9	1.5	<0.10	8	64	8	420	1120	0.07	117	WBM
	18/06/2014	70	23	0.7	449	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	15	10	1.5	<0.10	8	57	8	29	185	0.07	17	WBM
F4	1/12/2013	540	178	3.3	3570	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	17	10	1.5	<0.10	8	54	8	20	85	0.06	320	WBM
	11/02/2014	770	258	4.1	5090	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	15	10	1.5	<0.10	8	60	8	20	91	0.07	360	WBM
	1/05/2014	60	19	0.7	416																					WBM
F5	1/12/2013	520	162	2.60	3440.00	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	19	11	2.1	<0.10	10	64	8	39	177	0.11	330	WBM
	11/02/2014	270	101	1.9	1802	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	15	8	1.1	<0.10	7	59	8	20	40	0.07	106	WBM
																										WBM
																										WBM
																										WBM
																										WBM
F6	1/01/2014	130	61	1.8	865	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	17	9	1.3	<0.10	8	66	8	20	40	0.09	53	WBM
	28/05/2014	180	74	2.1	1214	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	17	9	1.4	<0.10	8	63	8	20	40	0.08	126	WBM
																										WBM
																										WBM
F7	6/03/2014	740	266	3.4	4900	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	16	9	1.3	<0.10	7	67	8	20	40	0.12	460	WBM
	1/05/2014	520	145	2.90	3440.00																					WBM
	28/05/2014	490	148	2.7	3230	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	19	11	1.8	<0.10	8	75	8	20	40	0.08	195	WBM
	18/06/2014	190	60	1.7	1280																					
F8	6/03/2014	1200	426	5.1	7930	<0.05	<0.05	<0.05	<0.05	<0.11	<0.03	<0.03	<2	<0.10	19	12	1.9	<0.10	9	83	8	76	340	0.1	750	WBM
	7/04/2014	670	365	4.30	5770.00	<0.05	<0.05	<0.05	<0.05	<0.11	<0.03	<0.03	<2	<0.10	17	11	1.3	<0.10	7	71	8	33	240	0.12	390	WBM
	1/05/2014	200	68	2.3	1307																					
F9	18/06/2014	170.00	87	2.2	1096	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	16	11	1.7	<0.10	8	62	8	20	40	0.12	71	WBM

Table 4.1: Monitoring results from TAG OIL Landfarm

## 4.1 Compliance with SC's 16 and 18

Conditions 16-18 require:

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

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

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

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

Compliance with SC's 16-18 has been achieved; refer to Appendix C for results

## 4.2 Compliance with SC's 19 - 23

Conditions 19-23 require:

### 4.2.1 Condition 19 – Soil Conductivity

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

It was identified during soil sampling that area's F3, F4, F7 and F8 had elevated soil conductivity, however all these areas now meet surrender criteria.

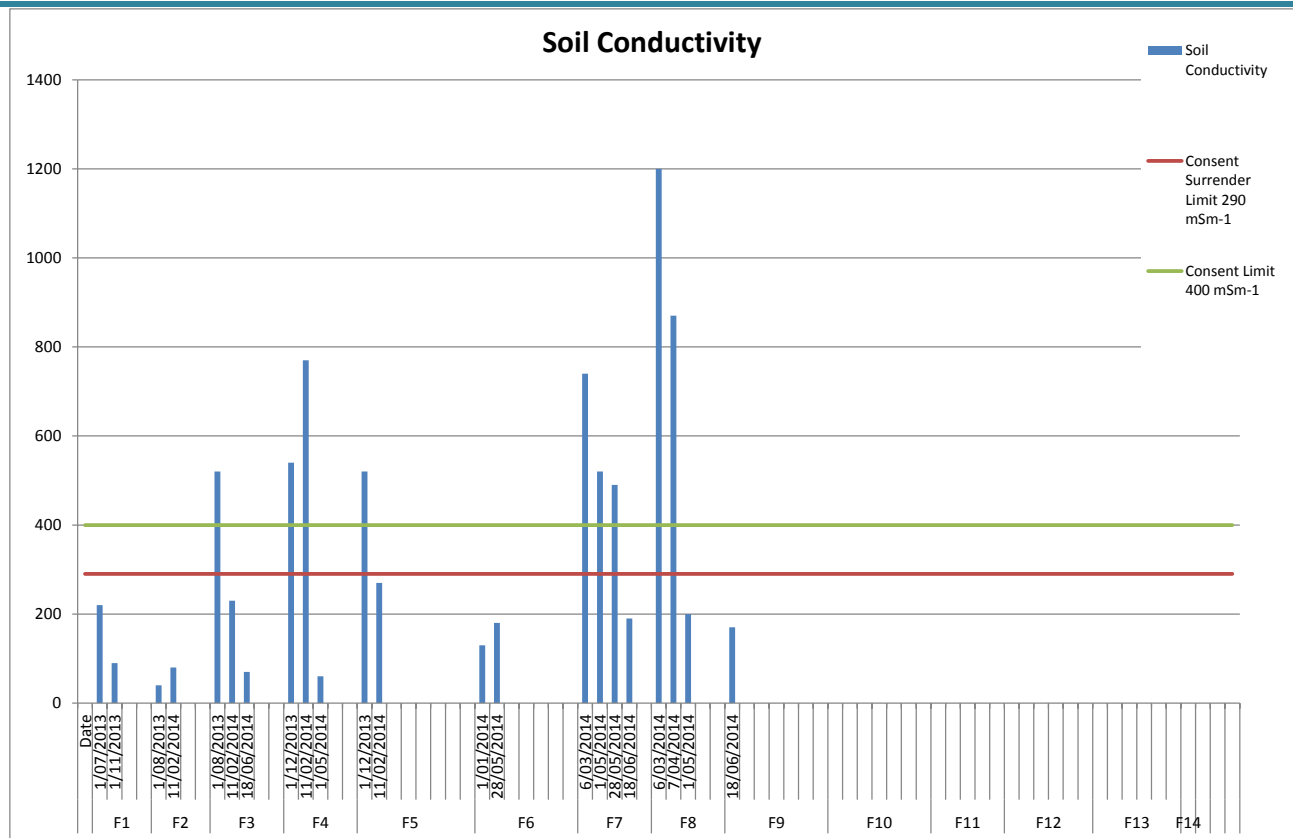


Figure 4.2.1. Soil Conductivity

#### 4.2.2 Condition 20 – Sodium Absorption Ratio

*“The sodium absorption ratio (SAR) of the soil / waste layer after landfarming shall be less than 18.0, or alternatively if the background SAR exceeds 18.0, the landfarming of waste shall not increase the SAR by more than 1.0.”*

All landfarmed areas have met surrender criteria in all sampling results.

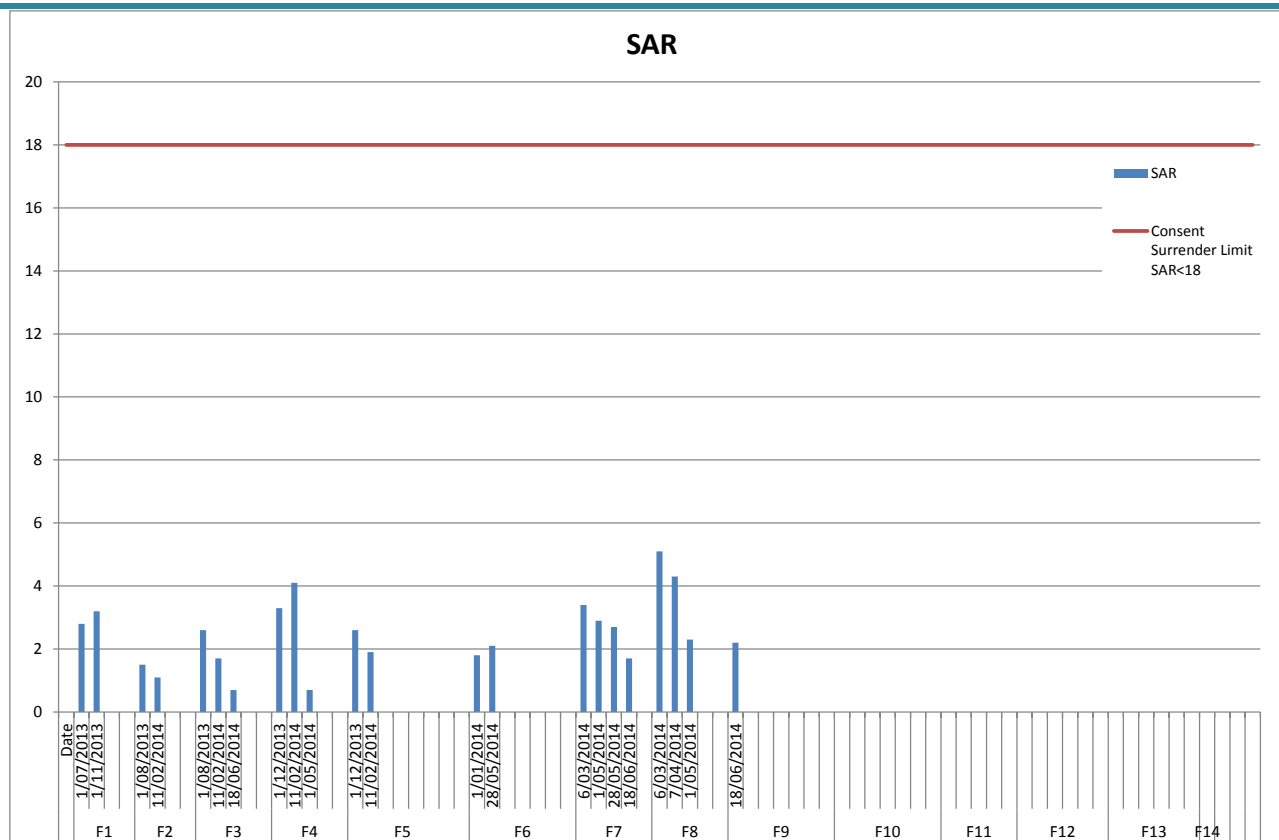


Figure 4.2.2 Sodium Absorption Ratio

#### 4.2.3 Condition 21 – Heavy Metals

*“The concentration of metals in the soil shall at all times comply with the Ministry of the Environment and New Zealand Water and Wastes Association’s Guidelines for the safe application of biosolids to land in New Zealand (2003), as shown in the following table:”*

Table 4.2: Consent Compliance Limits – Metals

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

As demonstrated in table 4.1 no elevated heavy metals were detected in the receiving environment soil after landfarming. All heavy metal levels were well below the guidelines values for the safe application of biosolids to land, and are basically at the background level you would expect in the soil at this specific location.

#### 4.2.4 Condition 22 – Conductivity, chloride, sodium, total soluble salts & hydrocarbons

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

**Table 4.3: Consent Surrender Limits**

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

MAHs – benzene, toluene, ethylbenzene, xylenes

PAHs – naphthalene, non coarc. (Pyrene) benzo(a)pyrene eq.

TPH – Total petroleum hydrocarbons (C<sub>7</sub>-C<sub>9</sub>, C<sub>10</sub>-C<sub>14</sub>, and C<sub>15</sub>-C<sub>36</sub>).

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

#### 4.2.5 Conductivity

As demonstrated in section 4.2.1 all the landfarmed areas now meet the surrender criteria for soil conductivity.

## 4.2.6 Chloride

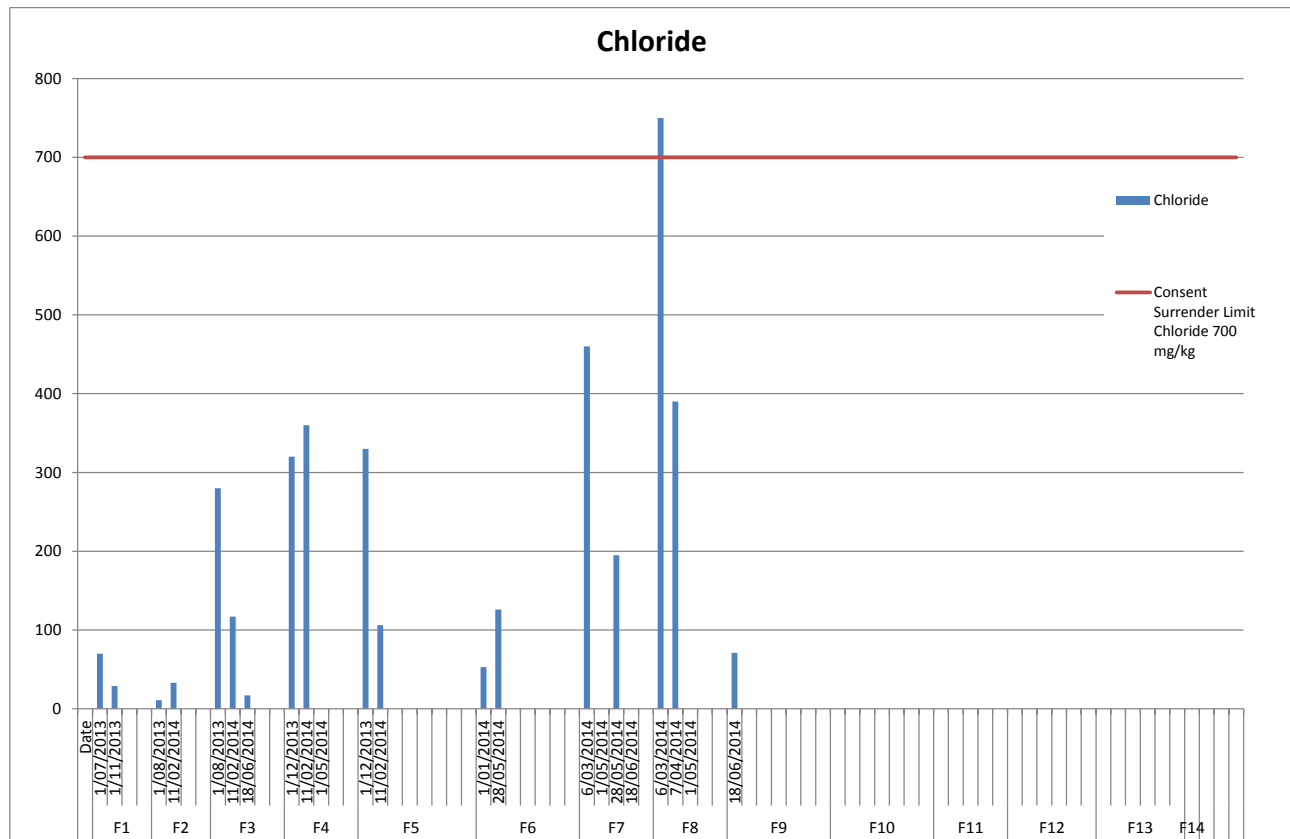


Figure 4.2.6 Chloride

As demonstrated in the graph above and in table 4.1 all of the landfarmed areas meet surrender criteria for the consent. The F8 area was initially above the surrender criteria, however from the last sample taken has now reduced and meets surrender criteria. The Chloride levels are pleasing considering Chloride is one of the main constituents that has been elevated within the water based drilling muds pre-disposal samples. This would suggest that the process of mixing the soil with the muds is diluting the chloride levels and also Chloride does readily leach out of the top soil profile.

## 4.2.7 Sodium

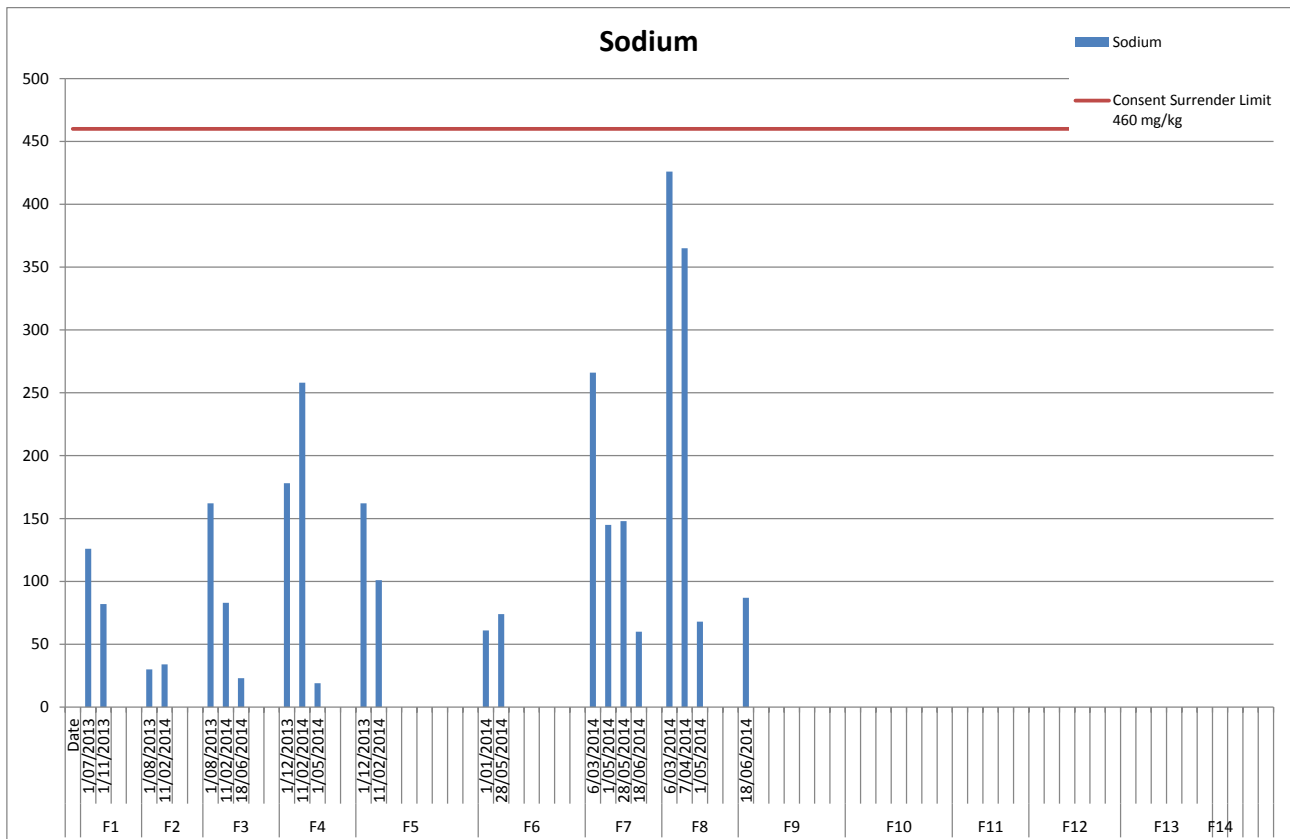


Figure 4.2.7 Sodium

As demonstrated in the graph above and in table 4.1 all sodium levels have been below the consent surrender limit.

#### 4.2.8 Total Soluble Salts

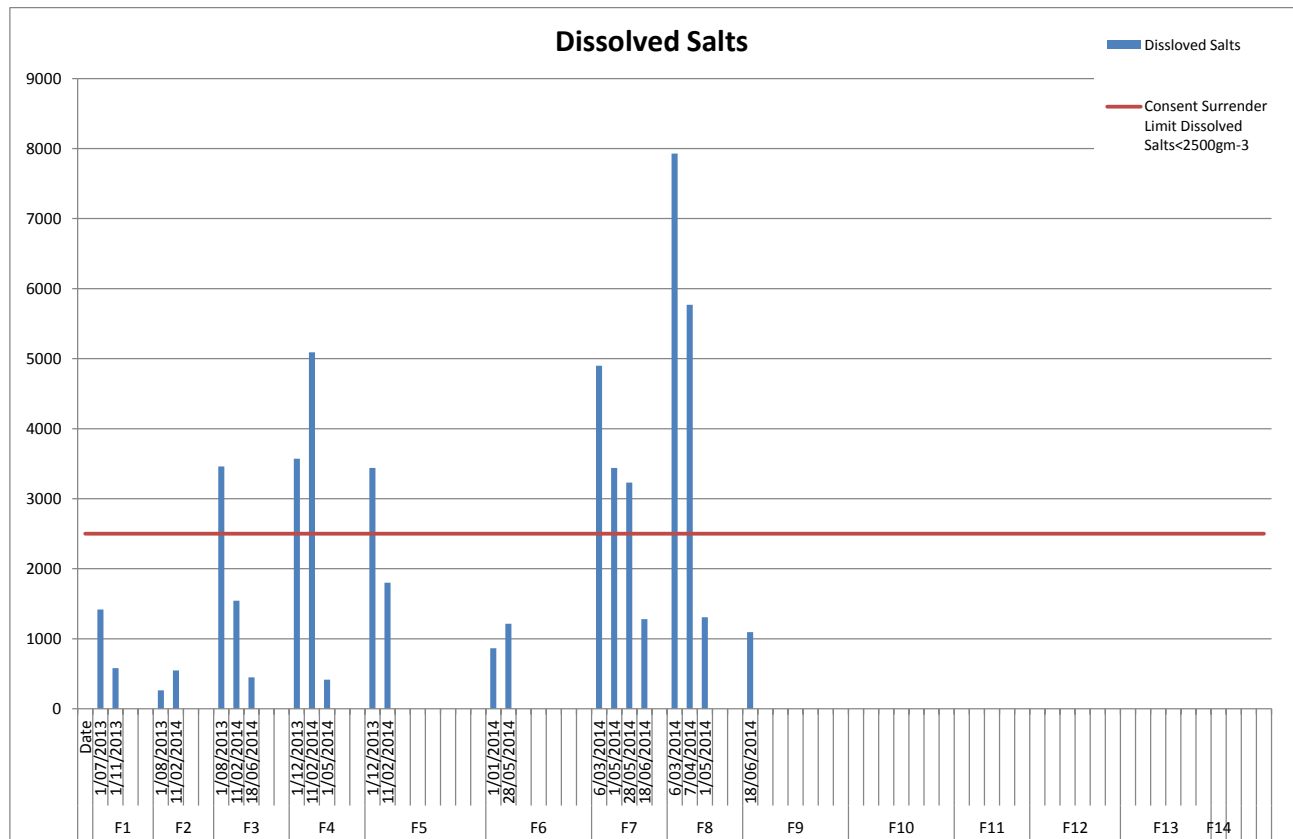


Figure 4.2.8 Total Soluble Salts

As shown on the graph above there were some initial areas that were above surrender criteria for total soluble salts. All landfarmed areas now meet the surrender criteria for total soluble salts.



#### 4.2.9 Total Percentage of Hydrocarbons C7-C9

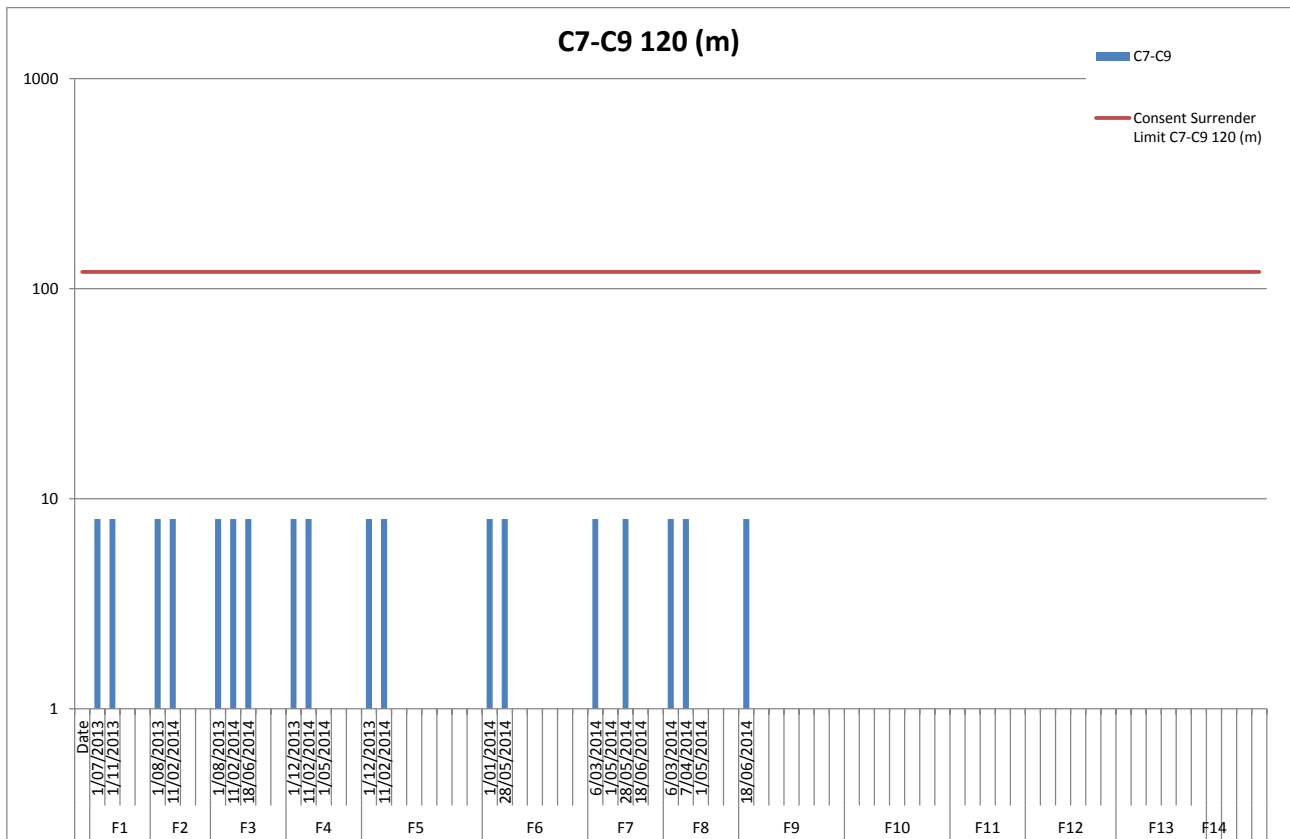


Figure 4.2.9 TPH C7-C9

All landfarmed areas have been below surrender criteria for C7 – C9 hydrocarbon chain.

#### 4.2.10 Total Percentage of Hydrocarbons C10-C14

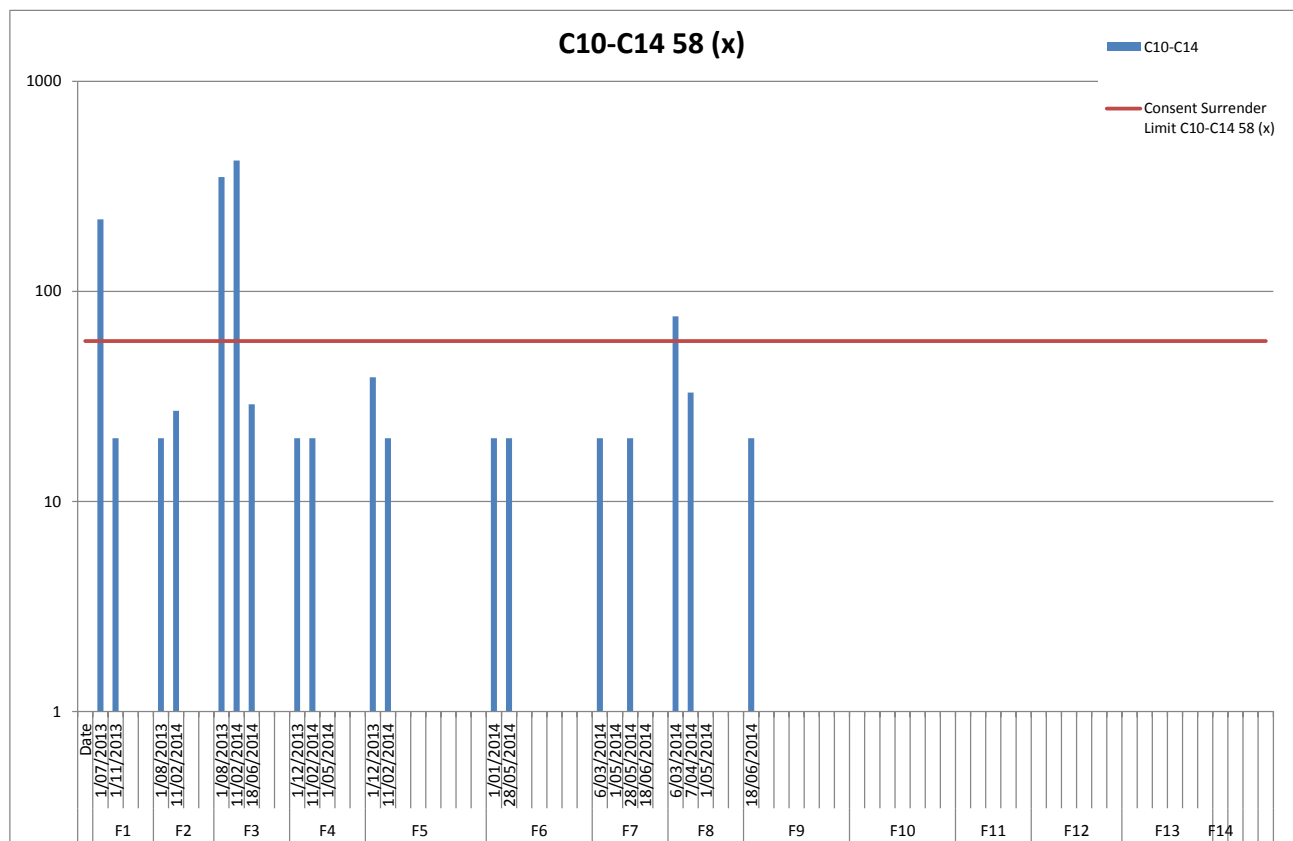


Figure 4.2.10 TPH C10-C14

Some initial soil sampling results showed F1, F3 and F8 were above surrender criteria, however well below consent requirements. All areas now for the C10 – C14 chain of hydrocarbons meet surrender criteria.

#### 4.2.11 Total Percentage of Hydrocarbons C15-C36

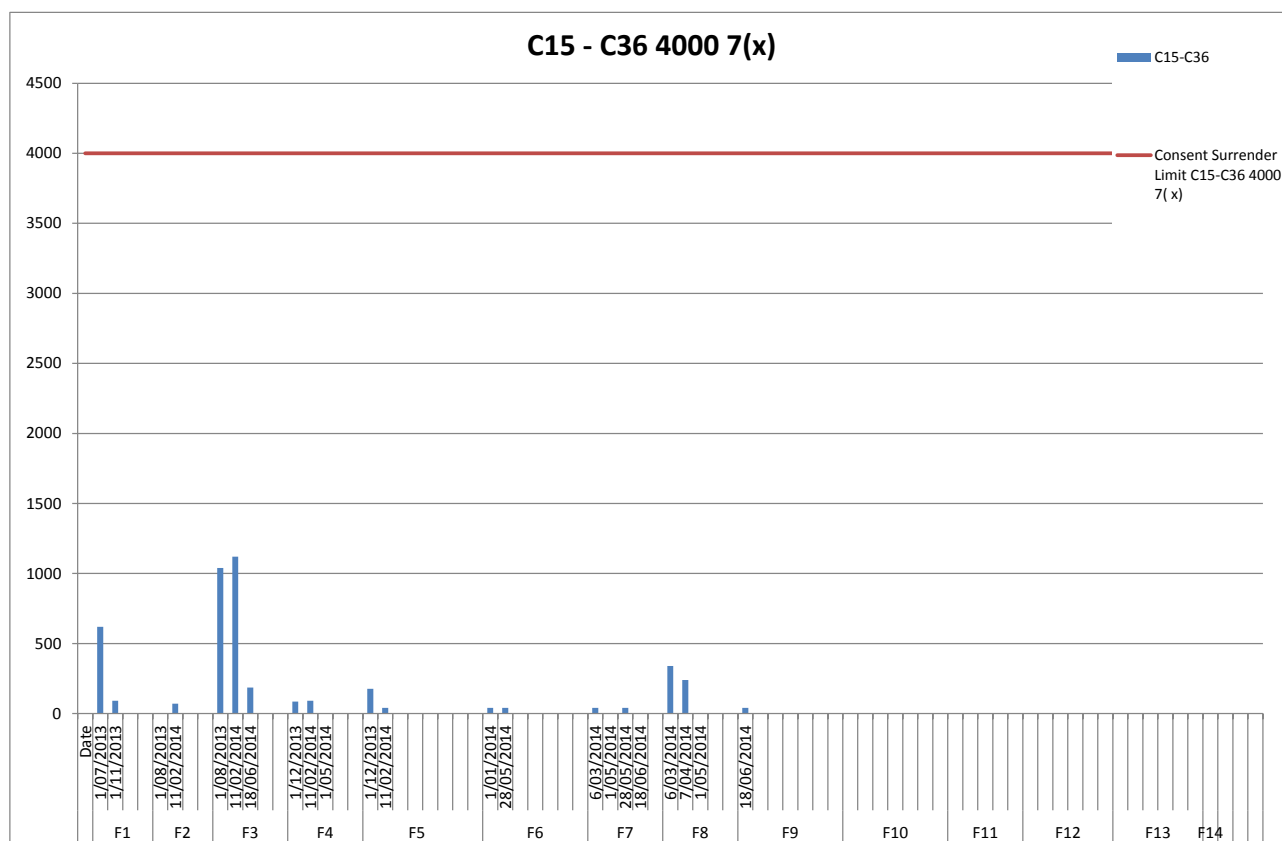


Figure 4.2.11 TPH C15-C36

All sampling results show that all landfarmed areas are below the surrender criteria.

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

Currently from all of BTW Company's monitoring of soil and surface water, surrender criteria has been met for areas F1 to F9 (all the areas landfarmed to date).

Monitoring will continue as per the conditions on the consent. However many of the soil monitoring areas will now be phased out due to having two consecutive sampling runs showing consent surrender criteria has been met.

## APPENDIX A COMPOSITION OF WASTE

### WBM – TYPICAL CHEMICALS

Table 1: Typical Chemicals used in Drilling

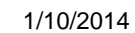
Chemical Description	Use	Phase
Sodium Sulphite with 2% Cobalt Chloride catalyst	Oxygen scavenger	Solid
Non-ionic Isothiazolin Solid	Biocide	Solid
Cationic Polymer	Shale stabiliser	Liquid
Sodium Hydroxide	PH control	Solid
Sodium Montmorillonite	Viscosifier	Solid
Polyanionic Cellulose	Filtrate control	Solid
Xanthan Gum	Viscosifier	Solid
Calcium Hydroxide	Flocculant	Solid
Ground Peanut Shells (Liquid casing)	Lost circulation material	Solid
Ammonium thiocyanate	Tracer in well	Solid
Potassium Chloride		

Table 2: Drilling Fluid Contingency Items

Chemical Description	Use	Phase
Zinc Oxide	Sulphide scavenger	Solid
Alcohol ethoxylate blend	Defoamer	Liquid
Sodium Bicarbonate	Calcium precipitation	Solid
Sodium Chloride	Clear Brine	Solid
Poly-glycol/Poly-glycollether Surfactant blend	Well lubricant	Liquid
Calcium Carbonate	Lost circulation material	Solid
Acrylamide acrylate polymer	Shale encapsulator	Solid/Liquid
Polymino Acid	Shale Stabiliser	Liquid
Barium Sulfate (barite)	Inert weighting agent	Solid
Citric Acid	PH control	Solid
Mica	Lost circulation material	Solid
Ground Walnut Shells	Lost circulation material	Solid
Sodium Carbonate	Calcium precipitation	Solid
Chrome free Lignosulfonate	Dispersant	Solid
Surfactant/Emulsifier blend	Stuck pipe compound	Liquid
Blended filming aminos	Corrosion Inhibitor	Liquid
Phosphate ester salt	Corrosion Inhibitor	Liquid
Sodium Silicate (Cementing)	Lost circulation material	Solid
Calcium Chloride (cementing)	Inhibitor	Solid

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**APPENDIX B      SITE MAP**



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## **APPENDIX C                      MANGAROA STREAM – SURFACE WATER RESULTS**



## APPENDIX D PHOTOGRAPHIC RECORD OF LANDFARMING

Early November 2013 F2 and beyond



June 2014 F2 through to F8





## APPENDIX E SAMPLING PLAN

