

BTW Company Ltd
Oeo Landfarm
Monitoring Programme
Annual Report
2016-2017

Technical Report 2017-08

ISSN: 1178-1467 (Online)

Document: 1845986 (Word)

Document: 1919944 (Pdf)

Taranaki Regional Council

Private Bag 713

STRATFORD

October 2017

Executive summary

BTW Company Ltd (the Company) operates a drilling waste landfarm which is located on South Road near Manaia, in the Rawa catchment, South Taranaki. The site was operational in terms of stockpiling and landfarming between September 2012 and November 2013. In this time period (2012-2013) the site sequestered water and synthetic based drilling muds with associated rock cuttings to land under the process of landfarming. The facility has been remediating since this date.

This report for the period July 2016 to June 2017 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess the Company's environmental and consent compliance performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of the Company's activities.

The Company holds one resource consent, which includes a total of 24 conditions setting out the requirements that the Company must satisfy.

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

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

The monitoring indicated that the elevated saline impacts, observed in the long term record of groundwater analysis had reduced to below the conditional limit in the final round of groundwater monitoring in this period. However, trace results of total petroleum hydrocarbons range C₁₀-C₁₄ (two rounds) and C₁₅-C₃₆ (one round) and trace benzene (one round) were observed. These trace results had reduced to below the laboratory limit of detection in the final groundwater monitoring round undertaken in May 2017.

Soil sampling of the final landfarmed application area, area F3, had indicated that this area of the site was close to its conditional limit for surrender. The analytical results of two of four soil samples collected, were marginally above the surrender concentration set for mid range hydrocarbons (C₁₀-C₁₄).

The remaining contaminants of concern were found to be within surrender concentrations. The main aim of the upcoming monitoring year will be to confirm that surrender criteria has been reached in area F3. Some issues in regards to revegetation were noted during inspections.

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

For reference, in the 2016-2017 year, consent holders were found to achieve a high level of environmental performance and compliance for 74% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 21% of the consents, a good level of environmental performance and compliance was achieved.

In terms of overall environmental and compliance performance by the consent holder over the last several years, this report shows that the consent holder's performance has remained at a good level.

This report includes recommendations for the 2017-2018 year.

Table of contents

	Page
1. Introduction	1
1.1. Compliance monitoring programme reports and the Resource Management Act 1991	1
1.1.1. Introduction	1
1.1.2. Structure of this report	1
1.1.3. The Resource Management Act 1991 and monitoring	2
1.1.4. Evaluation of environmental and administrative performance	2
1.2. Process description	3
1.3. Site description	4
1.4. Resource consents	7
1.4.1. Discharges of wastes to land	7
1.5. Monitoring programme	7
1.5.1. Introduction	7
1.5.2. Programme liaison and management	8
1.5.3. Site inspections	8
1.5.4. Chemical sampling	8
2. Results	11
2.1. Inspections	11
2.2. Results of discharge monitoring	12
2.2.1. Results of receiving environment monitoring	13
2.3. Investigations, interventions, and incidents	19
3. Discussion	20
3.1. Discussion of site performance	20
3.2. Environmental effects of exercise of consents	20
3.3. Evaluation of performance	21
3.4. Recommendations from the 2015-2016 Annual Report	23
3.5. Alterations to monitoring programmes for 2017-2018	23
4. Recommendations	24
Glossary of common terms and abbreviations	25
Bibliography and references	27
Appendix I Resource consents held by BTW Ltd	
Appendix II Annual report	

List of tables

Table 1	Monitoring well geology	6
Table 2	Soil analysis	9
Table 3	Groundwater analytes	10
Table 4	Landfarming application dates Oeo Landfarm	12
Table 5	Oeo Landfarm soil results area F3 2016-2017	14
Table 6	GND2286 2016-2017 monitoring period	17
Table 7	GND2287 2016-2017 monitoring period	17
Table 8	Summary of performance consent 7613-1.1 2016-2017	21
Table 9	Evaluation of environmental performance over time	22

List of figures

Figure 1	Oeo Landfarm with regional inset	6
Figure 2	An example of an extracted soil core	9
Figure 3	Company supplied landfarm application map Oeo Landfarm	13
Figure 4	Groundwater monitoring well locations Oeo Landfarm	16
Figure 5	Long term TDS record GND2287 Oeo Landfarm 2012-2017	19

1. Introduction

1.1. Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1. Introduction

This report is for the period July 2016 to June 2017 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consent held by BTW Company Ltd (the Company). The Company operates a landfarm (Oeo Landfarm) situated on South Road at Manaia in the Waimate catchment.

The Oeo Landfarm site became operational in the 2012-2013 monitoring year; during which there were eight disposals of approximately 4,278 m³ of water/synthetic-based muds/cuttings and fluid over a combined area of approximately 61,047 m². Operations at the site ceased in the 2013-2014 monitoring year, and the decision was made to not utilise the remaining small area available to spread, situated to the east of the Rawa Stream. The Company and the Council will continue to monitor this site until surrender criteria are met and the resource consent may be surrendered.

The report includes the results and findings of the monitoring programme implemented by the Council in respect of the consent held by the Company that relate to discharges of drilling material within the Waimate catchment.

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

1.1.2. Structure of this report

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

- consent compliance monitoring under the RMA and the Council's obligations;
- the Council's approach to monitoring sites through annual programmes;
- the resource consents held by the Company in the Waimate catchment;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted in the Company's site.

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

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

Section 4 presents recommendations to be implemented in the 2017-2018 monitoring year.

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

1.1.3. The Resource Management Act 1991 and monitoring

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

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

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

1.1.4. Evaluation of environmental and administrative performance

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

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

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

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

Environmental Performance

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

Good: Likely or actual adverse effects of activities on the receiving environment were negligible or minor at most. There were some such issues noted during monitoring, from self reports, or in response to unauthorised incident reports, but these items were not critical, and follow-up inspections showed

they have been dealt with. These minor issues were resolved positively, co-operatively, and quickly. The Council was not obliged to issue any abatement notices or infringement notices in relation to the minor non-compliant effects; however abatement notices may have been issued to mitigate an identified potential for an environmental effect to occur.

For example:

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

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

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

Administrative performance

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

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

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

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

For reference, in the 2016-2017 year, consent holders were found to achieve a high level of environmental performance and compliance for 74% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 21% of the consents, a good level of environmental performance and compliance was achieved.

1.2. Process description

Drilling waste

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

Drilling fluids

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

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

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

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 \$3-4,000/ha to \$30-40,000/ha (2013).

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

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

The landfarming process utilised at the Oeo Landfarm was on a single application basis. This meant that dedicated spreading areas received only a single application of material. When disposal was complete, the area was reinstated and monitored until the consent surrender criteria has been met.

1.3. Site description

The consented site consists of two land parcels totalling 13.8 ha of available spreading area. The site is located on privately owned marginal coastal land situated on reworked dune fields. The predominant soil

type has been identified as black loamy sand, and vegetation growth is primarily a mixture of pasture and dune grasses. Average annual rainfall for the site is 1,122 mm (taken from the nearby Glenn Road monitoring station). Two significant surface water bodies run adjacent to the spreading areas. The Waimate Stream flanks the north-western side of the main western site, whilst the Rawa Stream runs adjacent to the north-western side of the smaller eastern site. The Waimate Stream in the immediate vicinity of the site is essentially ephemeral and only flows during periods of prolonged wet weather. Prior to landfarming, the site had suffered from extensive dune ablation, visible in Figure 1. Basic subsurface soil stratigraphy is provided in Table 1.

Site data

Location	
Word descriptor:	South Road, Manaia, Taranaki
Map reference:	E 1684821
(NZTM)	N 5621560
Mean annual rainfall:	1,122 mm
Mean annual soil temperature:	~26.2°C
Mean annual soil moisture:	~15.88%
Elevation:	~25 m asl
Geomorphic position:	Cliff/dune backslope
Erosion / deposition:	Erosion
Vegetation:	Pasture, dune grasses
Parent material:	Aeolian deposit
Drainage class:	Free/well draining
Previous Land use:	Dry stock grazing



Figure 1 Oeo Landfarm with regional inset

Table 1 Monitoring well geology

Bore	Depth (m)	Drilling Formation
GND2286	0.00 – 0.50	Sandy topsoil
	0.50 – 2.00	Soft sandy clay
	2.00 – 10.00	Soft tephra
GND2287	0.00 – 0.50	Sandy topsoil
	0.50 – 3.00	Soft sandy clay
	3.00 – 10.50	Tephra
GND2288	0.00 – 0.50	Sandy topsoil
	0.50 – 2.50	Sandy soft clay
	2.50 – 10.00	Tephra
GND2350	0.00 – 0.50	Sandy topsoil
	0.50 – 3.50	Sandy clay
	3.50 – 5.00	Conglomerated sand, small gravels, hard
	5.00 – 7.50	Sandy clay
	7.50 – 8.50	Sandy clay, firm
	8.50 – 9.00	Solid rock
	9.00 – 10.50	Conglomerated sand, small gravels, firm

1.4. Resource consents

1.4.1. Discharges of wastes to land

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

The Company holds discharge consent **7613-1.1** to cover the discharge of drilling wastes (consisting of drilling cuttings and fluids) from hydrocarbon exploration activities with water based muds and synthetic based muds, onto and into land via landfarming. This consent was issued by the Council on 23 March 2010 as a resource consent under Section 87(e) of the RMA. It is due to expire on 1 June 2024.

- Condition 1 sets out definitions.
- Condition 2 requires the consent holder to adopt the best practicable option to minimise any environmental effects.
- Conditions 3 and 4 require notification and the provision of information and analytical data prior to receipt of wastes on site for stockpiling, and prior to discharge.
- Condition 5 and 6 require the notification and the provision of information and analytical data, of which will be made available to the Council via report annually.
- Condition 7 states that the monitoring is now limited to area F3 and the associated monitoring bore network.
- Conditions 8 to 10 stipulate the manner and dispersal of wastes, while condition 11 requires a buffer zone between areas of disposal and surface water bodies and site boundaries.
- Conditions 12 to 14 specify further site management requirements.
- Conditions 15 to 20 specify receiving environment limits for both soil and water.
- Condition 21 concerns site surrender.
- Condition 22 is related to archaeological discovery.
- Conditions 23 and 24 concern lapse provisions and consent reviews.

The permit is attached to this report in Appendix I.

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

1.5. Monitoring programme

1.5.1. Introduction

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

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

The monitoring programme for the Oeo landfarm site consisted of three primary components.

1.5.2. Programme liaison and management

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

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

1.5.3. Site inspections

The Oeo site was inspected five times during the monitoring period, 1st July 2016-30th June 2017.

1.5.4. Chemical sampling

The Council collected soil and groundwater samples as part of the annual compliance monitoring program, specific to the Oeo Landfarm site.

In previous years the Rawa Stream, which is situated to the east of the site (Figure 1) would have also been sampled to ascertain for any potential adverse environmental effects. However it was omitted from this year's monitoring as the long term analysis of the Rawa indicated negligible impacts from the exercise of this consent.

Soil Sampling

In this period four soil samples were collected. These samples were the result of composite samples¹ which was composed of ten soil cores (Figure 2) inserted to a nominal depth of 400 mm below ground level (bgl). The ten soil cores would then be combined and analysed for the analytes in Table 2.

¹ This method is modified from the Guidelines for the Safe Application of Biosolids to land in NZ (2003)

Table 2 Soil analysis

Council soil analysis		Hill Laboratory Soil Analysis
Calcium	Magnesium	Total Petroleum Hydrocarbon
Chloride	Sodium	C ₇ -C ₉
Conductivity	Ammoniacal nitrogen	C ₁₀ -C ₁₄
Total Petroleum Hydrocarbon	Nitrite/Nitrate Nitrogen	C ₁₅ -C ₃₆
Potassium	pH	BTEX
Moisture factor	Sodium Adsorption Ratio (SAR)	Naphthalene
	Total Soluble Salts	Non-carc (Pyrene)
		Benzo (a) Pyrene



Figure 2 An example of an extracted soil core

Groundwater analysis

The Oeo site contains a groundwater monitoring network (Figure 4). This originally consisted of four monitoring bores. Two of the four bores were omitted from further analysis due to the long term record which detailed no adverse effects. The two remaining wells (GND2286 and 2287) were retained within the programme due to elevated results which required further monitoring or due to the potential for further elevation.

The analysis undertaken for the two monitored groundwater wells are provided in the following Table 3. Groundwater monitoring was undertaken through the use of a low-flow peristaltic pump, fitted to a Yellow Springs Instrument (YSi) flow cell to obtain field readings. Samples are collected once field parameters had stabilised over the course of a fifteen minute period or three well volumes had been removed.

Table 3 Groundwater analytes

Council Groundwater Analysis	
Chloride	pH
Conductivity	Temperature
Level	Sodium
Total Dissolved Salts	
Hill Laboratory Groundwater Analysis	
Total Petroleum Hydrocarbons	Benzene
C ₇ -C ₉	Toluene
C ₁₀ -C ₁₄	Ethylene
C ₁₅ -C ₃₆	Meta-Xylene
	Ortho-Xylene

2. Results

2.1. Inspections

21 July 2016

The inspection was conducted in conjunction with groundwater sampling in fine conditions with a light westerly wind.

Two groundwater bores, GND2286 and 2287 were sampled using a peristaltic pump. No odour, sheen or foaming was encountered in sampling GND2286. However, noticeable foaming and a strong hydrocarbon odour were encountered in GND2287 but no sheen.

At the time of the inspection the pasture establishment was described as satisfactory.

8 November 2016

At the time of inspection the following was observed. No recent disposal activities had occurred at this site and no storage pits were present. The spreading areas were observed to have good pasture cover across the majority of the site.

No muds were identified at the soil surface. The foreshore was inspected, no deleterious effects observed, water was observed discharging onto the beach, this was described as clear.

14 November 2016

The inspection was conducted in conjunction with groundwater sampling in fine, breezy conditions.

Two groundwater bores were sampled, a slight odour was noticeable and foaming encountered in GND2287, with flecks of iron oxide settling out of suspension. No odour, sheen or foaming in GND2286.

The spreading areas were revegetating well although there was some evidence of wind damage in certain areas. The paddocks had been recently re-fenced; as a consequence site access via the metal track was no longer possible.

27 January 2017

The inspection was conducted in conjunction with soil sampling in fine weather with a moderate south west wind.

Two soil transects were undertaken in the F3 spreading area. These two transects were collected to approx. 400 mm depth, through damp, dark grey/brown sands. Light grey drilling muds were encountered between 100-300 mm depth (below ground level (BGL)). A slight hydrocarbon odour was noticeable. The vegetation was patchy in places; poor rootlet development was observed in the soil column.

14 June 2017

At the time of inspection the following was observed. The wind was from the west with a light breeze. No objectionable odours or visible emissions were found during the inspection. No recent disposal activities had occurred and no storage pits were present at the site.

Historic spreading areas which were observed had good pasture cover across all areas and the pasture appeared healthy. Only a small patch of bare pasture in the most recent spreading area was found to have weathered drilling mud at the surface. The mud was described as moist and didn't break apart easily. No hydrocarbon odours were present. The foreshore was inspected, no deleterious effects were observed.

2.2. Results of discharge monitoring

The Company initiated landfarming at the Oeo Landfarm in September 2012 when Mangahewa D SBM was spread across area F1 (Figure 3). Seven additional areas were farmed between September 2012 and June 2013, these are detailed in Table 4.

Table 4 Landfarming application dates Oeo Landfarm

Area ID	Mud Type	Date farmed	Well name
F1	SBM	September 2012	Mangahewa D
F2	WBM/SBM/ CS/CS	November 2012	Mangahewa D, Mangahewa C Cheal B & C, Maui B Cheal A
F3	WBM/SBM/ CS/CS/WW	December 2012	Mangahewa D, Mangahewa C, Cheal B & C, Maui B, Cheal A
F4	WBM/SBM	March 2013	Mangahewa C9, Sidewinder 6A
F5	WBM/CW	April 2013	Mangahewa C12, Sidewinder 7A, STOS KA20A
F6	WBM/CW	April 2013	Mangahewa C12, Sidewinder 7A, KA20A
F7	WBM	April 2013	Mangahewa C12, Sidewinder 7A, KA19/20A
F8	WBM	June 2013	Mangahewa C12, Sidewinder 7A, KA19/20A
SBM: Synthetic based muds , WBM: Water based muds, CS: Contaminated soil, CW: Contaminated water WW: Well work over			

The last application of landfarmable material was completed in June 2013 as stated in the above Table 4. Since this date the Company had provided annually to the Council, analysis of the areas of the site which had been utilised for landfarming.

In the 2014-2015 monitoring period the Company lodged an application to change the conditions of consent 7613, to discharge drilling wastes consisting of drilling cuttings and drilling fluids from hydrocarbon exploration activities with water based muds and synthetic based muds, onto and into land via landfarming. Note this occurred on the 27 March 2015.

The application was to surrender the consent for the areas of the site that had met surrender criteria as stipulated by condition 19 of the consent. The consent remained active for the remaining area (F3) which had yet to meet the surrender conditions. Included in the change was the requirement to also continue monitoring specific groundwater monitoring wells.

Thus the consented area was limited to area F3 and two of the four monitoring wells (GND2287 and 2286). The analysis provided by the Company is provided in their appended annual report (appendix II).

2.2.1. Results of receiving environment monitoring

2.2.1.1. Council Soil Results

Four composite soil samples were collected from landfarmed area F3 this monitoring period. The results of the soil analysis are provided in the following Table 6 with the associated end point concentrations as defined by consent 7613-1.1 for target chemicals where applicable.

Table 5 Oeo Landfarm soil results area F3 2016-2017

Soil analysis area F3	Collected	Consent Limit	27 Jan 2017	27 Jan 2017	31 May 2017	31 May 2017
	Time		11:15	11:45	10:15	11:00
Conductivity	mS/m@20°C	290	90.3	190.7	22.7	122.1
pH	pH	-	7.9	7.7	6.9	7.6
Calcium	mg/kg	-	108.6	179	40.9	150.4
Chloride	mg/kg	700	176	62.5	11.1	60.8
TPH Total	mg/kg	-	1,450	185	146	874
Potassium	mg/kg	-	131.1	64.1	14.1	131.7
Dry Matter (Env)	g/100g as rcvd	-	90	92	89	85
Magnesium	mg/kg	-	9.2	11.7	5	11.1
Sodium	mg/kg	460	106.6	45.8	21.7	86.6
Ammoniacal Nitrogen	mgN/kg	-	1.58	1.75	2.15	3.11
Nitrite/nitrate nitrogen	mgN/kg	-	6.94	15.26	1.01	1.62
Sodium absorption ration (SAR)	None	18	2.63876	0.8957	0.85246	1.83615
Total soluble field salts	mg/kg	2,500	706.7	1,492.4	177.7	955.6
TPH C ₇ -C ₉	mg/kg dry wt	120	< 8	< 8	< 8	< 8
TPH C ₁₀ -C ₁₄	mg/kg dry wt	58	62	< 20	< 20	74
TPH C ₁₅ -C ₃₆	mg/kg dry wt	4,000	740	148	170	970
TPH C ₇ -C ₃₆	mg/kg dry wt	-	800	148	170	1040
Benzene	mg/kg dry wt	1.1	< 0.05	< 0.05	< 0.05	< 0.05
Toluene	mg/kg dry wt	68	< 0.05	< 0.05	< 0.05	< 0.05
Ethylbenzene	mg/kg dry wt	53	< 0.05	< 0.05	< 0.05	< 0.05
m&p-Xylene	mg/kg dry wt	48	< 0.10	< 0.10	< 0.10	< 0.10
o-Xylene	mg/kg dry wt	48	< 0.05	< 0.05	< 0.05	< 0.05
1-Methylnaphthalene	mg/kg dry wt	-	-	-	< 0.011	< 0.012
2-Methylnaphthalene	mg/kg dry wt	-	-	-	< 0.011	< 0.012
Acenaphthene	mg/kg dry wt	-	< 0.03	< 0.03	< 0.011	< 0.06
Anthracene	mg/kg dry wt	-	< 0.03	< 0.03	< 0.011	< 0.012
Acenaphthylene	mg/kg dry wt	-	< 0.03	< 0.03	< 0.011	< 0.012
Benzo[a]anthracene	mg/kg dry wt	-	< 0.03	< 0.03	< 0.011	< 0.012
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.027	< 0.03	< 0.03	< 0.011	< 0.012
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	-	< 0.03	< 0.03	< 0.011	< 0.012
Benzo[e]pyrene	mg/kg dry wt	-	-	-	< 0.011	0.022
Benzo[g,h,i]perylene	mg/kg dry wt	-	< 0.03	< 0.03	< 0.011	0.013

Soil analysis area F3	Collected	Consent	27 Jan 2017	27 Jan 2017	31 May 2017	31 May 2017
	Time	Limit	11:15	11:45	10:15	11:00
Benzo[k]fluoranthene	mg/kg dry wt	-	< 0.03	< 0.03	< 0.011	< 0.012
Chrysene	mg/kg dry wt	-	< 0.03	< 0.03	< 0.011	< 0.012
Dibenzo[a,h]anthracene	mg/kg dry wt	-	< 0.03	< 0.03	< 0.011	< 0.012
Fluoranthene	mg/kg dry wt	-	< 0.03	< 0.03	< 0.011	0.014
Fluorene	mg/kg dry wt	-	< 0.03	< 0.03	< 0.011	< 0.06
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	-	< 0.03	< 0.03	< 0.011	< 0.012
Naphthalene	mg/kg dry wt	7.2	< 0.12	< 0.13	< 0.06	< 0.06
Perylene	mg/kg dry wt	-	-	-	< 0.011	< 0.012
Phenanthrene	mg/kg dry wt	-	< 0.03	< 0.03	< 0.011	0.033
Pyrene	mg/kg dry wt	160	< 0.03	< 0.03	< 0.011	0.022
TPH: Total Petroleum Hydrocarbons						

The results will be compared to consent surrender concentrations where applicable:

- Soil conductivity concentrations ranged from 22.7-190.7 mS/m@20°C, note the surrender concentration is set at 290 mS/m@20°C, these four results were below this concentration.
- Chloride ranged from 11.1-176 mg/kg, the consented surrender concentration is set at 700 mg/kg, and these four results were below this concentration.
- Sodium ranged from 21.7-106.6 mg/kg, with the surrender concentration set at 460 mg/kg, these values were all below this concentration.
- Calcium ranged from 40.9-179 mg/kg.
- Potassium ranged from 14.1-131.7 mg/kg.
- Magnesium ranged from 5-11.7 mg/kg.
- Sodium absorption ratio ranged from 0.85-2.63 SAR, the limit is 18.
- Total soluble field salts ranged from 177-1,492 mg/kg, with the limit set at 2,500 mg/kg.
- Total Petroleum Hydrocarbons (TPH)
 - Carbon chain C₇-C₉ results were all below the limit of detection for this analyte in all four samples collected, the limit of detection set by the lab was >8 mg/kg. The surrender concentration for this analyte is set at 120 mg/kg and these results indicate compliance in this chain.
 - Carbon chain C₁₀-C₁₄ results indicated two results, 62 mg/kg in January 2017 and in May 2017, a value of 74 mg/kg. These two values exceeded the consent limit with respect to surrender. The surrender concentration for this analyte is set at 58 mg/kg, two of these sample concentrations were marginally above this value in this monitoring period, thus area F3 can not be considered for surrender at present. Note the other two sample results were below the limit of detection which is set at >20 mg/kg.
 - Carbon chain C₁₅-C₃₆ results indicated a range of 148-1,040 mg/kg, as this analyte was found in all four soil samples analysed. The specific surrender concentration is 4,000 mg/kg. All samples indicate compliance with surrender criteria for this chain.

- Benzene, toluene, ethylbenzene and xylenes (m, p and o) (BTEX) results were all below the limit of detection for this analyte with the limit of detection set at >0.05, >0.05, >0.05, >0.10 and >0.05 mg/kg respectively. Note the surrender concentrations are set at 1.1, 68, 53, 48 and 48 mg/kg for these analytes.
- Polycyclic aromatic hydrocarbons (PAH):
 - Benzo (a) pyrene (BaP) concentrations were below the limit of detection for this compound.
 - Naphthalene concentrations were similarly below the limit of detection.
 - Pyrene results returned one low value, 0.022 mg/kg, the consent limit is 160 mg/kg.

Total petroleum hydrocarbon chain C₁₀-C₁₄ is the only analyte which remains above the consented concentration with respect to surrender. The remaining analytes indicate compliance with the specific consented concentration.

The analyte (C₁₀-C₁₄) appeared to be reducing in the previous monitoring period, and the results from this monitoring period indicate the concentration continues to slowly reduce. During the 2015-2016 monitoring period the analysis indicated a reduction from 600 mg/kg C₁₀-C₁₄ in August 2015 to 380 mg/kg by June 2016.

2.2.1.2. Groundwater analysis

The two wells which were retained for further analysis were GND2286 and GND2287 respectively. These wells were sampled quarterly throughout the year to ascertain for seasonal variation within the groundwater of the site. The location of the wells is provided in Figure 4. The analysis is provided in the following Tables 6 and 7.

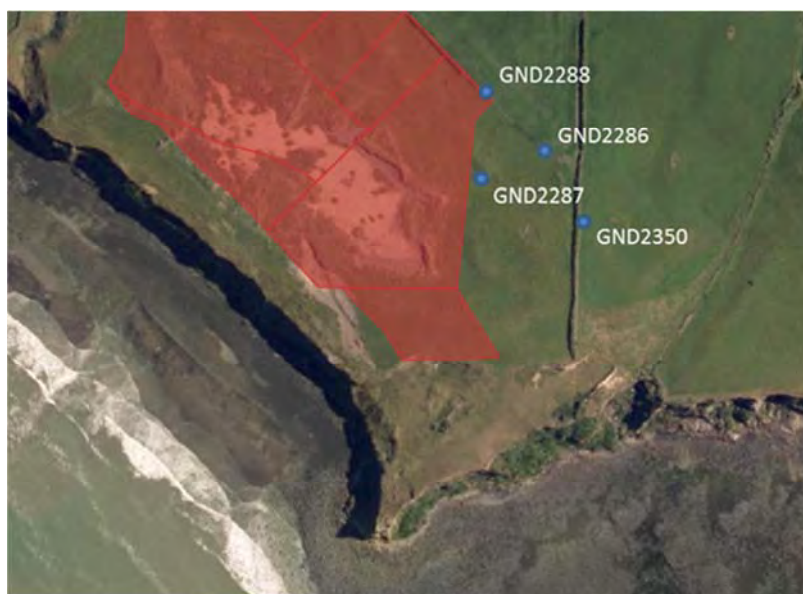


Figure 4 Groundwater monitoring well locations Oeo Landfarm

Table 6 GND2286 2016-2017 monitoring period

Site		GND2286	GND2286	GND2286	GND2286
		21 Jul 2016	14 Nov 2016	14 Mar 2017	31 May 2017
Parameter	Unit	12:50	10:50	11:30	12:25
Chloride	g/m ³	710	697	330	466
Conductivity	mS/m@20°C	239	215	126	195
Sodium	g/m ³	324	305	160	281
pH	pH	6.3	6.4	6.5	6.5
Water level	m	4.368	4.202	4.879	3.623
Temperature	°C	15.5	15.5	15.4	15.9
Total dissolved salts	g/m ³	1,849.2	1,663.5	974.9	1,508.7

Table 7 GND2287 2016-2017 monitoring period

	Site	GND2287	GND2287	GND2287	GND2287
	Collected	21 Jul 2016	14 Nov 2016	14 Mar 2017	31 May 2017
	Time	12:20	11:15	10:50	11:50
Chloride	g/m ³	510	287	746	109
Conductivity	mS/m@20°C	244	124	348	72.3
Sodium	g/m ³	439	228	677	126
pH	pH	6.8	6.7	6.8	6.7
Water Level	m	4.409	4.554	5.432	3.871
Temperature	°C	16	16.4	15.9	16.8
Benzene	g/m ³	<0.0010	< 0.0010	0.0022	< 0.0010
Toluene	g/m ³	<0.0010	< 0.0010	< 0.0010	< 0.0010
Ethylbenzene	g/m ³	<0.0010	< 0.0010	< 0.0010	< 0.0010
XYLENE-M	g/m ³	<0.002	< 0.002	< 0.002	< 0.002
XYLENE-O	g/m ³	<0.0010	< 0.0010	< 0.0010	< 0.0010
TPH C ₇ -C ₉	g/m ³	<0.10	< 0.10	< 0.10	< 0.06
TPH C ₁₀ -C ₁₄	g/m ³	<0.2	< 0.2	0.5	< 0.2
TPH C ₁₅ -C ₃₆	g/m ³	0.6	< 0.4	1.8	< 0.4
TPH C ₇ -C ₃₆	g/m ³	<0.7	< 0.7	2.4	< 0.7
Total dissolved salts	g/m ³	1,887.9	959.4	2,692.5	559.4

The results of the quarterly groundwater monitoring indicated the following:

- GND2287 is the impacted well in comparison to GND2286.
- GND2286 was originally retained for further analysis due to an increase in total dissolved salt (TDS) concentrations observed two monitoring periods prior to this period. This monitoring period indicated that the concentrations of TDS are now below the consented maximum of 2,500 g/m³ TDS.
- In this monitoring period the concentration of TDS within well GND2286 ranged from 974-1,849 g/m³ TDS.
- TDS in GND2287 ranged from 559-2,692 g/m³ TDS, note the limit is set at 2,500 g/m³ which indicated a minor breach in consent condition 15. Though of note, this concentration had reduced in the final monitoring round to its lowest concentration since monitoring began at this location in 2012, with a concentration of 559 g/m³ TDS (Figure 5).
- Chloride concentrations ranged 287-746 g/m³ in GND2287 while for GND2286 it ranged from 330-710 g/m³.
- Groundwater pH remained quite consistent in both wells; GND2286 pH 6.3-6.5, while for GND2287 was slightly higher at 6.7-6.8 pH.
- Groundwater temperature remained consistent throughout the year across both wells, ranging from 15.4-16.8°C.
- No analysis of petroleum hydrocarbon or related compounds were performed on well GND2286, due to the long term record indicating no marginal results above the limit of detection for these parameters. A spot check was undertaken at the end of the monitoring round in the previous monitoring period which indicated no results above the limit of detection.
- Analysis of benzene in GND2287 indicated one result above the limit of detection this monitoring period, 0.0022 g/m³ benzene was analysed. This is a reduction from the previous period where three results were found above the limit of detection, these ranged from 0.0011-0.0072 g/m³. Note this is a very low concentration.
- Ethylbenzene, toluene and xylene concentrations were all found to be below the limit of detection for these analytes, which is set at <0.0010 g/m³.
- Total petroleum hydrocarbons TPH:
 - Carbon chain C₇-C₉ results were below the limit of detection for this analyte.
 - Carbon chain C₁₀-C₁₄ results indicated a result of 0.5 g/m³ in the March round of sampling, note the limit of detection for this particular analyte is set at <0.2 g/m³.
 - Carbon chain C₁₅-C₃₆ was reported in two of four rounds this monitoring period, ranging from 0.6 g/m³ in July 2016 to 1.8 g/m³ in March 2017. Note this analyte was not detected, above the limit of detection in the final round of sampling, the limit of detection was set at >0.4 g/m³.
 - Carbon chain C₇-C₃₆, which is the sum of the three previous carbon chains indicated in the March 2017 a sample analysis value of 2.4 g/m³.
- The final groundwater monitoring round undertaken in May 2017 indicated no contaminants of concern with respect to monitoring well GND2287. The results were found to be below their conditional limit. TDS was sub 2,500 g/m³, no hydrocarbons or BTEX were found above the limit of detection for these analytes.

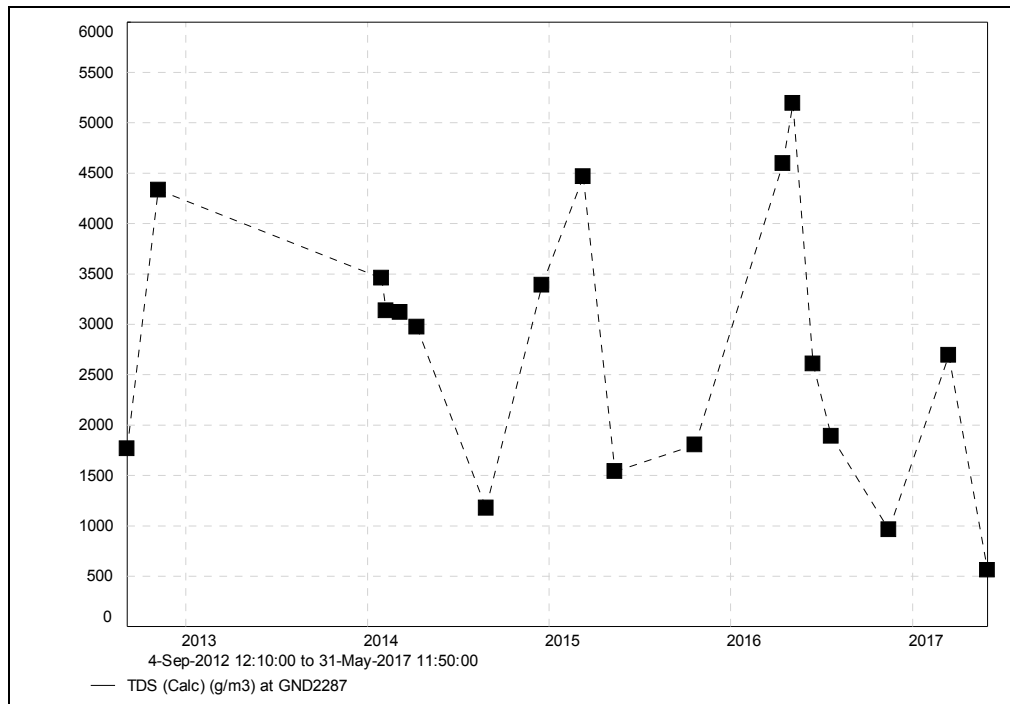


Figure 5 Long term TDS record GND2287 Oeo Landfarm 2012-2017

2.3. Investigations, interventions, and incidents

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

The Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The incident register 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 2016-2017 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans.

3. Discussion

3.1. Discussion of site performance

The Oeo Landfarm has been closed to the receipt of new material since the final application of landfarmable material was undertaken in June 2013. As it stands, one area (F3) which was landfarmed in September 2012, remained marginally over the specific surrender concentration with respect to mid range petroleum hydrocarbons.

The consent limit for surrender in respect mid range hydrocarbon C₁₀-C₁₄ is set at 58 mg/kg as defined by consent 7613-1.1 condition 20. Location F3's concentration was found to range between 60 -72 mg/kg C₁₀-C₁₄ in two of the four soil samples which were collected. In the other two soil samples (of the four collected) the results were below the limit of detection which would suggest slight variation across the area. This would confirm what has been observed (variation in soil samples) over the long term record of soil analysis with respect to area F3.

Re-vegetation was identified during inspections as being less than adequate in one location as it was described as bare or barren. The Council would encourage the consent holder to monitor this area and to revegetate it if required. This portion of Taranaki is quite exposed to elemental erosion which has affected other landfarms in the region over time.

3.2. Environmental effects of exercise of consents

The main environmental effect associated with the exercise of this consent related to localised groundwater impacts observed in the direct vicinity of where the storage cells had previously been located. The storage cells had been originally installed without specific liners, resulting in contaminants leaching to groundwater in the close vicinity. The impacts were limited to elevated saline impacts of total dissolved salts (for the most part), petroleum hydrocarbons and trace benzene which were observed in two of the four monitoring wells.

This occurred in the 2012-2013 monitoring year and has been observed to be slowly remediating since this date.

As previously discussed, GND2287 is the more impacted well when compared to the GND2286. GND2286 was retained for further monitoring post the successful partial surrender of the landfarm in October 2015, as the groundwater record denoted an increasing saline concentration at the time of assessment.

Monitoring indicated, post the successful partial surrender that GND2286 did not elevate above its conditional maximum of 2,500 g /m³ in this period. Petroleum analysis was not undertaken on this well in this period, as the long term record indicated levels below the limit of detection. This was further confirmed with a spot sample collected at the end of the last monitoring period.

In this monitoring period GND2287 indicated trace (very low) concentrations of TPH (C₁₀-C₁₄ and C₁₅-C₃₆) in two of the four monitoring rounds and benzene in one round undertaken this period. The results were lower when compared to the previous monitoring period and in the final round (May 2017) no results were analysed above the limit of detection for petroleum hydrocarbons or BTEX.

Surface water sampling of the Rawa Stream which runs on the eastern side of the facility was not undertaken this monitoring period. The long term record of analysis indicated negligible effects, thus it was omitted from further surface water monitoring.

Soil sampling had indicated that the final landfarming application area, F3, is close to its limit for surrender. The only parameter of concern with respect to surrender is the mid range petroleum hydrocarbon C₁₀-C₁₄.

The monitoring proposed for the upcoming monitoring period (2017-2018) will seek to confirm surrender soil criteria has been reached at the Oeo landfarm, in terms of the final landfarmed area, F3.

Groundwater analysis will continue to confirm TDS and trace hydrocarbons have remediated to below conditional maximums and specific background concentrations.

3.3. Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Table 8.

Table 8 Summary of performance consent 7613-1.1 2016-2017

Purpose: To discharge drilling material (consisting of drilling cuttings and drilling fluids) from hydrocarbon exploration activities 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	N/A	N/A
2. Best practicable option to be adopted	Inspections and liaison with consent holder	Yes
3. Notify TRC in writing prior to stockpiling	Notifications received	N/A
4. Notify TRC in writing prior to landfarming	Notifications received	N/A
5. Keep records relating to wastes, areas, compositions, volumes, dates, treatments and monitoring	Company records	Yes
6. Report on records in condition 5 to Council by 31 August each year	Report received, appendix II	Yes
7. Discharge depth limited to 100 mm for waste with hydrocarbons <5%, or 50 mm for waste with hydrocarbons >5%	Company records and inspection, no landfarming since June 2013	Yes
8. Incorporation into soil as soon as practicable so that top 250 mm layer contains less than 5% hydrocarbons	Inspection and sampling, no landfarming since June 2013	Yes
9. Single application of wastes to each area of land	Company records and inspection	Yes
10. No discharge within 25 m of a water body or property boundaries	Inspection, no landfarming since June 2013	Yes
11. Maximum volume of stockpiling 6,000 m ³ , discharge within 12 months of arrival on site	Company records and inspection, no landfarming since June 2013	N/A
12. Re-vegetate landfarmed areas as soon as practicable	Inspection indicated a barren patch which will require mitigation	For the most part
13. No destabilisation of neighbouring land	Inspection	Yes
14. Total dissolved salts in any fresh water body shall not exceed 2,500 g/m ³	Groundwater sampling indicated an exceedance of the limit in March 2017, though final monitoring round of the year indicated this concentration had reduced to below the limit	For the most part
15. Disposal of waste shall not lead to contaminants entering surface water or groundwater exceeding background concentrations	Sampling indicated trace values for TPH and benzene with elevated TDS in March round of groundwater, reduced to below the limit of detection for petroleum compounds and under TDS limit in June	No

Purpose: To discharge drilling material (consisting of drilling cuttings and drilling fluids) from hydrocarbon exploration activities 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?
16. Conductivity must be less than 400 mS/m. If background conductivity exceeds 400 mS/m, then increase shall not exceed 100 mS/m	Sampling	Yes
17. 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
18. Levels of metals in soil shall comply with guidelines	Sampling, spot check confirmed consent holder provided data in previous monitoring period 2015-2016	Yes
19. Prior to expiry/cancellation of consent these levels must not be exceeded: a. conductivity, 290 mSm-1 b. chloride, 700 g/m ³ c. dissolved salts, 2,500 g/m ³ d. sodium, 460 g/m ³	Sampling prior to surrender, limit 58 mg/kg, last sample 74 mg/kg C ₁₀ -C ₁₄	F3 still above surrender criteria in terms of mid range hydrocarbons Limit 58 mg/kg last sample 74 mg/kg C ₁₀ -C ₁₄
20. If condition 19 not met, consent cannot be surrendered	Sampling indicated mid range petroleum hydrocarbons still above surrender concentration of 58 mg/kg with a value of 74 mg/kg	N/A
21. Notification of discovery of archaeological remains	None found	N/A
22. Lapse condition	Inspection for evidence of exercise	N/A
23. Optional review provision re environmental effects	Next optional review June 2018	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		Good
Overall assessment of administrative performance in respect of this consent		High

Table 9 Evaluation of environmental performance over time

Year	Consent no	High	Good	Improvement req	Poor
2012-2013	7613-1			1	
2013-2014	7613-1		1		
2014-2015	7613-1.1		1		
2015-2016	7613-1.1		1		
Totals		0	3	1	0

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

3.4. Recommendations from the 2015-2016 Annual Report

In the 2015-2016 Annual Report, it was recommended:

1. That the monitoring of consented activities at the Oeo Landfarm in the 2016-2017 year continue at the same level as in 2015-2016. This was undertaken.

3.5. Alterations to monitoring programmes for 2017-2018

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

- the extent of information made available by previous authorities;
- its relevance under the RMA;
- its obligations to monitor emissions/discharges and effects under the RMA; and
- to report to the regional community.

The Council also takes into account the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki emitting to the atmosphere/discharging to the environment.

It is proposed that for 2017-2018 the monitoring of GND2286 be augmented to field readings, conductivity measurement, TDS and pH only, unless field observations suggest that additional analysis may be required. The analysis will remain unchanged for GND2287. Soil sampling will continue to confirm surrender criteria has been reached.

4. Recommendations

1. That the monitoring of consented activities at the Oeo Landfarm in the 2017-2018 year continue at the same level as in 2016-2017, for some minor changes to the monitoring of monitoring well GND2286.

Glossary of common terms and abbreviations

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

Al*	Aluminium.
As*	Arsenic.
Bund	A wall around a tank to contain its contents in the case of a leak.
Cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
Cu*	Copper.
Cumec	A volumetric measure of flow- 1 cubic metre per second (1 m ³ s ⁻¹).
DO	Dissolved oxygen.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
g/m ² /day	grams/metre ² /day.
g/m ³	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
Incident Register	The Incident Register contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
L/s	Litres per second.
m ²	Square Metres.
mS/m	Millisiemens per metre.
NH ₄	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH ₃	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO ₃	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
Pb*	Lead.

pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	<i>Resource Management Act 1991</i> and including all subsequent amendments.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
Zn*	Zinc.

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

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

Bibliography and references

BTW Company Ltd– Oeo Landfarm Annual Report – Consent 7613- 09389-2017.

BTW Company Ltd Annual report Special Condition 6 – Monitoring and reporting – Oeo landfarm annual report – Consent 7613- 09389-2016.

Cavanagh, J E, (2015) Land application of waste from oil and gas wells. Landcare Research. May 2015.

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

Ministry for the Environment and New Zealand Water and Wastes Association (2003): Guidelines for the safe application of biosolids to land in New Zealand.

Taranaki Regional Council (2016): *BTW Company Ltd Oeo Landfarm Monitoring Programme Annual Report 2015-2016*. Technical Report 2016-86.

Taranaki Regional Council (2015): *BTW Company Ltd Oeo Landfarm Monitoring Programme Annual Report 2014-2015*. Technical Report 2015-97.

Taranaki Regional Council (2014): *BTW Company Ltd Oeo Landfarm Monitoring Programme Annual Report 2013-2014*. Technical Report 2014-39.

Taranaki Regional Council (2013): *BTW Company Ltd Oeo Landfarm Monitoring Programme Annual Report 2012-2013*. Technical Report 2013-54.

Appendix I

Resource consents held by BTW Ltd

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

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

Name of
Consent Holder: BTW Company Limited
 PO Box 551
 New Plymouth 4340

Decision Date 13 October 2015
(Change):

Commencement Date 13 October 2015 (Granted Date: 23 March 2010)
(Change):

Conditions of Consent

Consent Granted: To discharge drilling wastes (consisting of drilling cuttings
 and drilling fluids) from hydrocarbon exploration activities
 with water based muds and synthetic based muds, onto and
 into land via landfarming

Expiry Date: 1 June 2024

Review Date(s): June 2018

Site Location: South Road, Manaia (Property owner: C & D Putt)

Legal Description: Lot 3 DP 8423 Sec 2 Pt Sec 1 Blk III Oeo SD
 (Discharge site)

Grid Reference (NZTM) 1684722E-5621595N

Catchment: Waimate

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

General condition

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

Special conditions

1. For the purposes of this consent the following definitions shall apply:
 - a) stockpiling means a discharge of drilling wastes from vehicles, tanks, or other containers onto land, but without subsequently spreading, or incorporating the discharged material into the soil within 24 hours; and
 - b) landfarming means the discharge of drilling wastes onto land, subsequent spreading and incorporation into the soil, 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) 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) at least 48 hours prior to landfarming stockpiled material. 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 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.

Consent 7613-1.1

5. The consent holder shall keep records of the following:
- a) wastes from each individual well;
 - b) composition of wastes (including concentrations of chloride, nitrogen and total petroleum hydrocarbons);
 - 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;
 - 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.

6. 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 5, for the period of the previous 1 July to 30 June.

Discharge limits

7. This consent only applies to area F3 and the associated groundwater monitoring bore network. Area F3, as shown in Figure 1, attached.
8. 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.

9. As soon as practicable following the application of drilling wastes to land in accordance with condition 8 of this consent, the consent holder shall incorporate the wastes into the soil to a depth of at least 250 mm, so that the hydrocarbon concentration at any point in the soil/waste mix is less than 50,000 mg/kg dry weight, anywhere in the 250 mm layer below the topsoil layer.
10. An area of land used for the landfarming of drilling wastes in accordance with conditions 8 and 9 of this consent, shall not be used for any subsequent discharges of drilling waste.
11. No discharge shall take place within 25 metres of surface water or property boundaries.

Operational requirements

12. The stockpiling of material authorised by this consent is limited to a maximum volume of 6000 cubic metres at any one time on the property. All stockpiled material must be landfarmed as soon as practicable, but no later than twelve months after being brought onto the site.
13. 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.
14. The exercise of this consent shall not result in the destabilisation of neighbouring land.

Receiving environment limits - water

15. The exercise of this consent shall not result in the concentration of total dissolved salts in any fresh water body exceeding 2500 g/m³.
16. 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.

Receiving environment limits - soil

17. 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.
18. 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.
19. The concentration of metals in the soil shall at all times comply with the guidelines for heavy metals in soil set out in Table 7.1, Section 7 of the Guidelines for the safe application of biosolids to land in New Zealand (Ministry for the Environment and New Zealand Water & Wastes Association, 2003).
20. From 1 March 2024 (three months prior to the consent expiry date), constituents in the soil shall not exceed the standards shown in the following table:

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

MAHs - benzene, toluene, ethylbenzene, xylenes

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

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

The requirement to meet these standards shall not apply if, before 1 March 2024, the consent holder applies for a new consent to replace this consent when it expires.

21. This consent can not be surrendered until the standards in condition 20 are being met.

Archaeological remains

22. 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, Taranaki Regional Council, has considered: tangata whenua interest and values, the consent holder's interests, the interest 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 authorisation or consent has been obtained.

Lapse and review

23. This consent shall lapse on 31 March 2015, 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.
24. 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 2012 and/or June 2018, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 13 October 2015

For and on behalf of
Taranaki Regional Council

A D McLay
Director - Resource Management

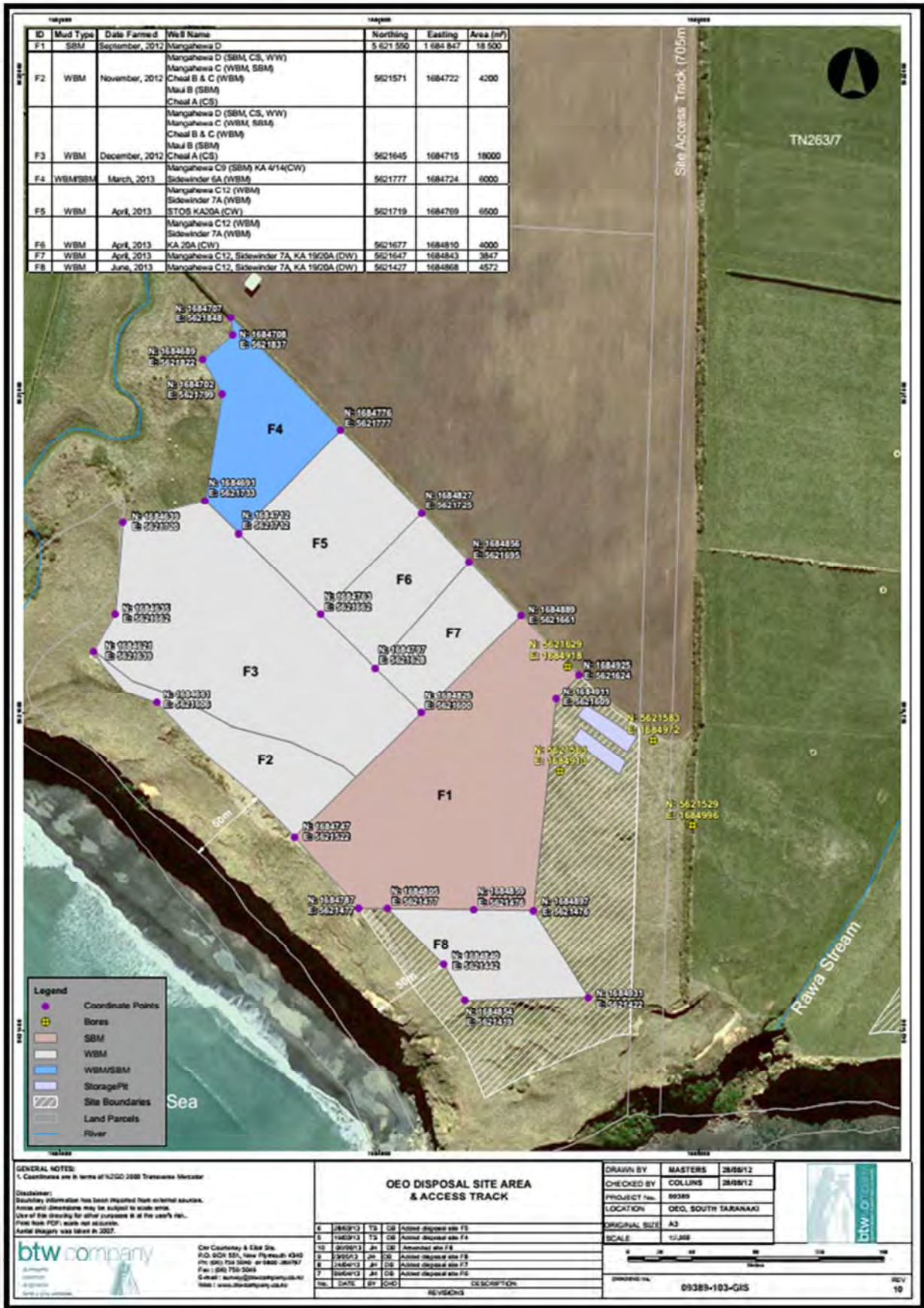


Figure 1 Oeo Site Map Drawing 09389-103-GIS

Appendix II

Annual report

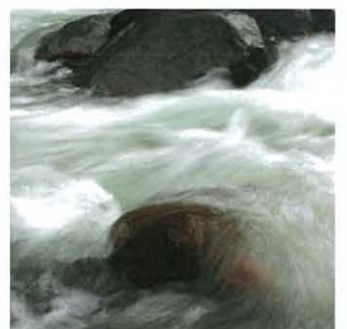
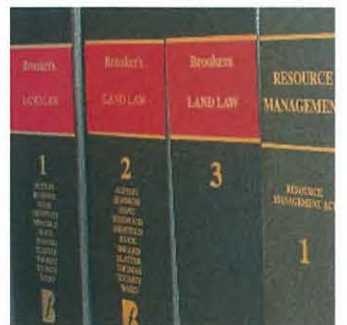
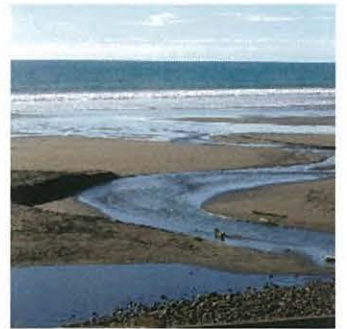
Annual Report

Special Condition 6 - Monitoring and Reporting

Oeo Land Farm Annual Report - Consent 7613

by *BTW Company*

btw company
surveyors . planners . engineers . land & g-i-s services



Oeo Land Farm Annual Report - Consent 7613 09389

Reviewed


Report Author



Dave Bolger
Senior Environmental Scientist

30/8/16
Date

Reviewed by



Cameron Twigley
Director, Planning and Environment

30/8/16
Date

09389
30/08/2016

CONTENTS

1	INTRODUCTION	2
1.1	Special Condition 6.....	2
1.2	July 2015 to June 2016 - Summary	2
1.3	Records required under Special Condition 5.....	3
1.4	Report Overview.....	3
2	MATERIAL STORAGE AND TREATMENT	5
2.1	Material Volumes.....	5
2.2	Sowing and Treatments.....	6
3	MONITORING INFORMATION	8
3.1	Monitoring.....	8
3.2	Sampling Locations	8
3.3	Methods	8
3.4	Inspection Notices	9
3.5	Infringement Notices.....	9
3.6	Abatement Notices	9
4	ANALYSIS OF RESULTS.....	10
4.1	Compliance with SC's 14 and 15	12
4.2	Compliance with SC's 16 - 20.....	12
4.2.1	Condition 16 – Soil Conductivity.....	12
4.2.2	Condition 17 – SAR	12
4.2.3	Condition 18 – Heavy Metals	12
4.2.4	Condition 19 and 20 – Constituent Closure Criteria.....	13
4.2.5	Chloride	13
4.2.6	Sodium	13
4.2.7	Dissolved Salts	13
4.2.8	TPH C7 – C9	14
4.2.9	TPH C10 – C14	14
4.2.10	TPH C15 – C36	14
5	SUMMARY.....	15
APPENDIX A	COMPOSITION OF WASTE	16
APPENDIX B	SITE MAP	17
APPENDIX C	PHOTOGRAPHIC RECORD OF LANDFARMING.....	18

1 INTRODUCTION

1.1 Special Condition 6

In accordance with Special Condition 6 (SC6) of resource consent 7613-1 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 5 (SC5), for the period of the previous 1 July to 30 June.

This report therefore includes all information related to activities provided for under consent 7613-1 from 1 July 2015 to 30 June 2016 as well as monitoring required under SC 14-20.

1.2 July 2015 to June 2016 - Summary

The site was completely decommissioned during the monitoring period (2013-14). Therefore no new material has been taken to the site during this monitoring period and no areas were landfarmed during this monitoring period.

In general the pasture establishment has been excellent across the site, especially considering the exposed nature of the site. The only area to demonstrate patchy vegetation establishment was the F3 area. It has been identified in the past the F3 area had higher levels of hydrocarbons and a significant iron pan runs through this section which also creates difficult conditions such as ponding for pasture establishment.

Some further remediation work of the F3 area did take place during the monitoring year, with some additional clean fill brought onto the site to assist with pasture establishment and reduce any potential sand blow outs over the site. A new strike of pasture has just taken place and it is considered the site should have comprehensive vegetation cover by the end of spring.

All soil and surface water sampling has ceased at the site as surrender criteria has been met by the consent holder.

A significant number of the native plants that were planted along the coastal buffer zone and the Waimate stream edge have survived. It is considered over time the establishment of these native species will provide some natural habitat and protection from the harsh elements at this location; this is seen as a positive along this section of coast. Refer to figure 2.2 for a photograph of the coastal planting.

1.3 Records required under Special Condition 5

The consent holder shall keep records of the following:

- a) wastes from each individual well;*

composition of waste (including concentrations of chloride, nitrogen and total petroleum hydrocarbons)

- b) stockpiling area(s);*
- c) volume of material stored;*
- d) landfarming areas, including a map showing individual disposal area with GPS co-ordinates;*
- e) volumes and weight of wastes landfarmed;*
- f) dates of commencement and completion of storage and landfarming events;*
- g) dates of sowing landfarming areas;*
- h) treatment applied;*
- i) 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 Special Condition (SC)6 of consent 7613-1. Information is supplied generally in the order as requested within SC5 a-j.

- Records required under SC 5 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 stored on well sites.

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 SC5 c), e) & g). This includes:
 - *stockpiling Area's;*
 - *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 SC5 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 of disposal which has been 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 SC5, condition j.
 - Section 4 provides the results of analysis as required by SC5, condition j. Special Conditions 14-20 of Consent 7613-1 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 SC5 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

No new material was disposed of or stockpiled during the monitoring year. The site was totally decommissioned during the monitoring period 2013-14.

Historical volumes of material landfarmed can be ascertained in previous annual monitoring reports and also on the site map provided in Appendix B.

2.2 Sowing and Treatments

Additional clean fill was added in the F3 area to assist with pasture established. Once the clean fill was added further sowing has taken place. As of 15-8-16 there was a good pasture strike in these isolated areas of F3. It is considered by the middle of spring the whole site should have excellent pasture cover.



Figure 2.1: F3 Area, additional clean fill, reworked and re sown, 15-8-16



Figure 2.2: Coastal Planting 15-8-16

3 MONITORING INFORMATION

The following section provides the details of soil and surface monitoring, including sampling locations and sampling methodology.

3.1 Monitoring

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 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.

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 areas landfarmed meet soil surrender criteria. No further soil sampling will take place by the consent holder as the soil surrender criterion has been met as demonstrated in section 4 of this report.

All past receiving environment samples were tested by Hill Laboratories and sampling methodology is in accordance with the TRC landfarm sampling procedures.

In the past the consent holder has monitored the Rawa Stream. The monitoring of the Rawa Stream ceased during the previous monitoring year due to no adverse effect recorded from the past landfarming activity.

3.2 Sampling Locations

Specific land farmed areas are located through the use of a GPS navigational system. These co-ordinates are contained within the "Oeo Landfarm Area and Track Access" plan (Appendix B) which shows areas of disposal and is updated following landfarming events. A central point is located within each area and a composite sample retrieved in a transect line from the central point. The line direction is dependent on the underlying orientation of the landfarmed material.

3.3 Methods

Sampling involves collecting a composite of 5 sub-samples along a transect line from the central GPS point on the specific landfarmed area. Typically, samples are retrieved from an approximate depth of 250mm but this can vary depending on the location of the drilling mud layer.

Once the 5 sub samples have been collected the soil is mixed together and the appropriate sampling containers are filled and sent to Hill Laboratories for testing for specific constituents as required by the consent.

The sampling methodology is consistent with the TRC methodology. The goal is to achieve a representative sample of each specific landfarmed area. As the actual level of constituents is known in the materials to be landfarmed via the pre disposal sampling, it is considered this methodology provides a representative sample of the material once mixed (power harrowed into the soil) on the land farming area, and also gives data on constituent levels within the top 250mm of the soil profile, which in essence is for the protection of human and livestock health.

3.4 **Inspection Notices**

All routine site inspections by TRC compliance officers have found activities on the site to **comply** with conditions of consent 7942-1.

3.5 **Infringement Notices**

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.

4 ANALYSIS OF RESULTS

The following Table 4.1 provides a summary of the monitoring results undertaken for the Oeo Landfarm during the reporting period. Please note we have provided the complete sampling results from the initial soil sampling at the site, we believe this is useful to observe trends of constituent breakdowns over time at the site. Analysis of the results of monitoring are required by SC5, condition j. Special Conditions 14-20 of Consent 7613-1 are also addressed in this section.

We have colour coded table 4.1 for ease of quick interpretation. Green indicates that the level of a specific constituent meets consent surrender criteria, and red indicates that surrender criteria has not been met yet. As demonstrated in table 4.1 all areas now have met the surrender criteria from the consent holder.

We note no further soil sampling was undertaken by the consent holder during the monitoring period, however the TRC still sample the F3 area for completeness to demonstrate surrender criteria had been met.

Analysis of the monitoring results is undertaken over the following Sections 4.1 and 4.2, with a summary proved in Section 5.

		Consent Surrender limit meet		Consent Surrender limit not meet																			TPH							
	Date	Soil conductivity <290m Sm-1 (see Consent if PD is greater than 400)	SAR <18	Total Soluble salts 2500 mg/kg	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 mg/kg	Chloride 700 mg/kg	Sodium 460 mg/kg	Material				
F1	26/10/2012	1450	18	9560	<0.05	<0.05	<0.05	<0.1	<0.14	0.04	<0.03	2	<0.1	7	13	6.7	<0.1	5	43	12	5100	11000	0.08	930			SBM			
	3/04/2013	1040	10.5	6840	<0.05	<0.05	<0.05	<0.1	<0.12	<0.03	<0.03	<2	<0.1	9	13	5.5	<0.1	6	45	8	1000	4600	0.14	660	808					
	4/07/2013	310	5.9	2060	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	8	14	3.8	<0.10	6	37	8	770	2800	0.11	280	227					
	15/11/2013		130	4.3	851	<0.05	<0.05	<0.05	<0.10	<0.13	<0.03	<0.03	<2	0.12		9	14	3.2	<0.10		6	44	8	61	470	2		82	111	
	11/04/2014					<0.05	<0.05	<0.05	<0.10	<0.13	<0.03	<0.03									8	20	210							
F2	15/01/2013	550	11.7	3640	<0.05	0.05	<0.05	<0.1	<0.14	<0.03	<0.03	2	0.1	8	24	3.6	<0.1	4	49	8	20	40	0.17	290	612	WBM				
	3/04/2013	710	12.4	4690	<0.05	<0.05	<0.05	<0.1	<0.12	<0.03	<0.03	<2	<0.1	7	17	2.6	<0.1	4	39	8	38	520	0.15	450	829					
	4/07/2013	50	4	337	<0.05	<0.05	<0.05	<0.05	<0.14	<0.03	<0.03	<2	0.11		11	16	2.5	<0.10	6	39	9	20	40	15	62		66			
F3	15/01/2013	750	9.9	4920																						708	SBM			
	3/04/2013	1310	22.8	8660	<0.05	<0.05	<0.05	<0.1	<0.13	0.15	<0.03	<2	<0.1	11	19	4.6	<0.1	7	47	8	2400	10200	0.12	940	1587					
	4/07/2013	180	4.2	1221	<0.05	<0.05	<0.05	<0.05	<0.14	0.06	<0.03	2	0.14	12	23	4	<0.10	8	42	9	450	2800	0.17	220	166					
	15/11/2013		360	7.8	2380	<0.05	<0.05	<0.05	<0.05	<0.05	0.12	<0.03	<2	0.14		10	19	4.6	<0.10		7	49	8	900	6100	1		360	363	
	11/04/2014				<0.05	<0.05	<0.05	<0.05	<0.14	<0.03	<0.03										9	620	2800							
	9/10/2014				<0.05	<0.05	<0.05	<0.05	<0.13	0.05	<0.03										8	590	3700							
	23/02/2015			180																	8	151	1990							
	23/02/2015			190																	8	131	1800							
F4	4/07/2013	120	2.6	779	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	0.16	8	13	2.5	<0.10	6	46	8	23	189	0.23	59	88	WBM/SBM				
	17/01/2014	150	2.6	970	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	0.15	9	14	2.9	<0.10	5	46	8	270	1390	1	72	112					
	11/04/2014				<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03									8	20	40								
F5	4/07/2013	200	4.6	1320	<0.06	<0.06	<0.06	<0.11	<0.14	<0.03	<0.03	<2	0.13	9	14	3.1	<0.10	6	46	9	250	1010	0.2	165	195	WBM				
	15/11/2013		130	5.4	858	<0.05	<0.05	<0.05	<0.10	<0.13	<0.03	<0.03	<2	0.2		10	15	2.4	<0.10		5	54	8	97	510		6	117	151	
	11/04/2014				<0.05	<0.05	<0.05	<0.10	<0.13	<0.03	<0.03										8	20	86							
F6	16/07/2013	50	2.1	343	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	0.12	7	11	1.8	<0.10	4	38	8	20	131	22	22	42	WBM				
	17/01/2014	20	1	138	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	0.13	9	14	2	<0.10	5	49	8	153	650	1	8	17					
	2/05/2014				<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03									8	20	40								
F7	16/07/2013	70	2.6	436	<0.05	<0.05	<0.05	<0.05	<0.13	<0.03	<0.03	<2	0.11	7	12	1.7	<0.10	4	40	8	68	370	0.13	39	58	WBM				
	17/01/2014	80	3.8	521	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	8	13	1.8	<0.01	5	50	8	83	610	1	51	83					
	2/05/2014				<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03									8	20	40								
F8	25/09/2013	70	3.2	462	<0.05	<0.05	<0.05	<0.05	<0.14	<0.03	<0.03	<2	0.17	10	16	2.9	<0.10	6	52	<9	420	1470		79	71	WBM				
	17/01/2014	70	2.9	449	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	2	0.17	9	16	2.6	<0.10	5	50	8	20	119	9	34	67					
	2/05/2014				<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03									9	20	40								

Table 4.1: Monitoring Results from Oeo Landfarm

4.1 Compliance with SC's 14 and 15

Conditions 14-15 require:

14. The exercise of this consent shall not result in the concentration of total dissolved salts in any fresh water body exceeding 2500 g/m³

15. 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.

Sampling of the Rawa Stream ceased the last monitoring period, due to no adverse effects from the activity on the stream since the start of the operation. The Rawa stream is some distance from the landfarming site and old stock piling area. The TRC continue to sample two groundwater monitoring bores on the site.

4.2 Compliance with SC's 16 - 20

4.2.1 Condition 16 – Soil Conductivity

For the monitoring period all landfarmed area's demonstrated compliance with consent conditions and meet surrender criteria, as demonstrated in table 4.1 above.

Area/s not within consent surrender limits: **None**

4.2.2 Condition 17 – SAR

Condition 17 requires:

17. 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.

As shown in table 4.1 above, all the landfarmed areas are within the surrender criteria for the consent.

Area/s not within consent surrender limits: **None**

4.2.3 Condition 18 – Heavy Metals

Condition 18 requires:

18. The concentration of metals in the soil shall at all times comply with the guidelines for heavy metals in soil set out in Table 7.1, Section 7 of the Ministry 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 Table 4.1, all metal concentrations are compliant with Table 7.1, Section 7 of 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).

4.2.4 Condition 19 and 20 – Constituent Closure Criteria

Condition 19 requires:

19. From 1 March 2024 (Three months prior to the consent expiry date), constituents in the soil shall not exceed the standards shown in the following table:

Table 4.2: 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 (C₇-C₉, C₁₀-C₁₄, and C₁₅-C₃₆).

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.

20. This consent may not be surrendered at any time until the standards in condition 19 are being met.

The monitoring data of these constituent surrender levels has been met as demonstrated in table 4.1 above. These guideline values are still considered the most appropriate values to protect livestock and public health.

4.2.5 Chloride

As shown in table 4.1 above, all landfarmed areas meet consent surrender criteria for Chloride.

4.2.6 Sodium

As shown in table 4.1, consent surrender requirements for Sodium have been reached for all monitored areas of the landfarm.

4.2.7 Dissolved Salts

As shown in table 4.1, consent surrender requirements for Dissolved Salts have been reached for all monitored areas of the landfarm

4.2.8 TPH C7 – C9

As shown in table 4.1, all results for TPH C7-C9 at the Oeo landfarm were within the consent surrender limits for all areas.

4.2.9 TPH C10 – C14

As shown in table 4.1, all landfarmed areas meet surrender limits. Further remediation work within the F3 area during the monitoring period, would have likely helped further reduce constituent levels within the F3 area.

4.2.10 TPH C15 – C36

Table 4.1 above shows results for TPH C15-C36 for all sites. All areas are now within the surrender criteria for the consent.

5 SUMMARY

For the monitoring period the site was only monitored by TRC. The site has continued to demonstrate the reduction of hydrocarbons in the soil as the bioremediation process continues. Further mixing of clean fill in the F3 area and re sowing of the site has had excellent results in establishing pasture and reducing sand erosion over the site.

The areas that have been landfarmed have only ever shown background levels of heavy metals as demonstrated in the comprehensive suite of sampling of heavy metals at the site over time.

It is worth noting the surrender criterion on the consent is a stringent standard to meet. These guidelines are set by the Ministry for the Environment to ensure constituents in the soil are at a level that poses negligible risk to agricultural activities, this includes pathways such as ingestion by stock. This standard is more stringent than what is required for a residential landuse scenario.

As demonstrated in the consent holder's comprehensive suite of soil sampling at the site, all constituents required to be tested as part of the consent conditions have now met consent surrender criteria. The site has been partially surrendered in the past, however from recently sampling it is expected the site will be completely surrendered during the next monitoring year.

APPENDIX A COMPOSITION OF WASTE

WBM – TYPICAL CHEMICALS

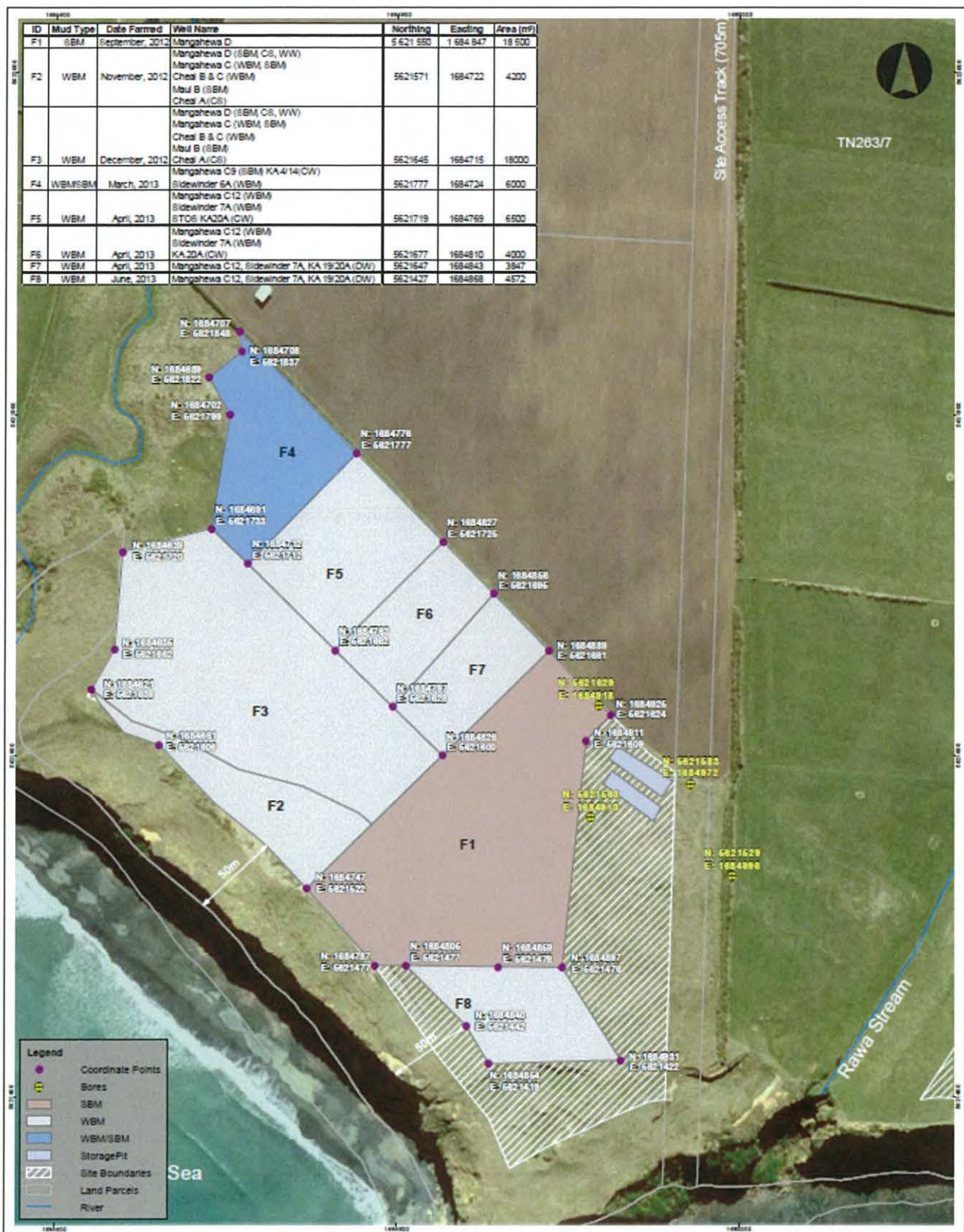
Table 1: Typical Chemicals used in Drilling

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 amines	Corrosion Inhibitor	Liquid
Phosphate ester salt	Corrosion Inhibitor	Liquid
Sodium Silicate (Cementing)	Lost circulation material	Solid
Calcium Chloride (cementing)	Inhibitor	Solid

APPENDIX B SITE MAP



APPENDIX C PHOTOGRAPHIC RECORD OF LANDFARMING



November 2014 Pasture establishment