BTW Company Limited
Brown Road-Wellington Landfarm
Monitoring Programme
2013-2014

Technical Report 2014-66

ISSN: 0144-8184 (Print)
ISSN: 1178-1467 (Online)
Document: 1413791 (Word)
Document: 1438548 (Pdf)

Taranaki Regional Council
Private Bag 713
STRATFORD

February 2015

Executive summary

This report describes the monitoring programme implemented by the Taranaki Regional Council (the Council) for the period July 2013 – June 2014 to assess BTW Company Limited's landfarming facility located on Brown Road at Waitara, in the Waiongana catchment. The report records the landfarm's environmental performance during the period under review, and the results and environmental effects of the Company's activities for the landfarm as a whole.

The Company holds two resource consents, which include a total of 55 conditions setting out the requirements that the Company must satisfy. The Company holds consent 6867-1 to allow it to discharge drilling waste consisting of water-based and synthetic based muds and cuttings and oily waste into land, and consent 7884-1 to discharge drilling and production wastes (as above but also including produced water and well workover fluids) into land via the process of landfarming. The Company held a third consent, 7670-1, which was surrendered in the previous monitoring period as surrender criteria had been met and the consented activities had been superseded by consent 7884-1. Disposal activity at the site ceased at the beginning of the monitoring period, and the site continues to be actively managed until remediation is complete and the consents expire or are surrendered.

Overall, the Company demonstrated a high level of environmental performance in respect of consent 6867-1, and a good level of environmental performance in respect of consent 7884-1.

The Council's monitoring programme for the year under review included seven scheduled inspections, three other inspections, 12 composite soil samples, 18 groundwater samples and eight surface water samples collected for physicochemical analysis, a four-site marine ecology survey of the intertidal area adjacent to the site, and review of Company supplied results.

The monitoring showed that contaminant concentrations in the soil were generally low, but that groundwater at the site remains partially impacted by the previous period's activities. By comparison with previous years, the monitoring indicated a substantial improvement in site operations and consent compliance, however, some of this improvement is due to the reduced level of site activity. The Company have worked well in managing the site and no Unauthorised Incidents (UIs) were recorded in respect of this consent holder during the period under review.

During the year, the Company demonstrated a high level of environmental performance with resource consent 6867-1, and a good level of environmental performance for consent 7884-1. While elevated concentrations of salt and benzene are still present in groundwater within the area consented under 7884-1, these concentrations are the consequence of activities in the previous period and are reducing. Further, there is no groundwater abstraction for use in the vicinity, and no evidence of effects off-site. Given the absence of environmental consequences and the legacy nature of the situation, it is deemed appropriate to categorise the performance of 7884-1 as 'good' rather than 'improvement required'.

Administrative performance was high for both consents.

For reference, in the 2013-2014 year, 60% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental

performance and compliance with their consents, while another 29% demonstrated a good level of environmental performance and compliance with their consents.

This report includes recommendation for the 2014-2015 year.

Table of contents

List of tables

List of figures

List of photos

1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is the Annual Report for the period July 2013-June 2014 by the Taranaki Regional Council (the Council) describing the monitoring programme associated with the resource consents held by BTW Company Limited (BTW), to operate a drilling and production waste landfarm situated on Brown Road at Waitara. This is the sixth Report to be prepared by the Council to cover the Company's discharges and their effects at this site. The site was extended in 2010-2011, and this is the third report to cover the activities at the expanded facility.

There has been a landfarm on Brown Road for several years. The original development of the facility ('Brown Road landfarm') was no longer used for the disposal of drilling waste since prior to the period under review. Stockpiling at this part of the site commenced in April 2006, and disposals in this area ceased in May 2011. During the 2010-2011 monitoring year, BTW were granted resource consent to expand operations into a second area to the immediate east of the original property. This second development was referred to as the 'Wellington' site, after the property owner, to distinguish it from the activities at the site as first established. The 'Wellington' part of the facilities became the primary disposal site in the 2010-2011 monitoring year, while BTW continued to jointly manage both the original area and the area subsequently developed, in accordance with the applicable consents.

During 2011-2012, the Council required BTW to apply for an additional resource consent to explicitly provide for the disposal of well work-over and production fluids, including hydraulic fracturing return fluids, in the newer area. This consent was granted on 8 July 2011. The landfarm extension was utilised for the remainder of the monitoring period to dispose of several different types of hydrocarbon exploration and production waste, in accordance with the latest consent. The initial consent for the Wellington area was subsequently surrendered during the 2011-2012 monitoring year as surrender criteria were deemed to have been satisfied, and all further activities were covered under the new consent.

Activity at the Wellington part of the site ceased during the 2013-2014 monitoring period. Monitoring of the site will continue until the consents are either successfully surrendered or expire, at which time contaminant levels in the soils must be within limits specified in the Ministry for the Environment's 'Guidelines for assessing and managing petroleum hydrocarbon contaminated sites in New Zealand' (MfE, 1999) and 'Guidelines for the safe application of biosolids to land' (MfE, 2003).

1.1.2 Structure of this report

Section 1 of this report is a background section. It sets out general information about compliance monitoring under the RMA and the Council's obligations and general approach to monitoring sites though annual programmes, the resource consents held by BTW, the nature of the monitoring programmes in place for the period under

review, and a description of the activities and operations conducted at the Company's landfarm.

Section 2 presents the results of monitoring during the period under review, including scientific and technical data, for the activities covered under consent 6867-1.

Section 3 presents the results of monitoring during the period under review, including scientific and technical data, for the activities covered under consent 7884-1.

Section 4 discusses the results, their interpretations, and their significance for the environment.

Section 5 presents recommendations to be implemented in the 2014-2015 monitoring year.

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

1.1.3 The Resource Management Act 1991 and monitoring

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

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

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

1.1.4 Evaluation of environmental and consent performance

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

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

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

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

Environmental Performance

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

- **Good** Likely or actual adverse effects of activities on the receiving environment were negligible or minor at most. There were some such issues noted during monitoring, from self reports, or in response to unauthorised incident reports, but these items were not critical, and follow-up inspections showed they have been dealt with. These minor issues were resolved positively, co-operatively, and quickly. The Council was not obliged to issue any abatement notices or infringement notices in relation to the minor non-compliant effects; however abatement notices may have been issued to mitigate an identified potential for an environmental effect to occur.

  For example:

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

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

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

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

1.2 Process description

1.2.1 Hydrocarbon exploration and production wastes management

For the purposes of disposal to land, waste from the petroleum industry can be divided into two broad categories; exploration (drilling) wastes, and production wastes.

1.2.1.1 Exploration Wastes

Drilling wastes

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 are normally recovered from return flows during the drilling of a well, for re-use after separation from rock cuttings. They may be intentionally discharged in bulk for changes to the drilling fluid programme or at the completion of drilling. Depending on operational requirements and fluid type and properties, fluids may be re-used in multiple wells.

Cuttings

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

1.2.1.2 Production wastes

Produced water

Produced water is subsurface water brought to the surface with oil and gas during the production of a well. It is primarily highly saline water, but its chemistry is altered through direct contact with geological formations and hydrocarbon reservoirs. The physical and chemical properties of produced water vary considerably depending on the geographic location of the field, geological formations, and the type of hydrocarbon product being produced.

Produced water is typically disposed of using deep well injection or similar disposal methods, but fixed quantities have on occasion been disposed of to land following evaluation of chemical concentrations and using different application methodologies.

Fracturing return fluids

Water and sand (proppant) make up 98% to 99.5% of the fluid used in hydraulic fracturing. In addition, chemical additives are used. The exact formulation varies depending on the well. Chemicals serve many functions in hydraulic fracturing. From

limiting the growth of bacteria to preventing corrosion of the well casing, chemicals are needed to ensure that the fracturing job is effective and efficient.

The number of chemical additives used in a typical fracture treatment depends on the conditions of the specific well being fractured. A typical fracture treatment will use very low concentrations of between 3 and 12 additive chemicals, depending on the characteristics of the water and the tight sand/shale formations being fractured. Each component serves a specific, engineered purpose. For example, the predominant fluids currently being used for fracture treatments in the gas shale plays are water-based fracturing fluids mixed with friction-reducing additives (called slickwater). The addition of friction reducers allows fracturing fluids and sand, or other solid materials called proppants, to be pumped to the target zone at a higher rate and reduced pressure than if water alone were used.

In addition to friction reducers, other additives include: biocides to prevent microorganism growth which can interfere with the gel management system, and to reduce biofouling of the fractures and the production of sour gas; oxygen scavengers and other stabilisers to prevent corrosion of metal pipes; and sometimes used acids that are used to remove drilling mud damage within the near-wellbore area. These fluids are used to create the fractures in the formation and to carry a propping agent (typically silica sand), which is deposited in the induced fractures to keep them from closing up.

The fracturing fluids disposed of to land through landfarming in Taranaki have been return fluids following the completion of hydraulic fracturing jobs. The make-up of these fluids is altered during the fracturing process as these fluids interact with hydrocarbon reservoirs and varying geological formations. This material is tested for an extensive range of contaminants prior to storage and subsequent disposal.

Fracturing fluids are disposed of in Taranaki via deep well re-injection. The discharge to land through landfarming of return fluids following the completion of hydraulic fracturing jobs in Taranaki has been explicitly consented only at the Wellington area of the Brown Road landfarm

1.2.2 Landfarming process description

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. Landfarming is a technology that uses natural and assisted bioremediation to reduce the concentration of petroleum compounds through degradation, while simultaneously utilising the drilling muds to stabilise poor quality sandy soils for subsequent land use.

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).

Photo 1 Recently landfarmed area, Wellington Brown Road landfarm 2013

The landfarming process utilised at the Brown Road facility is on a single application basis. This means dedicated spreading areas receive only single applications of waste. Basic steps in the landfarming process include:

1. Waste is transported from wellsites. 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 levelling 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, to re-instate and stabilise the site for future alternative use.

Consent 6867-1 allows for the disposal of drilling wastes. Oily wastes were added in the changes to the consent on 4 February 2010.

Consent 7884-1 allows for the disposal of drilling wastes, oily wastes, contaminated soil, and production fluids including hydraulic fracturing return fluids.

When disposal is complete, the area will be re-instated and the consents surrendered once proven to be suitable for uses such as grazing, following stabilisation and re-grassing.

1.2.3 Site description

The landfarm is located on Brown Road, Waitara. The area first used, is located on the property of Papawai Holdings Limited. The extension onto the adjoining Wellington property is to the immediate east. Both areas are identified in Figure 1. These areas are located on marginal coastal farm land situated on reworked dune fields. The predominant soil type has been identified as black loamy sand. Vegetation growth is primarily a mixture of pasture and dune grasses. Prior to the Wellington property consents (7670-1, 7884-1) being exercised there were areas of pine which have been subsequently removed and processed.

Average annual rainfall for the site is 1383mm (taken from nearby Motunui monitoring station). There are no significant surface water bodies located in the immediate vicinity of the areas that are landfarmed, other than small farm drains. Previous land use at the Wellington section of the landfarm has been a mixture of agriculture and small scale forestry. Further inland there are a number of commercial chicken sheds; one is located on the site (Figure 1).

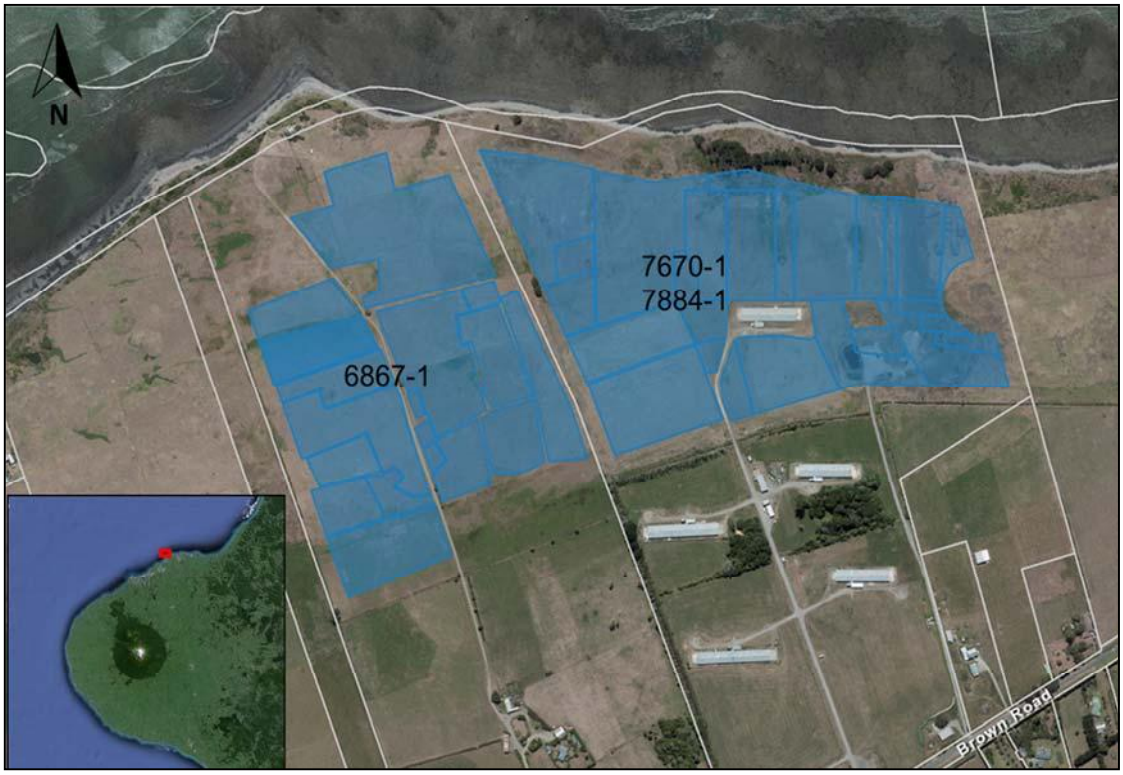


Figure 1 Aerial photograph showing the layout of the landfarming facilities on Brown Road, Waitara, and approximate regional location (inset)

Site data

Location

Word descriptor:	Brown Road, Waitara, Taranaki
Map reference:	E 1704599
(NZTM)	N 5683484
Mean annual rainfall:	1383 mm
Mean annual soil temperature:	~14.05°C
Mean annual soil moisture:	~33.06%
Elevation:	~10 m asl
Geomorphic position:	Dune backslope
Erosion / deposition:	Erosion
Vegetation:	Pasture, dune grasses
Parent material:	Aeolian deposit
Drainage class:	Free / well draining
Land use:	Active disposal (previously forestry)

Table 1 Bore construction data

Bore	*Depth (m)*	*Drilling Formation*
GND2282	0.00 – 0.50	Sandy topsoil
	0.50 – 2.50	Med – Hard sticky sandy clay
	2.50 – 10.00	Silty light brown peat
GND2283	0.00 – 0.50	Sandy topsoil
	0.50 – 2.50	Soft wet sands
	2.50 – 5.00	Soft silty light brown sandy mudstone
	5.00 – 10.00	Sandy soft peat
GND2284	0.00 – 0.50	Sandy topsoil
	0.50 – 2.00	Soft wet sands
	2.00 – 5.00	Soft silty light brown sandy mudstone
	5.00 – 10.00	Sandy soft peat
GND2285	0.00 – 0.50	Sandy topsoil
	0.50 – 2.00	Soft sandy clay
	2.00 – 5.00	Soft silty light brown sandy mudstone
	5.00 – 10.00	Sandy soft peat

1.3 Resource consents

1.3.1 Discharges of wastes to land

Sections 15(1)(b) and (d) of the Resource Management Act 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.

BTW holds discharge permit **6867-1** to cover the discharge of drilling cuttings, muds and fluids from hydrocarbon exploration drilling operations with water based muds, and drilling cuttings from hydrocarbon exploration drilling operations with synthetic based muds, onto and into land via land farming. This permit was issued by the Council on 27 April 2006 under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2020.

Discharge permit **6867-1** was varied on 4 February 2010 to include the following changes:

- allow mixing of different waste types,
- remove the chloride and nitrogen loading limits and consequently reduce the maximum application thickness from 150 mm to 100 mm,
- reduce the buffer distance to the Tasman Sea from 100 m to 50 m,
- increase the maximum stockpiled volume from 2,000 m^3 to 6,000 m^3, and
- allow for the disposal of oily wastes,

The varied consent now outlines the discharge of drilling wastes [consisting of drilling cuttings and drilling fluids] from hydrocarbon exploration activities with water based muds and synthetic based muds, and oily wastes from hydrocarbon exploration and production activities, onto and into land via landfarming.

Condition 1 sets out definitions.

Condition 2 concerns adoption of the best practicable option.

Condition 3 requires a management plan.

Conditions 4 and 5 relate to notification and sampling requirements prior to discharge.

Conditions 6 and 7 relate to monitoring and reporting.

Conditions 8 to 14 specify discharge limits.

Conditions 15 to 23 specify receiving environment limits.

Conditions 24 and 25 concern archaeological remains and consent review.

The permit is attached to this report in Appendix I.

BTW held discharge permit **7670-1** to cover the discharge of wastes from hydrocarbon exploration drilling operations with water based muds and synthetic based muds, and oily wastes from hydrocarbon exploration and production activities, onto and into land via land farming. This permit was issued by the Council on 9 July 2010 under Section 87(e) of the Resource Management Act. This consent was superseded by consent 7884-1 during the 2011-2012 monitoring year, and was subsequently surrendered by BTW on 3 August 2012.

BTW holds discharge permit **7884-1** to cover the discharge of wastes from hydrocarbon exploration drilling operations with water based muds and synthetic based muds, and oily wastes from hydrocarbon exploration and production activities, condensate storage tank wastewater, and well work-over fluids (which includes fracturing fluids) onto and into land via land farming. This permit was issued by the Council on 8 July 2011 under Section 87(e) of the Resource Management Act. It is due to expire on 1 June 2027.

There are 30 special conditions attached to the consent.

Conditions 1 to 3 deal with definitions, best practicable option and wastes to be discharged.

Conditions 4 to 8 deal with notifications, monitoring and reporting.

Conditions 9 to 11 relate to storage of wastes.

Conditions 12 to 20 deal with discharge limits.

Conditions 21 and 22 set limits on contaminants in receiving waters.

Conditions 23 to 27 deal with contaminants in soil.

Condition 28 relates to any archaeological remains found.

Conditions 29 and 30 deal with lapse and review of the consent.

A copy of the permit is attached in Appendix I.

1.4 Monitoring programme

1.4.1 Introduction

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

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

The monitoring programme for the Brown Road site consisted of five primary components.

1.4.2 Programme liaison and management

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

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

1.4.3 Site inspections

The Wellington part of the site was visited 6 times during the monitoring period, and the original Brown Road section was inspected once. As aforementioned, the original site is no longer operational, so the main points of interest were the on-going effects upon soil quality and pasture cover. The Wellington part of the site ceased operations at the beginning of the monitoring period, so inspections initially focussed on effects of stockpiling and landfarming (including pit capacity and liner integrity, and potential effects of spreading including ponding and buffer distances). Once the site had closed, inspections focussed on effects on soil quality and pasture establishment, and on the artificial drainage and potential offsite effects along the shoreline on the seaward side of the site.

The immediate area around the entire facility was surveyed for environmental effects including any odours.

1.4.4 Chemical sampling

Six composite soil samples from the Brown Road part of the site and six soil samples from the Wellington part of the site were collected for analysis during the monitoring period. The methodology utilised was compositing 10-15 soil cores (250 mm depth) taken at 10 m intervals along transects through spreading areas. These were analysed for chloride, conductivity, hydrocarbons, pH, sodium absorption ratio (SAR), sodium and total soluble salts.

On two occasions in the monitoring year, samples of surface water were collected upstream and downstream of the storage pits located on the Wellington property. These were analysed for barium, chloride, conductivity, hydrocarbons, pH, and total dissolved salts.

A total of 18 groundwater samples were taken from four monitoring bores during the monitoring period. All samples were analysed for pH, conductivity, TPH and BTEX, chloride, barium, and total dissolved solids. On one occasion, following on from incidents in the previous monitoring period, the samples were analysed for a wider suite of parameters including those specifically associated with hydraulic fracturing such as methanol, ethylene glycol and formaldehyde.

Three water samples were taken from the perforated pipes running through the site, and one sample was taken of a natural groundwater seep onto the beach. These samples were analysed for the same parameters as the other water samples.

1.4.5 Review of analytical results

The Council reviewed soil sampling results and the Company's supplied annual report, and the surrender of consent proposal report provided by the Company during the monitoring period.

The Company are required to sample all areas spread at temporal intervals which are specified in the consent. These samples were sent to an independent IANZ accredited laboratory for analysis for a wider range of contaminants. Chemical parameters tested were (all solid/sludge samples):

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

Receiving environment soil samples were also tested for electrical conductivity and SAR.

Liquid and oily waste predisposal samples were analysed for additional contaminants.

1.4.6 Marine ecological surveys

One marine ecological survey was carried out at four survey locations (3 potential impact and 1 control locations) during the monitoring period in order to assess any impacts on the shoreline caused by landfarming activities.

2. Results – Consent 6867-1

2.1 Inspections

One scheduled compliance inspection was undertaken of the original Brown Road part of the site during the monitoring period. This is discussed below.

9 June 2014

The following was found to be occurring: no objectionable odours or visible emissions were found during the inspection. No recent disposal activities had occurred at the site. Pasture cover was complete across areas where muds had been spread, and the pasture appeared healthy. No muds were identified within the soil profile. All ponded water around the paddocks was free of hydrocarbon sheen.

Photo 2 Brown Road landfarm former spreading areas looking towards the Wellington area 2014

2.2 Provision of Company data

BTW provided receiving environment soil sample data as part of their application to surrender consent 6867-1. They supplied summary data for all areas for all years, as well as results from two transects sampled during the monitoring year. The two transects ran the length of the site and were taken from either side of the access track (as shown in Figure 2). The results are presented in Table 2.

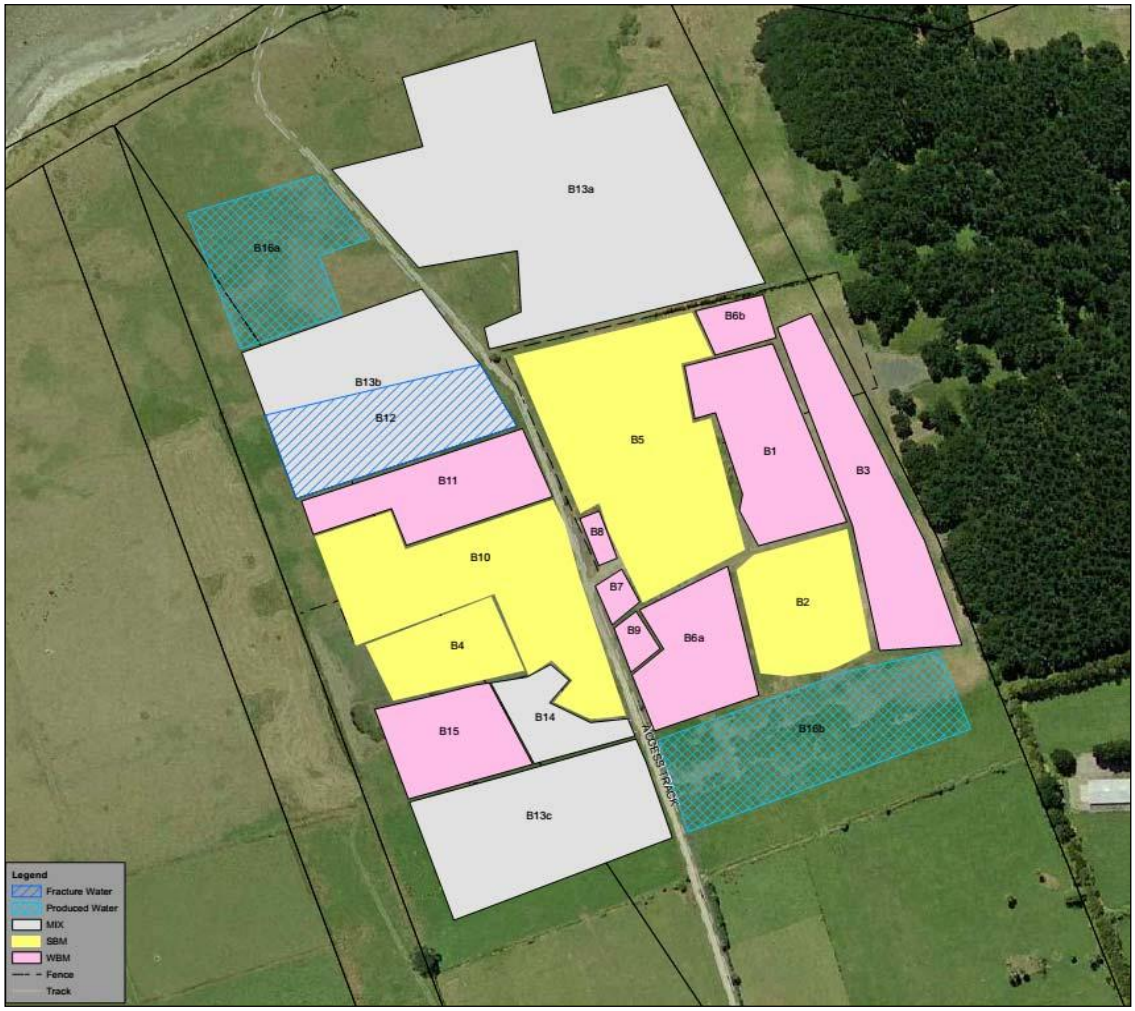


Figure 2 Brown Road original site completed landfarm areas B1-B16

Table 2 BTW supplied results, transects 1 and 2, Brown Road landfarm

Parameter	Unit	*Consent Limit*	T1	T2
Benzene	mg/kg	*1.1*	<0.05	<0.05
Toluene	mg/kg	*68*	<0.05	<0.05
Ethylbenzene	mg/kg	*53*	<0.05	<0.05
m & p Xylene	mg/kg	*48*	<0.10	<0.10
o Xylene	mg/kg	*48*	<0.05	<0.05
Benzo(a)pyrene (BAP)	mg/kg	*0.027*	<0.03	<0.03
Naphthalene	mg/kg	*7.2*	<0.14	<0.13
Pyrene	mg/kg	*160*	<0.03	<0.03
Total hydrocarbons	mg/kg	-	<70	167
C7-C9	mg/kg	*120.0*	<8	<8
C10-C14	mg/kg	*58*	<20	<20
C15-C36	mg/kg	*4000*	<40	167
Arsenic	mg/kg	*20*	3	4
Cadmium	mg/kg	*1*	<0.1	0.1
Chromium	mg/kg	*600*	11	11
Copper	mg/kg	*100*	17	19
Lead	mg/kg	*300*	3.4	2.6
Mercury	mg/kg	*1*	<0.10	<0.10
Nickel	mg/kg	*60*	5	4

Parameter	Unit	*Consent Limit*	T1	T2
Zinc	mg/kg	*300*	57	56
Barium*	mg/kg	*10000*	1130	870
Chloride	mg/kg	*700*	13	13
Conductivity	mSm-1	*290*	30	30
Sodium	mg/kg	*460*	20	23
Soluble salts	mg/kg	*2500*	184	198
Sodium absorption ratio	-	*18*	1.1	1.3

Their results showed compliance with all surrender criteria, heavy metals, salts and hydrocarbon concentrations were low in both composite samples. However, there was a Council taken sample result from October 2013 (transect 4 encompassing areas B10, B14 and B15, Figure 3, Table 4) that was shown to be outside of the surrender limit for one hydrocarbon fraction. The Company were given the Council GPS coordinates for the transect in question, and subsequently resampled this in May 2014. Their results are presented in Table 3.

Table 3 BTW supplied results for areas B10-B14-B15 'Transect 4', May 2014

Parameter	Unit	*Consent Limit*	Transect 4a	Transect 4b
Benzene	mg/kg	*1.1*	<0.05	<0.06
Toluene	mg/kg	*68*	<0.05	<0.06
Ethylbenzene	mg/kg	*53*	<0.05	<0.06
m & p Xylene	mg/kg	*48*	<0.03	<0.10
o Xylene	mg/kg	*48*	<0.03	<0.05
Benzo(a)pyrene (BAP)	mg/kg	*0.027*	<0.03	<0.03
Naphthalene	mg/kg	*7.2*	<0.14	<0.14
Pyrene	mg/kg	*160*	<0.03	<0.03
Total hydrocarbons	mg/kg	-	119	<70
C7-C9	mg/kg	*120.0*	<8	<9
C10-C14	mg/kg	*58*	<20	<20
C15-C36	mg/kg	*4000*	119	48

The May repeat sample results showed compliance with surrender criteria, which is consistent with Council sampling undertaken in June 2014 (Table 4, Section 2.3.1, below).

2.3 Results of receiving environment monitoring

2.3.1 Council soil results

During the monitoring year, six composite soil samples were collected by sub-sampling along transects at 10 m intervals to a depth of 250mm in completed spreading areas B10, B5, B13, B12, B14, B15, B16, B2 and B3 (Figure 3). The results are presented below in Table 4. The Company was looking to surrender consent 6867-1, having met surrender criteria in their own results for all areas. Council sampling was undertaken to confirm their results, and also as there were two older Council results (2010-2011 period) that had suggested surrender criteria had not been fully met in those areas.

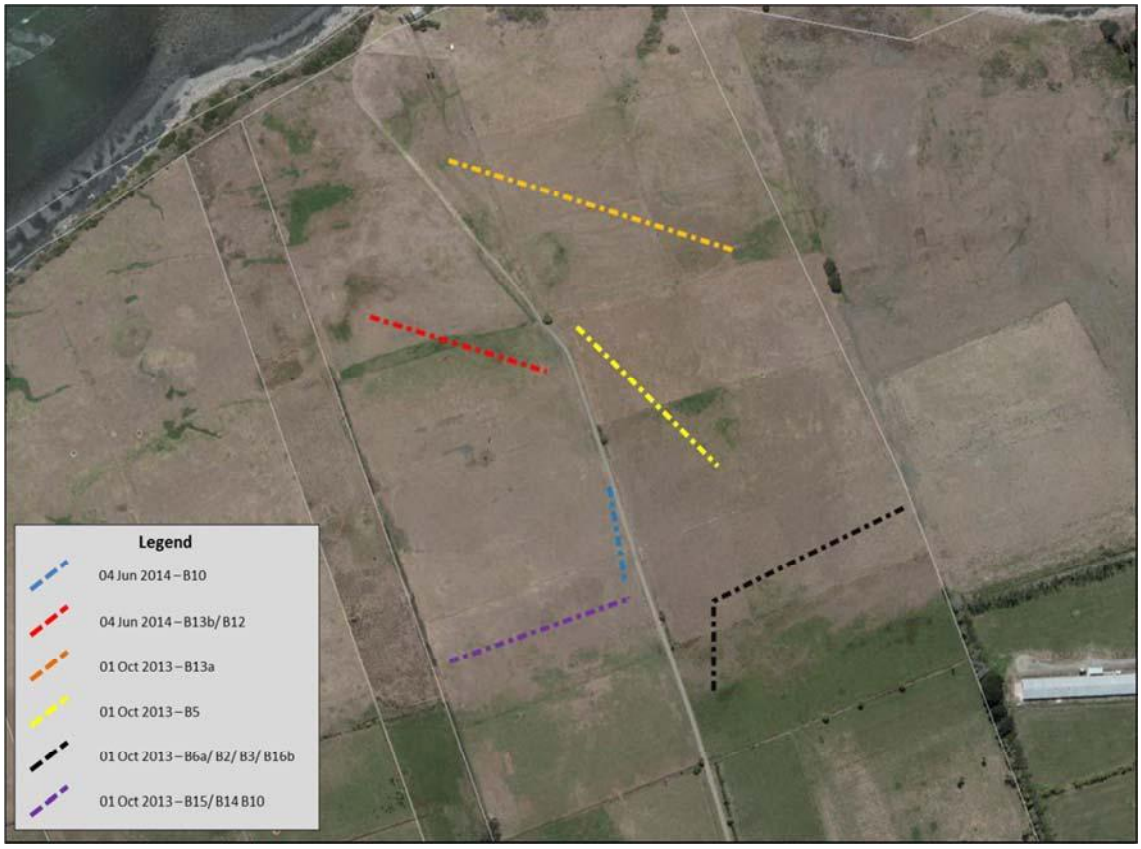


Figure 3 Soil sampling transects Brown Road landfarm 2013-2014

Table 4 Council soil sample results, Brown Road original site 2013-2014

Parameter	Unit	01 Oct 2013 *B13a*	01 Oct 2013 *B5*	01 Oct 2013 *B6a-B2-B3-B16b*	01 Oct 2013 *B15-B14-B10*	03 Jun 2014 *B10*	04 Jun 2014 *B13b-B12*
Calcium	mg/kg	126	33.5	21.4	217	-	-
Chloride	mg/kg DW	30.5	23.6	27.4	45.4	-	-
Conductivity	mS/m@20C	52.5	15.6	15.9	93.8	-	-
Hydrocarbons	mg/kg DW	169	<70	<70	1200	<70	73
C7-C9	g/m³	< 9	< 9	< 8	< 8	<8	<8
C10-C14	g/m³	<20	<20	<20	290	<20	<20
C15-C36	g/m³	169	< 40	< 40	910	50	73
pH	pH	6.9	6.8	6.4	7.5	-	-
Sodium absorption ratio	-	0.93	0.57	0.71	0.59	-	-
Sodium	mg/kg	41.4	14.8	14.2	33.2	-	-
Magnesium	mg/kg	15	10.2	5.4	14.6	-	-
Moisture factor	-	1.122	1.092	1.072	1.108	-	-
Total soluble salts	mg/kg	410.9	122.1	124.4	734.1	-	-

The soil sample taken in October 2013 from the transect that ran through areas B15, B14 and B10 returned a hydrocarbon result that was in excess of the surrender criteria for the C10-C14 hydrocarbon fraction (limit is 58 mg/kg). The Company was advised that the consent could not be surrendered at that point in time. Analysis of previous supplied and Council soil results indicated that areas B10 and B13 had initially had

high hydrocarbon concentrations, and Council results for area B10 (sampled previously in 2010) did not show compliance with surrender criteria.

B10 was resampled in June 2014 and found to be compliant with surrender criteria. BTW were supplied with the GPS coordinates for the Council transects and resampled the B15-14-10 transect on 14 May 2014. Their results are presented in Table 3, Section 2.2.

2.4 Investigations, interventions, and incidents

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

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

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

In the 2013-2014 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with BTW's conditions in resource consents or provisions in Regional Plans for the original Brown Road part of the site under resource consent 6867-1.

3. Results – Consent 7884-1

3.1 Inspections

Six scheduled compliance inspections were undertaken of the Wellington part of the site during the monitoring period. A further three inspections were undertaken in conjunction with environmental sampling. These are discussed below. One inspection was conducted as part of investigative sampling; this is discussed in Section 3.6.

4 July 2013

The following was found to be occurring: no objectionable odours or visible emissions were detected during the inspection. A re-inspection was undertaken to assess compliance with abatement notices 12030 and 12031 (issued during the previous monitoring period). The inspection found that that no perforated pipe ends were visible at the surface or observed to be discharging from the spreading areas and no overland flow was observed to be leaving the site. A concrete riser had been installed within the spreading area and it appeared that a buried perforated pipe was running from the chicken shed and discharging into the riser. Another perforated pipe led shoreward from the riser, but the end of this pipe was not visible. A sample was taken from water in the riser to assess whether contaminants are being conveyed through the pipe in that area. The shoreline was inspected; all groundwater seeps onto the beach were clear with natural iron oxide present. No detrimental effects were observed on the beach or reef.

14 October 2013

The following was found to be occurring: no objectionable emissions or odours were found during the inspection. The entire site had been reinstated and re-sown; the contouring looked good, very little mud was identified except in the small areas where pasture strike was patchy. Clover and other dune plants were also present. The concrete riser within the spreading area had been removed and no buried pipe ends were observed. The shoreward side of the spreading area had water seeping through soil face which was ponding below. The water was clear and free of hydrocarbon odour and naturally occurring iron oxide sheen was present. No overland flow was observed leaving the area and all surrounding grasses appeared healthy. The shoreline was inspected and no effects from site activities were observed.

22 October 2013

Soil sampling was conducted in areas F8, F9 and F12. Area F12 was found to have bare patches where pasture failed to establish. Sawdust and very strong hydrocarbon odours were also present in this area when the soil was disturbed. An additional sample was taken and sent to R J Hill Laboratories.

7 February 2014

The following was found to be occurring: no recent disposal activities had occurred and no storage pits were present. Areas where muds had been spread were showing varying degrees of pasture strike. The vegetation cover was essentially complete across all areas, but the eastern side had more clover and lupin than pasture. No perforated pipes were visible and no water was discharging from the spreading areas. The muds which had migrated to the surface were well weathered and broke apart easily. The shoreline was inspected and no effects from site activities were found.

25 February 2014
A brief site inspection was conducted in conjunction with groundwater monitoring at the Wellington part of the site. There had been no recent activity at this site. The pit area reinstatement was complete, and the site had re-vegetated with a mixture of pasture, scrub and gorse. The cover was patchy in places and dried out from recent dry weather. Otherwise the site looked good. Groundwater samples were turbid and two had hydrocarbon odours. Bore GND2283 did not have enough water for a full sample to be taken. Perforated pipe '4' was inspected and sampled, it was flowing at around 0.5 L/sec, lots of iron oxide was present and an organic odour was noted, but no hydrocarbons were detected in the discharge.

1 April 2014
The following was found to be occurring: no recent disposal activities had occurred at the site. Pasture cover was good across the majority of the spreading area with some small bare patches noted. The exposed soil appeared stable and any cuttings and/or muds present at surface were difficult to identify and weathering well. No water discharges from the spreading area were occurring onto the foreshore. The shoreline was inspected and no detrimental effects identified.

23 April 2014
The site was briefly inspected in conjunction with sampling of replacement groundwater bore GND2283. The bore had been replaced as the original bore had partially in-filled with sand. The sample was clear but a very slight hydrocarbon odour was detected. In general the site looked good, but there were still patches where pasture had not taken. Perforated pipe '4' was inspected and was discharging at about 0.5 L/sec, but the discharge was clear and odourless.

9 June 2014
The following was found to be occurring: the shoreline was inspected and no effects from site activities were found. All water seeps from the embankment to the foreshore were found to have mineral sheen and orange staining. No recent disposals had occurred. The topsoil remained stable throughout the site. No hydrocarbon odours were noted. Some test pits were dug and only small amounts of muds were identified within the soil profile.

24 June 2014
The following was found to be occurring: no objectionable odours or visible emissions were found during the inspection. The small areas that remained bare of pasture were stable. No recent disposals had occurred at the site. A pile of cuttings/gravel remained present at the historical pit location. Some cuttings had migrated to surface at the eastern end of the site, as had some pieces of liner material. Muds were well dispersed within the soil profile and no hydrocarbon odours were detected in the soil. There was a minor groundwater seep discharge below the spreading area at the north-eastern end of the site. This water had an iron mineral sheen and was soaking away in a boggy area. The surrounding vegetation appeared healthy. The shoreline was inspected and no effects from site activities were found.

The following action was taken: the consent holder was to advise the Council of their planned disposal operation for the stockpiled gravel material at site entrance/historical pit area. The Company advised that this was clean soil and metal intended for use at a different site.

3.2 Results of discharge monitoring

There were four disposals during the monitoring period of approximately 1350 m^3 of waste either stockpiled from the previous monitoring year or landfarmed directly on receipt at site. This material consisted of contaminated soil from the KA3 and KA6 wellsites, synthetic based mud and cuttings from Mangahewa C9 and 15 m^3 of well workover fluids from Mangahewa C9. The waste was spread at the 100 mm rate over an area of approximately 1.8273 Ha (areas F20-23, bottom right corner, Figure 4).

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

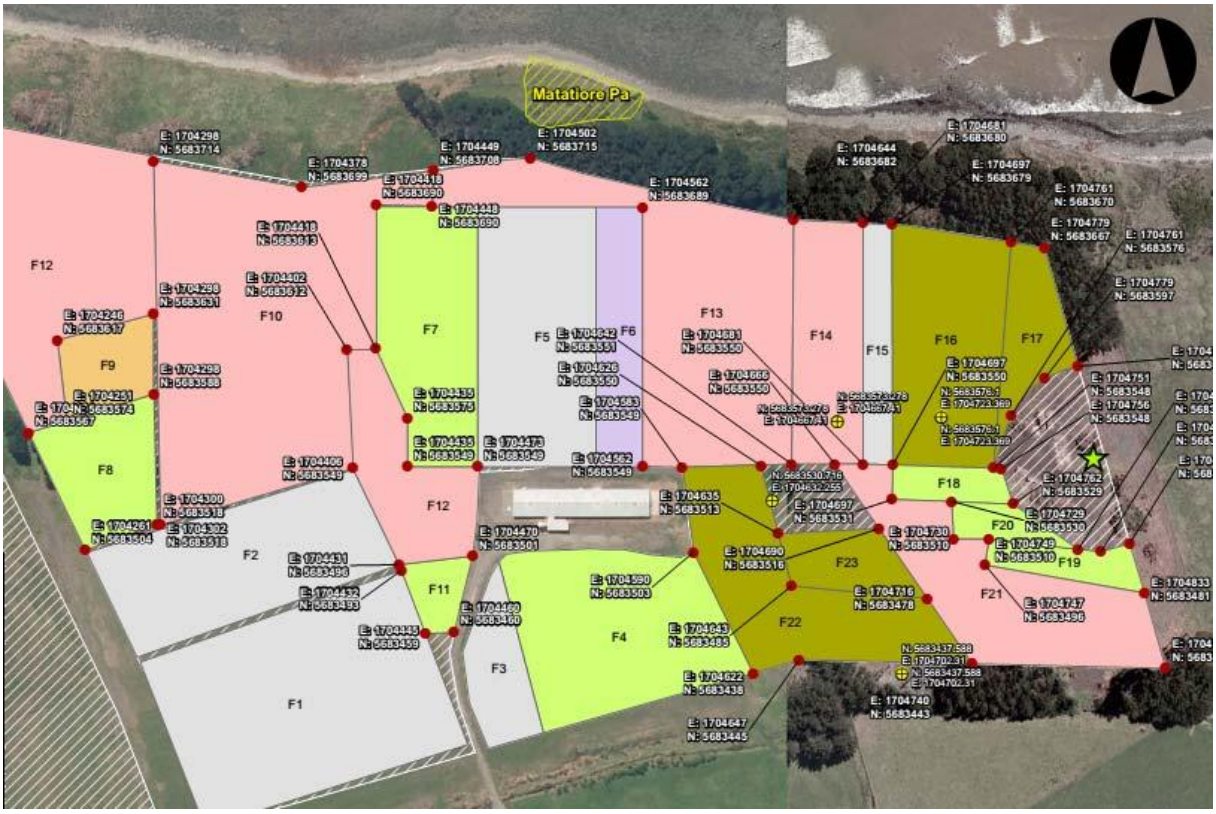


Figure 4 Brown Road Wellington landfarm completed spreading areas F1-F23

3.3 Results of receiving environment monitoring

3.3.1 Council soil results

During the monitoring year, six composite soil samples were collected by sub-sampling along transects at 10 m intervals to a depth of 250mm in completed spreading areas F8, F9, F12 and F17-F22 (Figure 5). The results are presented below in Table 5.

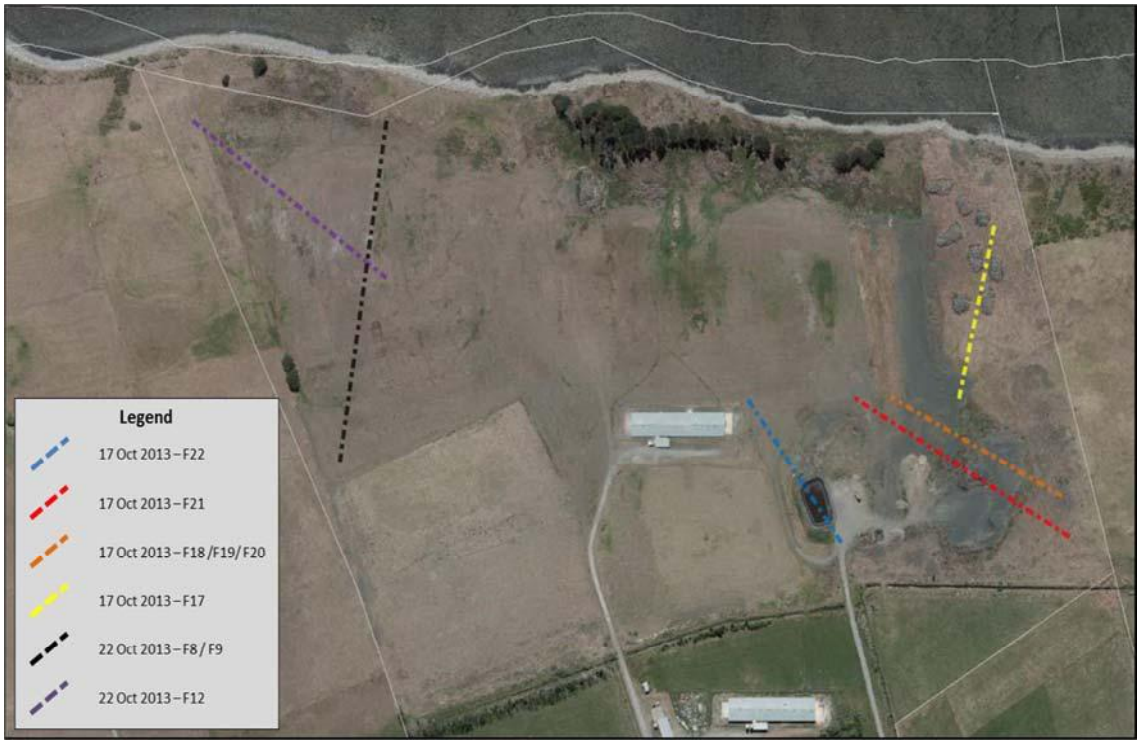


Figure 5 Soil sample transects 2013-2014 soil sampling

Table 5 Council soil samples Wellington Brown Road landfarm 2013-2014

Parameter	Unit	*F22*	*F21*	*F17*	*F18/F19/ F20*	*F12*	*F8/F9*
Calcium	mg/kg	25.5	22.1	22.6	6.9	168	21.7
Chloride	mg/kg	11.5	8.57	131	26.4	149	16.7
Conductivity	mS/m@20C	15.5	17.3	32.2	12.8	154	23.2
Hydrocarbon	mg/kg	230	680	490	68	20000	61
Magnesium	mg/kg	7.5	6.1	7.4	2.3	14.2	8.2
Moisture factor	-	1.108	1.123	1.247	1.100	1.154	1.182
pH	pH	6.8	6.8	6.3	6.3	8.1	6.5
Sodium absorption ratio	-	0.85	0.65	2.27	1.01	2.97	0.76
Sodium	mg/kg	19.0	13.4	48.6	12.0	149	16.4
Total soluble salts	mg/kg	121.3	135.4	252.0	100.2	1205.2	181.6

The areas sampled by the Council during the monitoring period show compliance with consent criteria. Only area F12 showed results of significance, with elevated hydrocarbons still outside the ultimate surrender criteria as at time of sampling, but within the application limit of 50,000 mg/kg.

3.3.2 Council groundwater results

During the monitoring quarterly groundwater sampling was conducted from four monitoring bores at the Wellington part of the site, located as shown in Figure 6. The results for each of the bores are presented in Tables 6 to 9 respectively.

Figure 6 Surface and groundwater sampling sites

Table 6 Groundwater monitoring results from bore GND2282 from the area of land use under consent 7884-1 during the 2013-2014 monitoring period

Parameter	Unit	03 Jul 2013	04 Sep 2013	17 Dec 2013	25 Feb 2014
Benzene	g/m³	<0.0010	0.0047	0.0038	0.0037
Toluene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
meta Xylene	g/m³	<0.002	<0.002	<0.002	<0.002
ortho Xylene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbons	g/m³	<0.7	0.8	<0.7	<0.7
C7 - C9	g/m³	<0.10	<0.10	<0.10	<0.10
C10 - C14	g/m³	<0.2	<0.2	<0.2	<0.2
C15 - C36	g/m³	<0.4	<0.4	<0.4	0.5
Alkalinity (total)	g/m³ $CaCO_3$	270	-	-	-
Barium (acid soluble)	g/m³	-	-	0.58	0.47
Barium (dissolved)	g/m³	1.21	0.72	-	0.40
Bicarbonate	g/m³ HCO_3	330	-	-	-
Bromine (dissolved)	g/m³	12.8	-	-	-
Calcium	g/m³	45	-	-	-
Chloride	g/m³	1980	1590	1360	958
Conductivity	mS/m@20C	702	561	478	362
Copper (dissolved)	g/m³	<0.003	-	-	-
Ethylene glycol	g/m³	<4	-	-	-
Formaldehyde	g/m³	<0.02	-	-	-
Hardness (total)	g/m³ $CaCO_3$	230	-	-	-
Iron (dissolved)	g/m³	70	-	-	-
Manganese (dissolved)	g/m³	2.8	-	-	-
Magnesium	g/m³	29	-	-	-
Mercury (dissolved)	g/m³	<0.00008	-	-	-
Methanol	g/m³	<2	-	-	-
Nickel (dissolved)	g/m³	0.003	-	-	-
Nitrate nitrogen	g/m³ N	0.02	-	-	-
Nitrite/nitrate nitrogen	g/m³ N	0.07	-	-	-

Parameter	Unit	03 Jul 2013	04 Sep 2013	17 Dec 2013	25 Feb 2014
Nitrite nitrogen	g/m³ N	0.05	-	-	-
pH	pH	6.2	6.3	6.4	6.6
Potassium	g/m³	1020	-	-	-
Propylene glycol	g/m³	<4	-	-	-
Sodium	g/m³	620	-	-	-
Sulphate	g/m³	30	-	-	-
Static water level	m	2.248	2.235	2.22	2.448
Sum of Anions	meq/l	62	-	-	-
Sum of Cations	meq/l	60	-	-	-
Temperature	Deg.C	16.1	16.5	16.9	16.4
Total dissolved solids	g/m³	3900	4340.5	3698.3	2800.8
Zinc (dissolved)	g/m³	0.038	-	-	-

Table 7 Groundwater monitoring results from bore GND2283 from the area of land use under consent 7884-1 during the 2013-2014 monitoring period

Parameter	Unit	03 Jul 2013	04 Sep 2013	17 Dec 2013	25 Feb 2014	23 Apr 2014
Benzene	g/m³	<0.0010	0.0069	<0.0010	0.0124	<0.0010
Toluene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
meta Xylene	g/m³	<0.002	<0.002	<0.002	<0.002	<0.002
ortho Xylene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbons	g/m³	<0.7	<0.7	<0.7	<0.7	<0.7
C7 - C9	g/m³	<0.10	<0.10	<0.10	<0.10	<0.10
C10 - C14	g/m³	<0.2	<0.2	<0.2	<0.2	0.2
C15 - C36	g/m³	<0.4	<0.4	<0.4	<0.4	<0.4
Alkalinity (total)	g/m³ $CaCO_3$	320	-	-	-	-
Barium (acid soluble)	g/m³	-	-	0.143	-	0.079
Barium (dissolved)	g/m³	0.159	0.06	-	-	-
Bicarbonate	g/m³ HCO_3	390	-	-	-	-
Bromine (dissolved)	g/m³	3.1	-	-	-	-
Calcium	g/m³	25	-	-	-	-
Chloride	g/m³	380	320	336	-	55.0
Conductivity	mS/m@20C	196.9	148	147	-	48.1
Copper (dissolved)	g/m³	0.0006	-	-	-	-
Ethylene glycol	g/m³	<4	-	-	-	-
Formaldehyde	g/m³	<0.02	-	-	-	-
Hardness (total)	g/m³ $CaCO_3$	107	-	-	-	-
Iron (dissolved)	g/m³	3.4	-	-	-	-
Manganese (dissolved)	g/m³	1.89	-	-	-	-
Magnesium	g/m³	10.7	-	-	-	-
Mercury (dissolved)	g/m³	<0.00008	-	-	-	-
Methanol	g/m³	<2	-	-	-	-
Nickel (dissolved)	g/m³	0.0023	-	-	-	-
Nitrate nitrogen	g/m³ N	0.005	-	-	-	-
Nitrite/nitrate nitrogen	g/m³ N	0.007	-	-	-	-
Nitrite nitrogen	g/m³ N	<0.002	-	-	-	-
pH	pH	7.2	7.2	6.9	-	6.9
Potassium	g/m³	175	-	-	-	-
Propylene glycol	g/m³	<4	-	-	-	-
Sodium	g/m³	220	-	-	-	-
Sulphate	g/m³	<0.5	-	-	-	-
Static water level	m	1.492	1.404	1.293	1.792	2.444
Sum of Anions	meq/l	17.3	-	-	-	-
Sum of Cations	meq/l	16.5	-	-	-	-
Temperature	Deg.C	15.6	15.4	18.1	-	-
Total dissolved solids	g/m³	1100	-	1137.4	-	372.2
Zinc (dissolved)	g/m³	0.0159	-	-	-	-

Table 8 Groundwater monitoring results from bore GND2284 from the area of land use under consent 7884-1 during the 2013-2014 monitoring period

Parameter	Unit	03 Jul 2013	04 Sep 2013	17 Dec 2013	25 Feb 2014
Benzene	g/m³	0.0047	0.0069	0.0014	0.0016
Toluene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
meta Xylene	g/m³	<0.002	<0.002	<0.002	<0.002
ortho Xylene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbons	g/m³	<0.7	<0.7	<0.7	<0.7
C7 - C9	g/m³	-	-	<0.10	<0.10
C10 - C14	g/m³	-	-	0.2	<0.2
C15 - C36	g/m³	-	-	<0.4	<0.4
Alkalinity (total)	g/m³ $CaCO_3$	132	-	-	-
Barium (acid soluble)	g/m³	-	-	0.22	0.11
Barium (dissolved)	g/m³	0.193	0.13	-	0.11
Bicarbonate	g/m³ HCO_3	161	-	-	-
Bromine (dissolved)	g/m³	7.0	-	-	-
Calcium	g/m³	23	-	-	-
Chloride	g/m³	360	351	241	228
Conductivity	mS/m@20C	148.4	125	98.4	86.9
Copper (dissolved)	g/m³	<0.0005	-	-	-
Ethylene glycol	g/m³	<4	-	-	-
Formaldehyde	g/m³	<0.02	-	-	-
Hardness (total)	g/m³ $CaCO_3$	101	-	-	-
Iron (dissolved)	g/m³	75	-	-	-
Manganese (dissolved)	g/m³	2.1	-	-	-
Magnesium	g/m³	10.4	-	-	-
Mercury (dissolved)	g/m³	<0.00008	-	-	-
Methanol	g/m³	<2	-	-	-
Nickel (dissolved)	g/m³	0.0007	-	-	-
Nitrate nitrogen	g/m³ N	<0.02	-	-	-
Nitrite/nitrate nitrogen	g/m³ N	<0.02	-	-	-
Nitrite nitrogen	g/m³ N	<0.02	-	-	-
pH	pH	6.4	6.2	6.3	6.5
Potassium	g/m³	109	-	-	-
Propylene glycol	g/m³	<4	-	-	-
Sodium	g/m³	132	-	-	-
Sulphate	g/m³	4.7	-	-	-
Static water level	m	1.592	1.545	1.468	1.870
Sum of Anions	meq/l	12.9	-	-	-
Sum of Cations	meq/l	13.3	-	-	-
Temperature	Deg.C	17.8	17.4	17.4	17.5
Total dissolved solids	g/m³	820	967.1	761.3	672.4
Zinc (dissolved)	g/m³	0.0119	-	-	-

Table 9 Groundwater monitoring results from bore GND2285 from the area of land use under consent 7884-1 during the 2013-2014 monitoring period

Parameter	Unit	03 Jul 2013	03 Jul 2013	04 Sep 2013	17 Dec 2013	25 Feb 2014
Benzene	g/m³	0.21	0.36	0.45	0.38	0.48
Toluene	g/m³	0.0019	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
meta Xylene	g/m³	<0.002	<0.002	<0.002	0.002	<0.002
ortho Xylene	g/m³	0.0016	0.0019	0.0011	<0.0010	<0.0010
Hydrocarbons	g/m³	<0.7	-	<0.7	<0.7	<0.7
C7 - C9	g/m³	-	-	-	<0.10	<0.10
C10 - C14	g/m³	-	-	-	<0.2	0.2
C15 - C36	g/m³	-	-	-	<0.4	<0.4
Alkalinity (total)	g/m³ $CaCO_3$	65	-	-	-	-

Parameter	Unit	03 Jul 2013	03 Jul 2013	04 Sep 2013	17 Dec 2013	25 Feb 2014
Barium (acid soluble)	g/m³	-	-	-	2.94	2.3
Barium (dissolved)	g/m³	4.8	-	3.30	-	-
Bicarbonate	g/m³ HCO_3	89	-	-	-	-
Bromine (dissolved)	g/m³	103	-	-	-	-
Calcium	g/m³	111	-	-	-	-
Chloride	g/m³	2800	-	2730	2510	2335
Conductivity	mS/m@20C	864	-	768	703	674
Copper (dissolved)	g/m³	<0.005	-	-	-	-
Ethylene glycol	g/m³	<4	-	-	-	-
Formaldehyde	g/m³	0.03	-	-	-	-
Hardness (total)	g/m³ $CaCO_3$	780	-	-	-	-
Iron (dissolved)	g/m³	520	-	-	-	-
Manganese (dissolved)	g/m³	12.3	-	-	-	-
Magnesium	g/m³	122	-	-	-	-
Mercury (dissolved)	g/m³	<0.00015	-	-	-	-
Methanol	g/m³	<2	-	-	-	-
Nickel (dissolved)	g/m³	<0.005	-	-	-	-
Nitrate nitrogen	g/m³ N	<0.2	-	-	-	-
Nitrite/nitrate nitrogen	g/m³ N	1.0	-	-	-	-
Nitrite nitrogen	g/m³ N	0.9	-	-	-	-
pH	pH	5.9	6.03	6.0	6.1	6.2
Potassium	g/m³	560	-	-	-	-
Propylene glycol	g/m³	<4	-	-	-	-
Sodium	g/m³	680	-	-	-	-
Sulphate	g/m³	1.9	-	-	-	-
Static water level	m	1.485	3.50	1.450	1.244	1.721
Sum of Anions	meq/l	80	-	-	-	-
Sum of Cations	meq/l	78	-	-	-	-
Temperature	Deg.C	17.6	18.0	18.0	18.0	18.3
Total dissolved solids	g/m³	5500	-	5942.1	5439.2	5214.8
Zinc (dissolved)	g/m³	0.011	-	-	-	-

In response to the incidents recorded at the site in the previous monitoring year, comprehensive investigative sampling was conducted in July 2013. This included sampling of the groundwater bores for a wider range of parameters including those specific to hydraulic fracture return fluids such as formaldehyde and glycols. These substances were effectively not detected in any of the groundwater samples. Heavy metal concentrations were also low in all samples.

Salinity parameters however, remained elevated in bores 2282 and 2285, with both wells showing continued exceedance of the total dissolved solids limit of 2500 g/m³. These values relate to discharges in the previous monitoring period, for which the Company was infringed in 2012, rather than ongoing or current discharges. The concentrations also appear to be reducing, and the groundwater at this site is not used as a potable or stock watering resource or for irrigation purposes. However the results currently show non-compliance with the consent limit and as such, reflect negatively on the overall compliance rating for consent 7884-1.

Similarly, benzene concentrations in one bore (GND2285) are still elevated to similar levels as in the previous monitoring period. Initially benzene was also picked up in bore 2283, but it appears this has reduced to effectively the detection limit. During the monitoring year bore 2283 was replaced as the older bore had partially in-filled with

sand. The 23 April sample was from the new bore and has come back clear of hydrocarbon contaminants.

Concentrations of total dissolved solids (TDS) and benzene are graphed in Figures 7 and 8, to show temporal trends from the previous and current monitoring periods, relative to guideline values and/or consent limits.

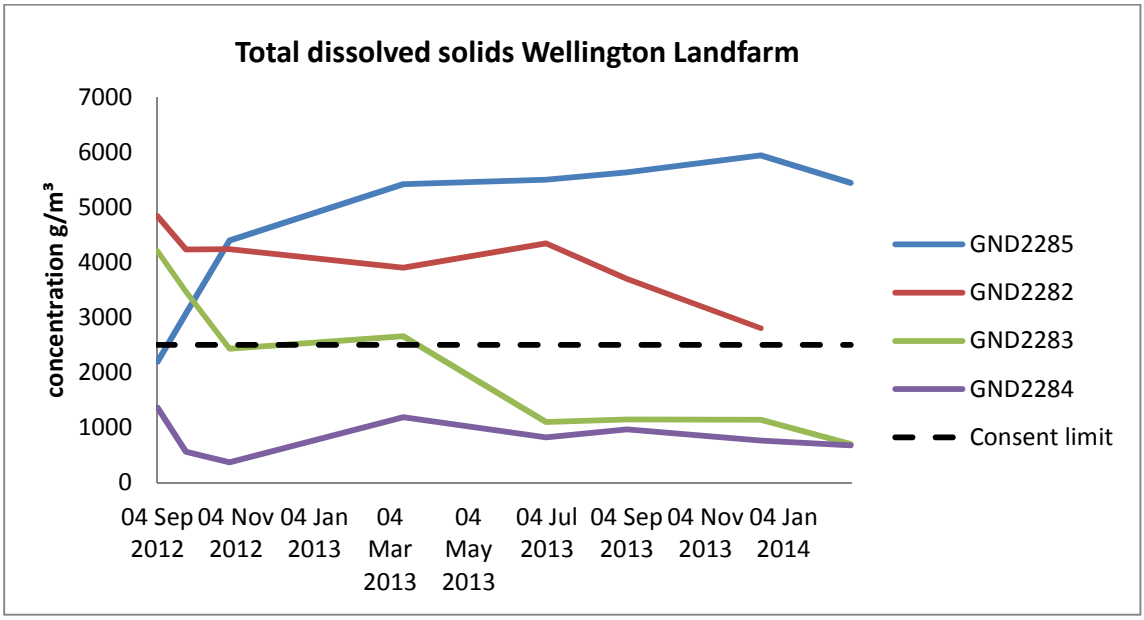


Figure 7 TDS groundwater concentrations in all bores, Wellington landfarm

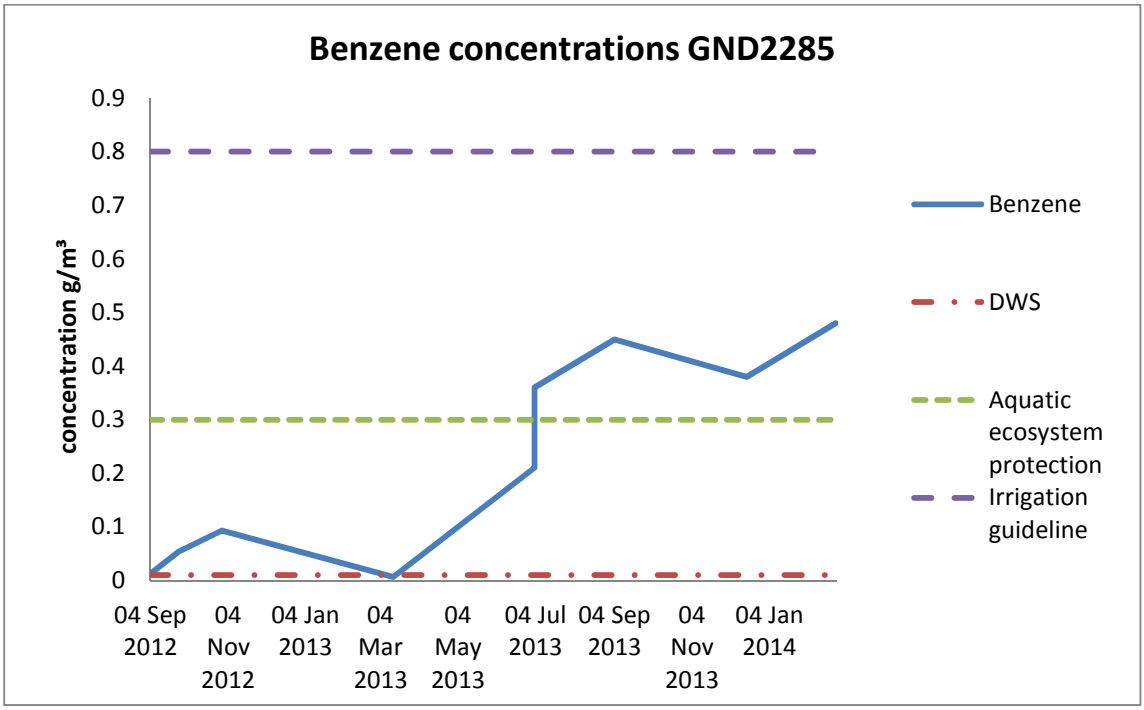


Figure 8 Benzene concentrations, bore GND2285, Wellington landfarm

TDS concentrations in bores 2282 and 2285 remain in excess of the TDS limit, but appear to have plateaued and begun to reduce in the current monitoring period. Bore 2283 had initially high concentrations, but has rapidly reduced towards background

levels for TDS. GND2284 has not shown any notable impacts from site activities in either monitoring period.

The concentrations of benzene in all bores has reduced towards the detection limit, with the exception of bore GND2285, which saw an initial increase in concentrations at the start of the monitoring period, and has subsequently fluctuated around 0.3 – 0.5 g/m³. As mentioned in the previous technical report for this site, this is in excess of the most stringent (drinking water) standard, but within the stock watering and irrigation guidelines (4 g/m³ and 0.8 g/m³ respectively), and this is expected to reduce through dilution and degradation. It should be noted that there is no abstraction of water for any use in the vicinity of the landfarm, and the bores (and groundwater) in question lie well within the perimeter of the site.

Ongoing monitoring of groundwater at the site will continue until the levels of contaminants are at an acceptable level in all bores.

3.3.3 Council surface water results

The unnamed farm drain on the landward side of the site was sampled twice during the monitoring period at two sampling sites, one upstream and one downstream of the stockpiling and spreading areas. Sampling sites are identified in Figure 6. Samples were analysed for similar parameters to the groundwater samples. Results are presented in Table 10, below.

Table 10 Council surface water samples, Wellington farm drain 2013-2014

Parameter	Unit	04 Sep 2013 *Upstream*	04 Sep 2013 *Downstream*	17 Sep 2013 *Upstream*	17 Sep 2013 *Downstream*
Benzene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
Toluene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
meta Xylene	g/m³	<0.002	<0.002	<0.002	<0.002
ortha Xylene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbons	g/m³	<0.7	<0.7	<0.7	<0.7
Barium	g/m³	0.014	0.027	0.014	0.043
Chloride	g/m³	39	51	33.9	61.8
Conductivity	mS/m@20C	20.3	24.1	19.5	29.3
pH	pH	6.7	6.6	6.5	6.4
Temperature	Deg.C	16.2	16.2	18.0	17.9
Total dissolved solids	g/m³	157.1	186.5	150.9	226.7

No hydrocarbons were detected in any of the samples. There were slight differences in salinity parameters between the upstream and downstream sites on both occasions, but all measured parameters were within the normal range for near-coastal surface water. No significant effects on preceding water quality are anticipated from slightly elevated salinity at a site that borders the Tasman Sea.

3.4 Review of analytical results

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

BTW collected a total of 29 composite samples from areas F5, F9, F10 and F12-F23 during the monitoring period, using the methodology detailed in Section 3 of the BTW supplied annual report. BTW's soil results are included in Table 4.1, Section 4 of the BTW supplied annual report, Appendix II.

The supplied soil sample results, combined with soil results from the previous monitoring year indicate that all areas except F12, F18 and F21 have already met surrender criteria for all parameters (based on supplied BTW results). Areas such as F8, F13 and F14, which were initially outside of surrender compliance for salinity parameters have shown a reduction in the current monitoring year to within surrender criteria. The results for area F12 show hydrocarbon concentrations are still in excess of surrender criteria (but within the application limit of 50,000 mg/kg). The Council results from area F12 also show elevated hydrocarbons. These results have been discussed with the Company, who are planning to re-till this area in the 2014-15 monitoring period.

No significant heavy metals have been detected in any of the samples in the current or previous monitoring period, however, low levels of poly-cyclic aromatic hydrocarbons were detected in the samples from areas F18 and F21, which will need to reduce before these areas can be considered to have met surrender criteria.

BTW also sampled the farm drain on the landward side of the site, and one of the perforated pipes during the monitoring year. These results are presented in Appendix C of the BTW supplied report, included in Appendix II. Their results are similar to the Council surface water results. No hydrocarbons or significant metals have been detected in either sample; all other measured parameters are typical of coastal surface water in Taranaki.

3.5 Marine ecological surveys

Surveys in the vicinity of the landfarm facility were conducted in spring during the monitoring period. These surveys are designed to assess any potential impact of landfarming on the receiving coastal environment by recording any change in diversity, abundance and composition of intertidal reef communities.

The results of the surveys are summarised below. The surveys were conducted to look specifically at the more recently used site, but given the close proximity, the results are applicable to both properties. Full survey results are presented in Appendix III.

In order to assess the effects of the land farm on the nearby intertidal communities, ecological surveys were conducted between 19 September and 17 October 2013 at four sites (identified in Figure 9). These surveys included three potential impact sites and one control sites. Potential adverse effects of the land farm on the intertidal communities were assessed by comparing species richness and diversity at the potential impact sites relative to the control site.

Figure 9 Intertidal survey sites, Brown Road landfarm (Wellington area)

As both species richness and diversity were similar at the control sites and potential impact sites, the results indicate that the land farm was not having detectable adverse effects on the intertidal reef communities. Natural environmental factors, in particular sand inundation, appeared to be the dominant driver of species richness and diversity for the sites surveyed.

Photo 3 Conducting an intertidal survey at potential impact site 500m east of the Brixton Outfall (SEA 901055), showing some of the species observed

3.6 Investigations, interventions, and incidents

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

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

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

In the 2013-2014 period, the Council was not required to record incidents in association with BTW's conditions in resource consents or provisions in Regional Plans for the Wellington part of the site under resource consent 7884-1. However, an additional investigation was undertaken at the beginning of the monitoring period following incidents recorded against this consent in the previous monitoring period.

3 July 2013 Investigation

The Wellington area of the Brown Road landfarm was visited to collect samples as part of an investigation into the effects of the site's activities on groundwater following incidents recorded in the previous monitoring year. In the previous year, the Company had been issued an infringement notice following the detection of the presence of trace levels of benzene in one perforated pipe leaving the site at the seaward boundary. The Company were also directed to remove the pipe, and completed this work early in the monitoring period.

The four existing groundwater monitoring wells on site were sampled for the standard monitoring parameters plus a wider range of parameters specifically associated with hydraulic fracturing return fluids. Those results are included in Tables 6 to 9, Section 3.3.2. An inspection was also undertaken of the embankment face along the front of the site and a sample was taken from a groundwater seep which was running from the embankment onto the beach (WSB000020, Figure 6). The sample had no odour, foam or sheen. Samples were collected from the remaining perforated pipes (GND2362-2364, Figure 6). Results for the perforated pipe discharges and the groundwater seep are presented in Table 11.

Table 11 Investigative water sampling results, July 2013, Wellington Brown Road landfarm

Parameter	Unit	GND2362	GND2363	GND2364	WSB000020
Benzene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
Toluene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
meta-Xylene	g/m³	<0.002	<0.002	<0.002	<0.002
ortho-Xylene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
Hydrocarbons	g/m³	<0.7	<0.7	<0.7	<0.7
C7-C9	g/m³	<0.10	<0.10	<0.10	<0.10
C10-C14	g/m³	<0.2	<0.2	<0.2	<0.2
C15-C36	g/m³	<0.4	<0.4	<0.4	<0.4
Alkalinity (total)	g/m³ $CaCO_3$	150	133	96	37
Barium (dissolved)	g/m³	0.141	0.124	0.106	0.107
Bicarbonate	g/m³ HCO_3	183	162	116	46
Bromine (dissolved)	g/m³	2.3	0.65	2.1	4.0
Calcium	g/m³	29	31	30	25
Chloride	g/m³	150	142	167	340
Conductivity	mS/m@20C	95.8	111.8	129.2	136.7
Copper (dissolved)	g/m³	0.0065	0.0052	0.0066	0.0032
Ethylene glycol	g/m³	<4	<4	<4	<4
Formaldehyde	g/m³	<0.02	<0.02	<0.02	<0.02
Hardness (total)	g/m³ $CaCO_3$	111	123	138	158
Iron (dissolved)	g/m³	33	15.7	15.3	0.38
Manganese (dissolved)	g/m³	1.45	1.37	1.13	0.65
Magnesium	g/m³	9.5	10.8	15.5	23
Mercury (dissolved)	g/m³	<0.00008	<0.00008	<0.00008	<0.00008
Methanol	g/m³	<2	<2	<2	<2
Nickel (dissolved)	g/m³	0.0030	0.0013	0.0021	0.0008
Nitrate nitrogen	g/m³ N	1.51	1.94	3.8	11.4
Nitrite/nitrate nitrogen	g/m³ N	1.57	1.97	3.9	11.4
Nitrite nitrogen	g/m³ N	0.059	0.029	0.071	0.008
pH	pH	6.75	6.81	6.15	6.5
Potassium	g/m³	120	190	187	50
Propylene glycol	g/m³	<4	<4	<4	<4
Sodium	g/m³	64	47	67	167
Sulphate	g/m³	36	126	190	29
Sum of Anions	meq/l	8.1	9.4	10.9	11.8
Sum of Cations	meq/l	9.3	10.0	11.0	11.7
Temperature	Deg.C	10.5	13.7	10.1	-
Total dissolved solids	g/m³	580	680	820	810
Zinc (dissolved)	g/m³	0.108	0.0027	0.0070	0.0058

A comprehensive list of constituents were tested for at this site as shown in Table 11. The results given in Table 11 indicate relatively brackish ground and surface water at the site. Brackish water is water that has more salinity than fresh water , but not as much as sea water, which is consistent with background water quality expected at a coastal site. These results give no clear indications of any impact of site activities. The samples were free of hydrocarbon and heavy metal contaminants, with the exception of a slightly elevated zinc concentration in perforated pipe 2 (GND2362), which is well within the drinking water criterion (<3 g/m³, ANZECC) and poses no environmental risk. Salts were slightly elevated, but within typical coastal groundwater concentrations. The contaminants potentially associated with hydraulic fracturing return fluids (such as formaldehyde and methanol) were not detected in any of the samples.

The investigative sampling did not show any contaminants beyond background concentrations leaving the site through perforated pipes or natural springs/seeps along the seaward site boundary. This suggests the removal of perforated pipe 1 was effective in preventing the fast tracking of contaminants offsite, and suggests there is minimal risk of ongoing leaching of significant contaminants through groundwater and onto the site. Nonetheless, monitoring of ground and surface water at the site will continue in both the bores and the perforated pipes to ensure ongoing compliance. It is recommended that the pipes are sampled annually as part of the monitoring programme. A recommendation to this effect is given in Section 5.

Photo 4 Groundwater seep onto beach, sampled July 2013 (left), discharge from perforated pipe 4 showing significant but naturally occurring iron oxide (right)

4. Discussion

4.1 Discussion of site performance

There was very little activity at either part of the site during the monitoring period. The original part of the Brown Road site has been unused since 2011 and Council and Company soil sampling has shown contaminants in the soil meet surrender criteria. The Company have applied to surrender the older consent 6867-1. At the time of reporting, this application is under consideration.

Spreading on the Wellington part of the site was finished in September 2013, at which time the storage areas had been reinstated and final sowing of pasture had been undertaken. However, site performance, housekeeping and reporting have improved significantly since that time. During the year under review, the Company has worked well to manage and complete the site, and has been thorough and prompt with all sampling and reporting to Council.

4.2 Environmental effects of exercise of consents

Minor but significant adverse environmental effects had occurred at the site in the previous monitoring period, where site groundwater had been impacted from poor storage of fluid waste under consent 7884-1. In the 2013-2014 monitoring period, there have been no further discharges at site, and groundwater contaminant levels appear to be reducing as expected. These contaminants are already reducing in concentration and will continue to reduce over time, and monitoring will continue until background concentrations are reached.

There have been negligible impacts on soils at the site, with most spreading areas having already reached surrender criteria for most of the species assessed. Area F12 has been identified by both the Council and the Company as requiring extra attention. Hydrocarbon concentrations are still fairly high in 'hot spots' where the application and tilling processes were not as well done as in other areas. The Company have fenced this area and are arranging for this area to be re-tilled to further mix and aerate the soil/waste layer and assist bioremediation. It is recommended this work be completed in the 2014-2015 year; a recommendation to this effect is given in Section 5.

Surface water samples taken from the drain on the landward part of the site have not shown any effects from site activities. The remaining perforated pipes and beach seeps show no contaminants in excess of baseline/background concentrations. The other perforated pipes were removed as required by an abatement notice issued at the end of the previous monitoring period.

No effects of site activities have been detected off site, with intertidal surveys returning positive results and water samples from seeps onto the beach showing levels of hydrocarbon contaminants to be at detection levels.

Overall, there have been less than minor environmental effects at this site during the monitoring period, however, high salinity and trace/low level hydrocarbons are continued to be detected in two of the groundwater bores on the site.

4.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Tables 12-13.

Table 12 Summary of 2013-2014 performance for Consent **6867-1**
To discharge drilling wastes [consisting of drilling cuttings and drilling fluids] from hydrocarbon exploration activities with water based muds and synthetic based muds, and oily wastes from hydrocarbon exploration activities, onto and into land via landfarming

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Definitions which apply to the consent	Not applicable	N/A
2. Best practicable option to be adopted	Inspections and liaison with consent holder	Yes
3. Current management plan in place	Current plan approved 25 March 2010	Yes
4. Notification 48 hours prior to stockpiling	No material received on site during monitoring period	N/A
5. Notification 48 hours prior to landfarming	No landfarming undertaken during monitoring period	N/A
6. Keep records relating to wastes, areas, compositions, volumes, dates, treatments and monitoring	Company records received	Yes
7. Report on records in condition 6 to Council by 31 August each year	Report	No*
8. Discharge depth limited to 100mm for waste with hydrocarbons < 5%, or 50mm for waste with hydrocarbons > 5%	No landfarming undertaken during monitoring period	N/A
9. Single application of wastes to each area of land	No landfarming undertaken during monitoring period	N/A
10. Incorporation into soil as soon as practicable so that top 250mm layer contains less than 5% hydrocarbons	No landfarming undertaken during monitoring period	N/A
11. Re-vegetate landfarmed areas as soon as practicable	Inspection	Yes
12. No discharge within 25m of a water body, property boundary or within 50m of the Tasman Sea	No landfarming undertaken during monitoring period	N/A
13. Consent applies only to wastes generated in Taranaki	No landfarming undertaken during monitoring period	N/A
14. Maximum volume of stockpiling 6000m^3, discharge within eight months of arrival on site	No material received on site during monitoring period	N/A
15. Levels of metals in soil shall comply with guidelines	Sampling undertaken in previous years	Yes
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 undertaken in previous years	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
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. Total dissolved salts in surface water or groundwater shall not exceed 2500 g/m³	No fresh surface water in vicinity, groundwater not analysed	N/A
19. Disposal of waste shall not lead to contaminants entering surface water	No fresh surface water in vicinity	N/A
20. No adverse impacts on groundwater or surface water	No fresh surface water in vicinity, groundwater not assessed	N/A
21. Level of dissolved salts in surface water	No fresh surface water in vicinity	N/A
22. Prior to expiry, cancellation, or surrender of consent soil hydrocarbon content must comply with MfE guidelines	Sampling prior to surrender	Yes
23. Prior to expiry, cancellation, or surrender of consent these levels must not be exceeded: a) conductivity 290 mS/m b) dissolved salts 2500 g/m³ c) sodium 460 mg/kg d) chloride 700 mg/kg	Sampling prior to surrender	Yes
24. Notification of discovery of archaeological remains	None found	N/A
25. Optional review provision re environmental effects	Next optional review in June 2014	N/A
Overall assessment of environmental performance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

*Records received as part of surrender application, not annual report

Table 13 Summary of 2013-2014 performance for Consent **7884-1.**
To discharge wastes from hydrocarbon exploration, well work-over, production and storage activities, onto and into land via landfarming

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Definitions which apply to the consent	Not applicable	N/A
2. Best practicable option to be adopted	Inspections and liaison with consent holder	Yes
3. Only specified wastes to be discharged	Information provided by consent holder	Yes
4. Notification 48 hours prior to stockpiling	Notifications received	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
5. Notification 48 hours prior to landfarming	Notifications received	Yes
6. Sample of wastes from each individual source to be collected and analysed	Information provided by consent holder	Yes
7. Keep records relating to wastes, areas, compositions, volumes, dates, treatments and monitoring	Information provided by consent holder	Yes
8. Report on records in condition 7 to Council by 31 August	Report received 27 August 2014	Yes
9. Well work-over fluids to be stored in tank or pit	Inspections and information provided by consent holder	Yes
10. Liquid oily wastes to be stored in tank or mixed into pit	None received during monitoring period	N/A
11. All wastes landfarmed ASAP or within 12 months	Inspections and information provided by consent holder	Yes
12. Well work-over fluids to be kept separate from other waste types	Inspections and information provided by consent holder	Yes
13. No waste to be discharged into F1 and F2 areas	Inspections and information provided by consent holder	Yes
14. Solid waste to be applied either 100mm or 50mm thick depending on hydrocarbon concentration	Inspections and information provided by consent holder	Yes
15. Parameters for rate of liquid waste application	Inspections and information provided by consent holder	Yes
16. Incorporation of solid wastes to a depth of at least 250mm ASAP	Inspections and information provided by consent holder	Yes
17. Hydrocarbon concentration shall not exceed 50,000mg/kg dry weight	Sampling and information provided by consent holder	Yes
18. Single application of wastes to each area of land	Inspections and information provided by consent holder	Yes
19. No discharge within 25m of a water body, property boundary or within 50m of the Tasman Sea	Inspections and information provided by consent holder	Yes
20. Re-vegetate landfarmed areas as soon as practicable	Inspections and information provided by consent holder	Yes
21. Total dissolved salts in surface water or groundwater shall not exceed 2500 g/m^3	Samples collected	No, but reducing
22. Contaminants in surface or groundwater not to exceed background concentrations	Sampling	No, but reducing
23. 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
24. 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

Condition requirement	Means of monitoring during period under review	Compliance achieved?
25. Concentration of metals in soil to comply with guidelines	Sampling	Yes
26. Levels of contaminants prior to expiry, cancellation, or surrender of consent		N/A
27. Consent may not be surrendered until condition 26 is satisfied		N/A
28. Notification of discovery of archaeological remains	None found	N/A
29. Consent to lapse in 2016 unless given effect to	Consent exercised	N/A
30. Optional review provision re environmental effects	Next optional review in June 2015	N/A
Overall assessment of environmental performance in respect of this consent		Good
Overall assessment of administrative performance in respect of this consent		High

During the year, the Company demonstrated a high level of both environmental performance and administrative with resource consent 6867-1 as defined in Section 1.1.4.

Adverse environmental effects were not observed at the original site during the monitoring period. No discharge activity (stockpiling or landfarming) occurred at the site during the monitoring period. Compliance with all surrender criteria has been demonstrated at the original 'Brown Road' part of the site and the Company have applied to surrender consent 6867-1. It is recommended that consent 6867-1 be surrendered in the 2014-2015 monitoring year. A recommendation to this effect is given in Section 5.

The Company's environmental performance in relation to resource consent 7884-1 is rated as 'good', and the Company demonstrated a high level of administrative compliance with the resource consent, taking all factors surrounding non-compliant levels of salt and benzene into account. Activity at the site ceased at the beginning of the monitoring period when all available spreading areas had been completed. No incidents have been recorded in the 2013-14 monitoring period, and site management has improved greatly from the previous monitoring period. However, there are contaminants detected in the groundwater monitoring bore that remain outside of consent compliance, relating to poor site practices in the previous monitoring period.

4.4 Recommendations from the 2011-2013 Biennial Report

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

1. THAT monitoring of the original disposal areas (as covered by consent 6867-1) in the 2013-2014 year be modified from that in 2011-2013, by the resumption of standard soil sampling of spread areas to assess compliance with surrender criteria.

2. THAT it be noted the monitoring of the 'Wellington' development of the landfarm (ie the area covered by consent 7884-1) has been modified to include a groundwater component focussing primarily on stockpiling facilities, this component to continue in 2013-2014.

3. THAT it be noted the soil biota programme has been extended by the addition of a laboratory based investigative programme to assess the chemical toxicity of the various wastes on microorganisms and to confirm bioactivity levels of soil health and degradation.

4. THAT barium testing in groundwater samples is by the dissolved barium test method.

5. THAT sampling is conducted of the remaining perforated pipes and natural groundwater seeps at the landfarm boundary.

6. THAT area F7 is resampled to confirm compliance for the SAR limit.

7. THAT the option for a review of resource consent 7884-1 in June 2015, as set out in condition 30 of the consent, be exercised, on the grounds that the Council are reviewing the suitability of landfarming for the disposal of wastes derived from hydraulic fracturing (ie a review of what constitutes 'best practicable option' for such wastes).

Recommendations 1 and 2 were implemented in full, and the resumption of standard soil sampling at the site has subsequently shown (in conjunction with the Company's results) that surrender criteria have been met at the site.

Recommendation 3 has been implemented, but at the time of reporting, the results and findings have not been completed, these will be reported on in the following monitoring period.

Recommendations 4 and 5 have been implemented, and it is recommended that the perforated pipe sampling be continued as part of the monitoring programme.

Recommendation 6 has been implemented by the Company, subsequent results have shown compliance.

Recommendation 7 will potentially be exercised in the 2014-15 monitoring period, although the site is no longer operational, and is therefore not intended for any future disposal of the wastes described in recommendation 7.

4.5 Alterations to the monitoring programme for 2014-2015

During the 2013-2014 monitoring year the programme was modified slightly from the previous monitoring period, with the addition of the sampling of perforated pipes and groundwater seeps at the site boundary, following an incident recorded in the previous monitoring period.

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 the obligations of the Act in terms of monitoring emissions/discharges and effects, and subsequently reporting to the regional community. The Council also takes into account the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki emitting to the atmosphere/discharging to the environment.

It is proposed that for 2014-2015 the monitoring programme is changed in the following manner:

a) Groundwater sampling of bores GND2282 – 2285 is conducted quarterly using a peristaltic low flow pump instead of disposable bailers.

b) Inspection frequency is reduced from 6 times per year to twice yearly, reflecting the change in activity at the site (both parts are now both closed).

c) The surface water sampling of the farm drain is reduced to annually as this is viewed as a low risk pathway for contamination now that the site has closed, and previous monitoring results have indicated negligible impacts from site activities on this water body.

d) In place of the second surface water sampling run, annual sampling is conducted of the remaining perforated pipes at the site to monitor whether any further contaminants are leaving the site through groundwater at the down-gradient site boundary.

5. Recommendations

1. THAT monitoring of consented activities at the Brown Road-Wellington landfarm site in the 2014-2015 year be amended from that undertaken in 2014-2015, in the following manner:

   a) Groundwater sampling of bores GND2282 – 2285 is conducted quarterly using a peristaltic low flow pump instead of disposable bailers.

   b) Inspection frequency is reduced from 6 times per year to twice yearly, reflecting the change in activity at the site (both parts are now both closed).

   c) The surface water sampling of the farm drain is reduced to annually as this is viewed as a low risk pathway for contamination now that the site has closed, and previous monitoring results have indicated negligible impacts from site activities on this water body.

   d) In place of the second surface water sampling run, annual sampling is conducted of the remaining perforated pipes at the site to monitor whether any further contaminants are leaving the site through groundwater at the down-gradient site boundary.

2. THAT the Company completes further remedial work in spreading area F12, where initial application and incorporation was not completed to a high standard.

3. THAT the surrender of resource consent 6867-1 be processed at the Company's request noting that surrender criteria have now been met at the site.

4. THAT resource consent 7884-1 not be considered for surrender until levels of contaminants in groundwater are at satisfactory levels.

Glossary of common terms and abbreviations

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

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

Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
l/s	Litres per second.
MAHs	Monocyclic aromatic hydrocarbons: these molecules consist of a single six-sided hydrocarbon ring.
MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
mS/m	Millisiemens per metre.
Mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
NH_4	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH_3	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO_3	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
OW	Oily waste.
PAHs	Polycyclic aromatic hydrocarbons: these molecules consist of two or more six-sided hydrocarbon rings joined together.
Pb*	Lead.
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
PM_{10}	Relatively fine airborne particles (less than 10 micrometre diameter).
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	*Resource Management Act* 1991 and including all subsequent amendments.
SBM	Synthetic based mud.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.

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

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

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

Bibliography and references

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

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

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

Taranaki Regional Council 2005: Guidelines for the control of drilling waste disposal onto and into land, Taranaki Regional Council.

BTW Company Limited, 2007: Swift Energy New Zealand Limited Drilling Mud Disposals. Site Use & Monitoring Report – September 2007.

Taranaki Regional Council, 2008: Swift Energy NZ Ltd Brown Road Landfarm Monitoring Programme Annual Report 2006-2007. Technical Report 2007-59.

Taranaki Regional Council, 2009: Origin Energy Resources NZ Ltd Brown Road Landfarm Monitoring Programme Annual Report 2007-2008. Technical Report 2008-82.

Taranaki Regional Council, 2010: Origin Energy Resources NZ Ltd Drilling Waste Landfarms Monitoring Programmes Annual Report 2008-2009. Technical Report 2009-90.

Taranaki Regional Council, 2010: BTW Company Limited Brown Road Landfarm Monitoring Programme Annual Report 2009-2010. Technical Report 10-59.

Taranaki Regional Council, 2011: BTW Company Limited Brown Road Landfarm Monitoring Programme Annual Report 2010-2011. Technical Report 11-60.

Taranaki Regional Council, 2014: BTW Company Limited Brown Road -Wellington Landfarm Monitoring Programme Biennial Report 2011-2013. Technical Report 13-62.

Appendix I

Resource consents held by BTW Company Ltd

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 P O Box 551 Taranaki Mail Centre NEW PLYMOUTH 4340
Decision Date:	8 July 2011
Commencement Date:	8 July 2011

Conditions of Consent

Consent Granted:	To discharge wastes from hydrocarbon exploration, well work-over, production and storage activities, onto and into land via landfarming at or about (NZTM) 1704599E-5683484N
Expiry Date:	1 June 2027
Review Date(s):	June 2015, June 2021
Site Location:	70 Brown Road, Waitara [Property owner: M Wellington]
Legal Description:	Lot 1 DP 5462 Blk III Paritutu SD [Discharge site]
Catchment:	Waitara

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 to section 36 of the Resource Management Act.

Special conditions

1. For the purposes of this consent the following definitions shall apply:

    a) Landfarming means the discharge of wastes onto land, subsequent spreading and incorporation into the soil, for the purpose of attenuation of hydrocarbon and/or other contaminants, and includes any stripping and relaying of topsoil.
    b) Storage means a discharge of wastes from vehicles, tanks, or other containers onto land for the purpose of temporary storage prior to landfarming, but without subsequently spreading onto, or incorporating the discharged material into the soil within 48 hours.

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.

3. Only those wastes specified in application 6815 shall be discharged.

Notifications, monitoring and reporting

4. The consent holder shall notify the Chief Executive, Taranaki Regional Council, [by emailing worknotification@trc.govt.nz.] at least 48 hours prior to permitting wastes onto the site. Notification shall include the following information:

    a) the consent number;
    b) the name of the well and wellsite, or other source, from which the waste was generated;
    c) the type of waste to be stored; and
    d) the volume of waste to be stored.

5. The consent holder shall notify the Chief Executive, Taranaki Regional Council, [by emailing worknotification@trc.govt.nz.] at least 48 hours prior to landfarming wastes. Notification shall include the following information:

    a) the consent number;
    b) the name of the well and wellsite, or other source, from which the waste was generated;
    c) the type of waste to be landfarmed;
    d) the volume of the waste to be landfarmed;
    e) the concentration of hydrocarbons in the waste; and
    f) the specific location and area over which the waste will be landfarmed.

6. The consent holder shall take a representative sample of the wastes from each individual source and have it analysed for the following:

   a) total petroleum hydrocarbons [C_6-C_9, C_{10}-C_{14}, C_{15}-C_{36}];
   b) benzene, toluene, ethylbenzene, and xylenes;
   c) polycyclic aromatic hydrocarbons screening;
   d) chloride, nitrogen, pH, potassium, and sodium; and
   e) for well work-over fluids only, ethylene glycol, gluteraldehyde, hexavalent chromium and methanol;

   and shall provide the results to the Chief Executive, Taranaki Regional Council, prior to landfarming the wastes.

7. The consent holder shall keep records of the following:

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

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

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

Storage

9. Well work-over fluids requiring storage prior to landfarming, shall be stored in a tank, or in a pit with an impermeable synthetic liner.

10. Liquid oily wastes shall be either:

    a) stored in a tank, or in a pit with an impermeable synthetic liner; or
    b) mixed directly into a pit containing a suitable volume of water based mud waste, in a manner that prevents the liquid oily wastes entering the ground.

11. All wastes must be landfarmed as soon as practicable, but no later than twelve months after being brought onto the site.

Discharge limits

12. Well work-over fluids shall be kept separate and distinct from other waste types.

13. No wastes shall be discharged in the F1 and F2 areas landfarmed under consent 7670-1.

14. For the purposes of landfarming, solid wastes shall be applied to land in a layer not exceeding:

    a) 100 mm thick for wastes with a hydrocarbon concentration less than 50,000 mg/kg dry weight; or
    b) 50 mm thick for wastes with a hydrocarbon concentration equal to or greater than 50,000 mg/kg dry weight.

15. For the purposes of landfarming, liquid wastes shall be applied to land:

    a) at a rate not exceeding 1 cubic metre of waste per 4 square metres of land; and
    b) at a rate such that there is no overland flow of liquids; and
    c) at a rate such that no ponded liquids remain after one hour, after application.

16. As soon as practicable following the application of solid wastes to land, the consent holder shall incorporate the wastes into the soil to a depth of at least 250 mm.

17. The hydrocarbon concentration in the soil over the landfarming area shall not exceed 50,000 mg/kg dry weight at any point where:

    a) liquid waste has been discharged; or
    b) solid waste has been discharged and incorporated into the soil.

18. Any areas of land used for the landfarming of wastes in accordance with conditons 14-16 of this consent, shall not be used for any subsequent discharges of waste.

19. No discharge shall take place within 25 metres of surface water courses or of property boundaries, or within 50 metres of Mean High Water Springs.

20. As soon as practicable following landfarming, areas shall be sown into pasture [or into crop]. The consent holder shall monitor revegetation and if adequate establishment is not achieved within two months of sowing, shall undertake appropriate land stabilisation measures to minimise wind and stormwater erosion.

Receiving environment limits - water

21. The exercise of this consent shall not result in the concentration of total dissolved salts in any fresh water body exceeding 2500 g/m^3.

22. Other than as provided for in condition 21, 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

23. 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.

24. 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.

25. The concentration of metals in the soil shall at all times comply with the guidelines for heavy metals in soil set out in Table 7.1, Section 7 of the Ministry for the Environment and New Zealand Water & Wastes Assoication's Guidelines for the safe application of biosolids to land in New Zealand [2003].

26. From 1 March 2027 [three months prior to the consent expiry date], constituents in the soil shall not exceed the standards shown in the following table:

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 - napthalene, non-carc. [pyrene], benzo(a)pyrene eq.
TPH - total petroleum hydrocarbons [C_7-C_9, C_{10}-C_{14}, C_{15}-C_{36}]

The requirement to meet these standards shall not apply if, before 1 March 2027, the consent holder applies for a new consent to replace this consent when it expires, and that application is not subsequently withdrawn.

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

Archaeological remains

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

Lapse and review

29. This consent shall lapse on 30 September 2016, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

30. 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 2015 and/or June 2021, 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 8 July 2011

For and on behalf of
Taranaki Regional Council

_____

Chief Executive

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 P O Box 551 Taranaki Mail Centre NEW PLYMOUTH 4340
Change To Conditions Date:	4 February 2010 [Granted: 27 April 2006]

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, and oily wastes from hydrocarbon exploration and production activities, onto and into land via landfarming at or about (NZTM) 1704006E-5683454N
Expiry Date:	1 June 2020
Review Date(s):	June 2012, June 2014
Site Location:	Brown Road, Waitara [Property owner: Papawai Holdings Limited, C/- GL & HM Rogers]
Legal Description:	Pt Sec 1 Matataiore Blk & Pt Sec 50 Papawai Blk Waitara W Dist Blk I SD
Catchment:	Tasman Sea Waiongana

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 Council all the administration, monitoring and supervision costs of this consent, fixed in accordance to section 36 of the Resource Management Act.

Special conditions

1. For the purposes of this consent the following definitions shall apply:

    a) stockpiling means a discharge of drilling wastes from vehicles, tanks, or other containers onto land, but without subsequently spreading, or incorporating into the soil within 24 hours of such discharge; and
    b) landfarming means the discharge of drilling waste onto land, subsequent spreading and incorporation into the soil, and includes any stripping and relaying of topsoil.

2. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects on the environment from the exercise of this consent.

Management plan

3. The consent holder shall maintain, to the written satisfaction of the Chief Executive, Taranaki Regional Council, a landfarming and stockpiling management plan to demonstrate the activity will be conducted to comply with all of the conditions of this consent. The management plan shall be reviewed annually and shall include as a minimum:

    a) control of site access;
    b) procedures for notification to the Taranaki Regional Council of disposal activities;
    c) procedures for the receipt and stockpiling of drilling wastes onto the site;
    d) methods used for the mixing and testing of different waste types;
    e) procedures for landfarming drilling wastes [including means of transfer from stockpiling area, means of spreading, and incorporation into the soil];
    f) procedures for sowing landfarmed areas;
    g) contingency procedures;
    h) sampling regime and methodology; and
    i) post-landfarming management, monitoring and site reinstatement.

Notification and sampling requirements prior to discharge

4. The consent holder shall notify the Chief Executive, Taranaki Regional Council, [by emailing worknotification@trc.govt.nz.] at least 48 hours prior to permitting 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;
    d) the volume of waste to be stockpiled; and
    e) for oily wastes the concentration of total petroleum hydrocarbons [C_6-C_9, C_{10}-C_{14}, and C_{15}-C_{36}], polycyclic aromatic hydrocarbons [PAH], and benzene, toluene, ethylbenzene and xylenes [BTEX].

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

Monitoring and reporting

6. The consent holder shall keep records of the following:

    a) wastes from each individual well [including records of all additives used at the wellsite during the drilling process];
    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.

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

Discharge limits

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. An area of land used for the landfarming of drilling wastes in accordance with condition 8 of this consent shall not be used for any subsequent discharges of drilling waste.

10. As soon as practicable following the application of drilling wastes to land, the consent holder shall incorporate the material 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.

11. 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.

12. No discharge shall take place within 25 metres of a surface water body, property boundary, or 50 metres of the Tasman Sea.

13. The exercise of this consent is limited to wastes generated within the Taranaki region.

14. The stockpiling of material authorised by this consent shall be limited to a maximum volume of 6,000 m^3 at any one time on the property. In any case all stockpiled material must be landfarmed within eight months of being brought onto the site.

Receiving environment limits

15. At any time the levels of metals in the soil shall 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" [MfE and NZWWA 2003].

16. The conductivity of the soil layer containing the discharge shall be less than 400 mSm^{-1}, or alternatively, if the background soil conductivity exceeds 400 mSm^{-1}, the application of waste shall not increase the soil conductivity by more than 100 mSm^{-1}.

17. The sodium absorption ratio [SAR] of the soil layer containing the discharge shall be less than 18.0, or alternatively if the background soil SAR exceeds 18.0, the application of waste shall not increase the SAR by more than 1.0.

18. The exercise of this consent shall not result in a level of total dissolved salts within any surface water or groundwater of more than 2500 gm^{-3}.

19. The exercise of this consent, including the design, management and implementation of the discharge [including but not limited to stockpiling on land and/or discharge onto and into land], shall not lead or be liable to lead to contaminants entering a surface water body.

20. The exercise of this consent shall not result in any adverse impacts on groundwater as a result of leaching, or on surface water including aquatic ecosystems, and/or result in a change to the suitability of use of the receiving water as determined by the Chief Executive, Taranaki Regional Council.

21. The exercise of this consent shall not result in any of the following effects on surface water:

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

22. At the time of expiry, cancellation, or surrender of this consent the levels of hydrocarbons in the soil shall comply with the guideline values for sandy soil in the surface layer [less than 1 metre depth] set out in Tables 4.12 and 4.15 of the Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand [Ministry for the Environment, 1999].

23. At the time of expiry, cancellation, or surrender of this consent soil parameters shall not exceed the following limits: conductivity, 290 mS/m; total dissolved salts, 2500 mg/kg; sodium, 460 mg/kg; and chloride, 700 mg/kg.

24. In the event that any archaeological remains are discovered as a result of works authorised by this consent, the works shall cease immediately at the affected site and tangata whenua and the Chief Executive, Taranaki Regional Council, shall be notified within one working day. Works may recommence at the affected area when advised to do so by the Chief Executive, Taranaki Regional Council. Such advice shall be given after the Chief Executive, 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.

Review

25. 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 2014, 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, or to take into account any Act of Parliament, regulations, national policy statement, and national environmental standard which is relevant to this consent.

Signed at Stratford on 4 February 2010

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Appendix II

Supplied annual report for consent 7884-1

Annual Report

Special Condition 8 - Monitoring and Reporting

Wellington Land Farm Annual Report - Consent 7884

by BTW Company






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

Wellington Land Farm Annual Report - Consent 7884
10181

	Reviewed	
Report Author	Dave Bolger	28/8/14 Date
Reviewed by	Cameron Twigley	28/4/14 **Date**

10181
28/08/2014

CONTENTS

1 INTRODUCTION

1.1 Special Condition 8

In accordance with Special Condition 8 (SC8) of resource consent 7884 -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 7 (SC7), for the period of the previous 1 July to 30 June.

This report therefore includes all information related to activities provided for under consent 7884-1 from 1 July 2013 to 30 June 2014 as well as monitoring required under SC 21-27.

1.2 July 2013 to June 2014 - Summary

During the annual reporting year areas F20 to F23 have been landfarmed, these areas are shown on the attached overall landfarming plan in Appendix B. The material that has been landfarmed during the reporting period comprises of synthetic based mud, contaminated soil and well work over fluid. Approximately 1.8 hectares of land has been landfarmed during this annual reporting year.

The site was decommissioned during the monitoring year. Once each waste source was removed from each stock piling pit and landfarmed, the stock piling pits were decommissioned and the land reinstated.

The last area to be landfarmed was F23 in September 2013. At the completion of landfarming this area of the site was completely reinstated and sown in a mixture of oats and permanent pasture. The site has now been inactive for approximately 8 months and there is no intension to do any further landfarming on the site, in essence the site is complete.

A new bore was installed during the reporting year, due to an original bore infilling with sand and making it difficult for the TRC to sample the groundwater. At the request of the TRC BTW arranged the installation of a new groundwater monitoring bore to assist with monitoring the groundwater running through the site.

Extensive soil sampling has taken place since the inception of the site. The last round of soil sampling monitoring has demonstrated that from the 23 individual areas landfarmed only F12 and F18 don't meet surrender criteria. However, we note the data for the F18 area is likely bias in terms of the landfarming material results, due to the large pile of trees that were burnt adjacent to this area and incomplete combustion of material (charcoal) was found within the soil matrix, which is likely to have caused a constituent to be recorded at a trace level with the soil analysis.

Overall the soil sampling results andsurface water results from the surface drains and perforated pipes through the site have provided data that would suggest no adverse environmental effects beyond the consented area.

In summary, to only have one proven landfarmed area (F12) above consent surrender criteria for a complex site that has taken a mixture of waste source is considered a positive result for the reporting year.

1.3 Records required under Special Condition 7

The consent holder shall keep records of the following:

a) Composition of waste;
b) Storage areas;
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) photographic evidence of pasture establishment treatment;
i) treatment applied;
j) details of monitoring, including sampling locations, sampling methods and the results of analysis;

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

1.4 Report Overview

The following information has been collated for the purpose of demonstrating compliance with SC8. Information will be supplied generally in order as requested within SC7 a-j.

- Records required under SC7 condition a) 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 or well work over fluids and are stored on well sites.

  Condition a) is also addressed in Section 4 of this report.

- A map of the site showing individual disposal areas, GPS co-ordinates and stockpiling areas is located in Appendix B displaying compliance with SC7 b), d) & f). This includes:
  - *Storage 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 c), e), g), h) & i) of SC7 which are listed below;

  - *volumes of material stored;*
  - *volumes and weights of wastes landfarmed;*
  - *dates of sowing landfarmed areas;*
  - *photographic evidence of pasture establishment;*
  - *treatments applied.*

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

- Section 3 provides details of monitoring, including sampling locations and sampling methods as required by SC7, condition j.

- Section 4 provides the results of analysis as required also by SC7, condition j. Special Conditions 21-25 of Consent 7884-1 are also addressed in this section.

2 MATERIAL STORAGE AND TREATMENT

The following section provides the information related to recording of details required within c), e), g), h) & i) of SC7 which are listed below;

- *volumes of material stored;*
- *volumes and weights of wastes landfarmed;*
- *dates of sowing landfarmed areas;*
- *photographic evidence of pasture establishment;*
- *treatments applied.*

2.1 Material Volumes

The remaining material that was stockpiled was landfarmed early in this monitoring year (August and September). The material was 385.2m³ of synthetic based muds and 15m³ of well work over fluid. The contaminated soil taken to the site was never stock piled on-site and was landfarmed immediately in two events. Initially 750m³ of material was landfarmed, then 200m³ of soil was landfarmed.

Table 2.1 provides the information required relating to the volumes of material landfarmed during the annual monitoring year. Overall the total volume of material landfarmed was 1350.2m³

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

Location	Material Type	Date Landfarmed	Area of cover (m²)	Thickness of material (mm)	Volume landfarmed (m³)
F20	WWF	August 2013	1008	100	15
F21	SBM	August 2013	7650	100	385.2
F22	CS	August 2013	7550	100	750
F23	CS	September 2013	2065	100	200

2.2 Sowing and treatments

No treatments have been applied to materials landfarmed at the Wellington Landfarm, and no fertiliser will be applied by the consent holder.

Sowing of grass and oats has occurred on landfarmed areas F18 to F23 during the monitoring year in October 2013. Photographic evidence of this, which is required under SC7 h), is included in Appendix D.

3 MONITORING INFORMATION

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

3.1 Monitoring

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

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

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

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

Monitoring results have been provided in a spread sheet form to assist with compliance and consent requirements for surrender (See Section 4). The results provided include the complete set of soil sampling results on each individual area to meet consent conditions; however as shown in Appendix E the individual tests undertaken by BTW are far greater than the consent requirements.

The results demonstrate that all but F12 and F18 areas meet surrender criteria for this consent. Surrender criteria data and analysis is discussed in section 4.

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

Apart from the soil sampling, additional surface water sampling has been undertaken of the up gradient drains plus the perforated nova coils that run through the landfarming site. The results of the sampling are contained in Appendix C and demonstrate compliance with special condition 16, 17 and 18. The results provide no evidence of contamination of the surface water or the subsurface water beyond the site boundary.

3.2 Sampling Locations

Specific landfarmed areas are located and identified through the use of a GPS navigational system. These co-ordinates are contained within the 'Wellington Disposal Site' – Site plan (Appendix B) which shows individual areas of disposal and this is updated whenever new landfarm areas are completed. A central point is located within each area and a composite sample (10 sub samples) retrieved in a transect line from the central point. The line direction is dependent on the underlying orientation of the landfarmed material. The transect line is approximately 60 meters in length, essentially 30meters either side of the central coordinate point.

3.3 Methods

Sampling involves collecting a composite of 10 sub-samples which are located with GPS along a transect line running from the central point of a landfarmed area. Typically, samples are retrieved from approximately 250mm but this can vary depending on the location of the drilling mud layer. This procedure has been adopted by the TRC for land farming sites where the composition of the waste is known (pre-disposal samples) and the location of each specific waste source is known.

3.4 Inspection Notices

The site has basically been inactive since about November 2013. However during the initial part of the monitoring year the site was very active with spreading material and decommissioning of the site.

All inspections from the TRC during the monitoring year have found the site to be compliant with the resource consent conditions.

3.5 Infringement Notices

No infringement notices have been issued during the monitoring year by the TRC.

3.6 Abatement Notices

No abatement notices have been issued during the monitoring year by the TRC.

3.7 Site Improvements

In general there has been a follow on from best practices from the previous monitoring years, and BTW has work closely with the TRC to ensure appropriate levels of monitoring on the site continued, even once the site was decommissioned at the end of 2013.

The site was totally decommissioned at the end of 2013, and as part of the decommissioning all the lined pts were removed and the liners plus other general rubbish associated with the site was taken by waste management to landfill. The contouring of the site was completed and all topsoil/sand was redistributed on the surface of the site.

Consent condition 15 details that landfarming of well work over liquid waste must occur at a ratio of 1 cubic metre of waste to 4 square meters. This has been identified as not workable and not the best environmental practice for the site. A proactive approach from BTW Company has seen the areas required to spread well work over fluid increased. This practice has been completely done voluntary and has come at quite an expense to BTW as additional site area is required to achieve the best practices for the site. An example of this is the last well work over fluid area to be landfarmed (F20), which from the consent condition only required 60m² of area for the 15m³ of well work over fluid. BTW increased the area to 1000m² which in today's environment is an expensive approach to take however deemed necessary in safeguarding the site and surrounding environment.

One of the groundwater monitoring bores became in-filled with sand over the monitoring year and became difficult for TRC to sample. The four groundwater monitoring bores had been installed voluntary by BTW to assist TRC with the groundwater monitoring of the site. As one of the bores became difficult to sample BTW arranged the installation of a new bore in a similar location to continue to assist the TRC with gathering groundwater data from within the site.

BTW Company has continued to be very transparent with all its operations with the TRC and any other interested parties and will continue this practice into the next annual reporting year.

4 ANALYSIS OF RESULTS

The following Table 4.1 provides a summary of the monitoring results undertaken over the reporting period. Analysis of the results of monitoring are required by SC7, condition j. Special Conditions 21-25 of Consent 7884-1 are also addressed in this section.

Where compliant with consent surrender conditions, the fields are coloured green, where the sampling indicates the sampled constituent has not yet reached surrender limits for the receiving environment, the field is coloured red.

Analysis of the monitoring results is undertaken over the following Sections 4.1 and 4.2, with a summary proved in Section 4.3

Table 4.1: Monitoring results from Wellington Landfarm

		Surrender Criteria met				Surrender Criteria not met																				
	Date	Soil conductivity <290mS m-1 (see Consent if PD is greater than 400)	Sodium 460 mg/kg	SAR <18	Dissolved salts <2500gm-3	Benozene <1.1(v)	Toulene <68(4m)	Ethylbenzene (53)(4.v)	Xylenes (48) (4,m)	Naphthalene (7.2) (p)	Non-carc. (Pyrene) (160) (4p)	Benzo(a)pyrene eq.(5) (0.027)(p)	Arsenic (20mg/kg)	Cadmium (1mg/kg)	Chromium (600mg/kg)	Copper (100mg/kg)	Lead (300mg/kg)	Mercury (1mg/kg)	Nickel (60mg/kg)	Zinc (300mg/kg)	C7-C9 120 (m)	C10-C14 58 (x)	C15-C36 (4000) (7,x)	nitrogen g/100g dry wt	Chloride 700 mg/kg	Material
F1	4/11/2012																								23	WBM
	19/04/2013	90	41	1.1	594	0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	11	23	3.9	<0.10	6	57	8	20	40	26	23	WBM
																										WBM
F2	21/01/2012					0.05	<0.05	<0.05	<0.10	<0.03	<0.03	<0.03	<2	<0.10	10	18	3.3	<0.10	6	57	8	20	40	0.05	310	WBM
	19/04/2013	250	76	2.2	1643	0.05	<0.05	<0.05	<0.10	<0.12	<0.03	<0.03	<2	<0.10	9	16	2.3	<0.10	4	53	8	20	40	2	116	WBM
																										WBM
F3	14/02/2012																								19	WBM
	12/06/2012																				9	20	40			WBM
	11/04/2013	1	49	1.4	260	0.05	<0.05	<0.05	<0.10	<0.05	<0.05	<0.05	<2	<0.10	12	15	2.6	<0.10	5	63	8	20	40	0.13	36	WBM
																										WBM
F4	21/01/2012		1,400			<0.05	<0.05	<0.05	<0.10	<0.13	<0.03	<0.03	6	<0.10	13	24	2.9	<0.10	5	73	8	20	40	0.11	<30	WWF
	12/06/2012																				9	20	40			WWF
	19/04/2013	60	47	2.3	389	0.05	<0.05	<0.05	<0.10	<012	<0.03	<0.03	<2	<0.10	9	27	5.2	<0.10	5	56	8	20	40	22	27	WWF
																										WWF
F5	21/01/2012		580			<0.05	<0.05	<0.05	<0.10	<0.13	<0.03	<0.03	<2	<0.10	12	24	4.4	<0.10	6	68	8	390	1350	0.09	610	WBM
	18/02/2012	180	57	1.6	1155																			6	610	WBM
	12/06/2012																				9	20	129			WBM
	12/12/2012		910			0.05	<0.05	<0.05	<0.10	<0.12	<0.03	<0.03	<2	<0.10	8	15	1.8	<0.10	4	55	9	40	340	0.09	6	WBM
	19/04/2013	630	178	2	4140	0.05	<0.05	<0.05	<0.10	<0.13	<0.03	<0.03	<2	<0.10	10	16	2.7	<0.10	4	56	8	20	380	1	210	WBM
	28/09/2013	40	0.5	1.6	251	<0.05	<0.05	<0.05	<0.10	<0.13	<0.03	<0.03	<2	<0.10	9	15	2.5	<0.10	5	50	<8	<20	<40	2	7	WBM
																										WBM
F6	21/01/2012		450			0.05	< 0.05	< 0.05	< 0.10	<0.13	<0.03	<0.03	7	<0.1	10	17	41	0.26	5	71	<8	<20	191	<0.05	<30	CS / WW
	18/02/2012	70	43	1.3	436																					CS / WW
	12/06/2012																				9	20	117			CS / WW
	12/12/2012		460			0.05	< 0.05	< 0.05	< 0.10	<0.14	<0.03	<0.03	<2	<0.10	7	15	5.9	<0.1	4	52	10	124	620	0.15	12	CS / WW
	11/04/2013	50	43	1.7	356	0.05	< 0.05	< 0.05	< 0.05	< 0.05	<0.05	<0.10	<2	<0.10	10	16	3.4	< 0.10	4	68	8	20	40	2	17	CS / WW
																										CS / WW
F7	29/05/2012	170	218	8.7	1135	0.05	<0.05	<0.05	<0.10	<0.015	<0.03	<0.03	<2	<0.10	11	17	1.4	0.1	6	75	9	20	40	0.07	91	WWF
	12/12/2012		380			0.05	<0.05	<0.05	<0.10	<0.13	<0.03	<0.03	<2	<0.10	7	14	1.4	<0.10	4	42	9	20	40	0.06	41	WWF
	19/04/2013	100	161	9.3	667	0.05	<0.05	<0.05	<0.10	<0.13	<0.13	<0.13	<2	<0.10	9	13	1.3	<0.10	4	56	8	20	40	9	33	WWF
																										WWF
F8	10/07/2012		580	0.7	564	0.06	0.09	<0.05	<0.05	<0.13	<0.03	<0.03	<2	<0.10	11	21	1.7	<010	6	79	8	20	220	0.1	7	WWF
	12/12/2012		580			0.05	<0.05	<0.05	<0.10	<0.12	<0.03	<0.03	<2	<0.10	8	15	1.7	<0.10	4	55	8	20	40	0.06	<3	WWF
	24/04/2013	30	35	1.9	218	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<2	<0.10	8	13	1.4	<010	4	51	8	20	51	5	7	WWF
																										WWF
F9	10/07/2012		840	0.6	323	0.05	<0.05	<0.05	<0.1	<0.13	<0.03	<0.03	<2	<0.10	9	15	2.1	<0.10	4	63	8	780	11,100	0.09	15	SBM
	30/10/2012					0.05	<0.05	<0.05	<0.1	<0.14	0.21	<0.04	<2	<0.10	9	17	3.3	<0.10	4	72	8	780	9200	0.12	50	SBM
	12/12/2012		780			0.05	<0.05	<0.05	<0.1	<0.14	0.05	<0.03	<2	<0.10	7	16	6.7	<0.10	4	48	13	360	7400	0.1	27	SBM
	24/04/2013	140	113	2.4	950	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<2	<0.10	8	14	2.4	<0.10	4	59	8	290	3100	3	44	SBM
	28/09/2013	70	26	0.7	488	<0.05	<0.05	<0.05	<0.10	<0.14	<0.03	<0.03	<2	<0.13	18	16	17.9	<0.10	10	75	8	20	260		15	SBM
																										SBM
F10	10/07/2012		470			0.06	0.09	<0.05	<0.05	<0.12	0.04	<0.03	2	0.3	10	17	69	0.2	7	136	8	400	2800	0.08	36	SBM
	30/10/2012					0.05	<0.05	<0.05	<0.1	<0.13	0.12	0.04	<2	0.24	10	17	44	0.15	5	108	8	3,000	8,300	0.06	103	SBM
	12/12/2012		440			0.06	<0.08	<0.06	<0.11	<0.15	0.06	<0.03	<2	0.14	14	19	18.6	<0.10	8	90	12	1,650	4,800	0.18	108	SBM
	24/04/2013	170	92	1.8	1148	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<2	<0.10	9	15	11.9	<0.10	4	56	9	260	1700	1	6	SBM
	28/09/2013	30	11	0.5	191.4	<0.05	<0.05	<0.05	<0.10	<0.14	<0.03	0.07	<2	0.19	10	31	20	<0.10	6	63	8	20	72		15	SBM
	7/05/2014					<0.05	<0.05	<0.05	<0.10	<0.13	<0.03	<0.03									8	20	40			SBM
F11	15/11/2012	20	17	1.6	118.8	0.05	<0.05	<0.05	0.12	<0.13	0.04	<0.03	<2	<0.10	8	13	1.1	<0.10	4	55	8	20	101	0.05	3	WWF
	12/12/2012		270			0.05	<0.05	<0.05	<0.10	<0.12	<0.03	<0.03	<2	<0.10	6	10	1	<0.10	3	41	8	20	40	0.05	7	WWF
	24/04/2013	20	19	1.1	165	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<2	<0.10	8	12	1	<0.10	5	48	8	20	40	5	6	WWF
																										WWF
F12	15/11/2012	32	1,450	12.9	2140	0.05	<0.05	<0.05	<0.12	<0.13	0.06	<0.03	<2	<0.10	6	22	6	<0.10	3	52	8	2600	6400	0.12	290	SBM
	12/12/2012		780			0.05	<0.05	<0.05	<0.10	0.28	0.39	0.05	<2	<0.10	8	19	12.6	<0.1	5	64	95	2100	23300	0.09	220	SBM
	24/04/2013	380	245	2.6	2490	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<2	<0.10	9	14	2.4	<0.10	5	48	8	1120	3600	1	63	SBM
	28/09/2013	140	151	4.3	950	<0.05	<0.05	<0.05	2.1	0.58	0.35	0.03	2	0.19	11	18	7.3	0.11	6	63	38	2700	12900		88	SBM
	7/05/2014					<0.06	0.1	0.09	1.76	0.91	0.14	0.03									20	1010	6300			SBM
F13	15/11/2012	50	41	1.6	330	0.05	<0.05	<0.05	<0.10	<0.13	<0.03	<0.03	<2	<0.10	7	13	2.5	<0.10	3	52	8	20	40	0.09	35	SBM
	12/12/2012		630			0.05	<0.05	<0.05	<0.10	<0.14	0.06	<0.03	2	0.16	8	16	22	<0.10	5	73	9	1100	6800	0.11	330	SBM
	24/04/2013	920	636	6.1	6100	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<2	<0.10	10	16	12.4	<0.10	6	53	8	2500	6400	1	620	SBM
	28/09/2013	290	153	3	1907	<0.05	<0.05	<0.05	<0.10	<0.13	<0.03	<0.03	<2	<0.10	11	16	7	<0.10	5	55	8	310	1460		300	SBM
	7/05/2014					<0.05	<0.05	<0.05	<0.10	<0.13	<0.03	<0.03									8	20	40			SBM
F14	15/11/2012	480	292	5.8	3180	0.05	<0.05	<0.05	<0.1	<0.13	0.04	<0.03	<2	<0.10	9	14	12.5	<0.1	4	73	8	2200	4700	0.09	370	SBM
	24/04/2013	530	350	4.4	3500	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<2	<0.10	11	22	7	<0.10	6	55	9	1980	4100	1	390	SBM
	28/12/2013	780	969	11.7	6140	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.03	<2	<0.10	9	17	2.4	<0.10	5	55	8	20	97		580	SBM
	5/06/2014	150	173	5.3	970	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.03	<2	<0.10	12	17	2.6	<0.10	6	59	8	20	145	0.06	88	SBM
F15	11/04/2013	180	200	4.2	1195	0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	12	16	2.2	<0.10	5	65	8	82	680	1	69	WBM
	28/09/2013	60	94	6.9	383	<0.06	<0.06	<0.06	<0.06	<0.14	0.1	<0.03	<2	<0.10	12	34	4.2	<0.10	6	47	<9	69	570		41	WBM
	5/06/2014					0.05	<0.05	<0.05	<0.05	<0.14	<0.03	<0.03									8	20	240			WBM
F16	13/06/2013	50	74	5.7	350	0.06	<0.06	<0.06	<0.06	,0.14	<0.03	<0.03	2	<0.10	17	30	4.3	<010	9	54	9	45	280	0.12	29	CS
	28/09/2013	40	52	3.7	277	<0.05	<0.05	<0.05	<0.10	<0.14	0.23	<0.03	<2	<0.10	13	29	3.5	<0.10	7	52	9	250	1360		40	CS
	5/06/2014					<0.05	<0.05	<0.05	<0.10	<0.14	0.03	<0.03									9	20	270			CS
F17	21/06/2013	0.2	19	1.6	105.6	0.05	<0.05	<0.05	<0.05	<0.14	<0.03	<0.03	<2	<0.10	10	12	1.6	<0.10	6	42	9	20	75	1	6	CS
	28/09/2013	20	24	1.6	145.2	<0.05	<0.05	<0.05	<0.10	<0.14	<0.03	<0.03	<2	<0.10	10	12	1.5	<0.10	4	52	9	20	40		9	CS
																										CS
F18	18/07/2013	0.4	51	3	271	0.05	<0.05	<0.05	<0.05	<0.12	0.06	0.05	<2	<0.10	9	16	2.5	<0.10	4	39	8	20	40		36	WWF
	28/09/2013	40	52	2.6	290	<0.05	<0.05	<0.05	<0.10	<0.13	0.15	0.01	<2	<0.10	11	19	3.3	<0.10	4	46	8	20	54		37	WWF
	5/06/2014					<0.05	<0.05	<0.05	<0.10	<0.12	0.12	0.08														WWF
F19	18/07/2013	0.2	12	0.9	99	0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	9	11	1.2	<0.10	4	41	8	20	40	1	3	WWF
	28/09/2013	10	12	1.1	79.2	<0.05	<0.05	<0.05	<0.05	<0.12	0.12	0.06	<2	<0.10	9	12	1.4	<0.10	4	46	8	20	40		4	WWF
	5/06/2014					<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03									8	20	40			WWF
F20	27/09/2013	1	11	0.8	79.2	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	11	12	1.1	<0.10	4	49	8	20	40		3	WWF
	4/03/2014					<0.05	<0.05	<0.05	<0.05	<0.11	<0.03	0.02									8	20	40			

		Consent Surrender limit meet			Consent Surrender limit not meet															TPH						
	Date	Soil conductivity <290mSm-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
F21	9/10/2013	160	1.8	1082	<0.05	<0.05	<0.05	<0.05	<0.13	0.17	0.13	<2	<0.10	8	12	1.6	<0.10	5	45	8	490	1960	2	107	77	SBM
	4/03/2014				<0.05	<0.05	<0.05	<0.05	<0.12	0.04	0.11									8	39	340				
F22	9/10/2013	40	1.7	231	<0.05	<0.05	<0.05	<0.05	<0.13	0.07	<0.03	<2	<0.10	11	21	3.3	<0.10	5	52	8	90	400	1	14	33	CS
	4/03/2014				<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03									8	20	83				
F23	9/10/2013	40	1.3	244	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	10	13	1.8	<0.10	5	54	8	20	88	<0.05	12	27	CS
	4/03/2014				<0.05	<0.05	<0.05	<0.05	<0.11	<0.03	<0.03									8	20	40				

4.1 Compliance with SC's 21 and 22

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

22. Other than as provided for in condition 21, the exercise of this consent shall not results in any containment concentration, within surface water or groundwater, which after reasonable mixing, exceeds the background concentration for that particular contaminant.

Surface water samples were collected from three locations this monitoring year. Two surface water samples were taken from the drain to the south of the site and the nova coil outlet drain. Compliance with SC21 is displayed within Appendix C.

4.2 Compliance with SC's 23 - 27

4.2.1 Condition 23 – Soil Conductivity

Condition 23 requires:

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

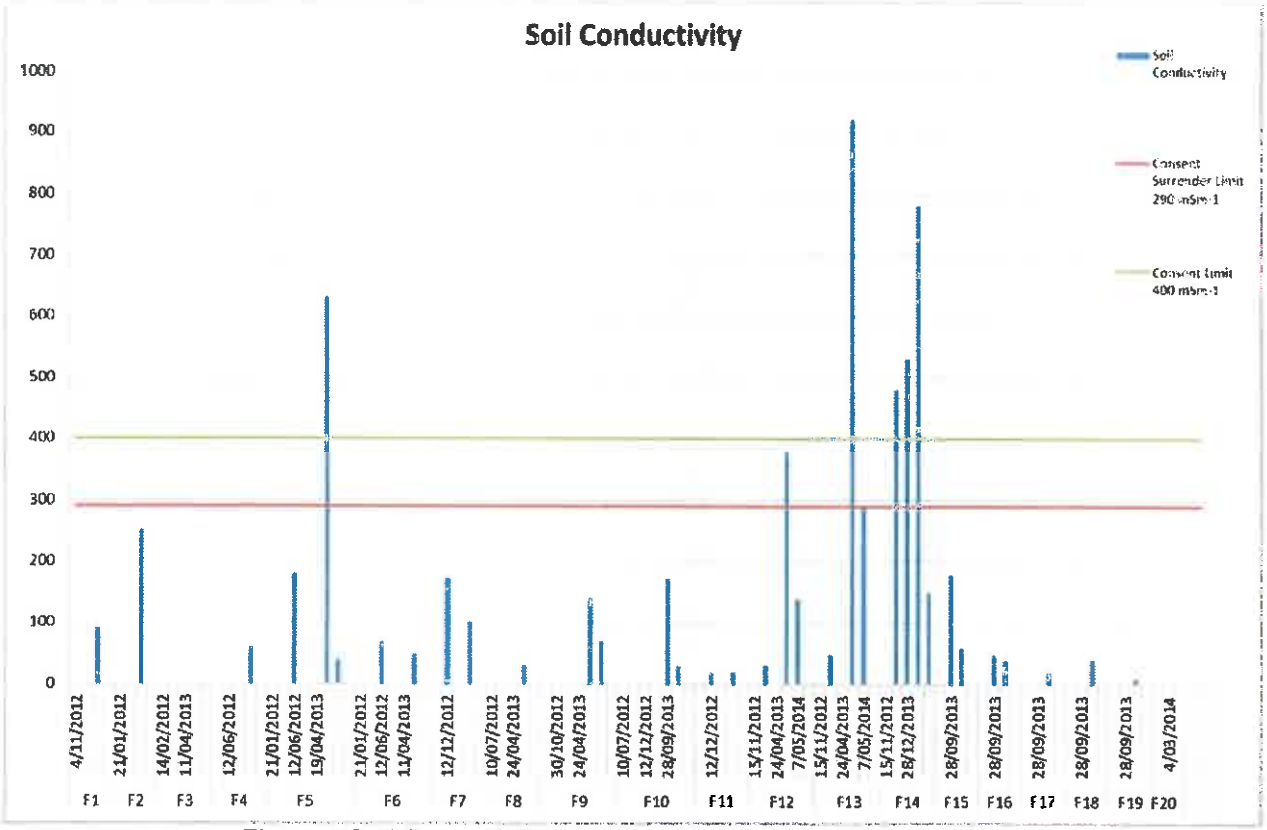


Figure 1 Soil Conductivity analysis – Wellington Disposal Site

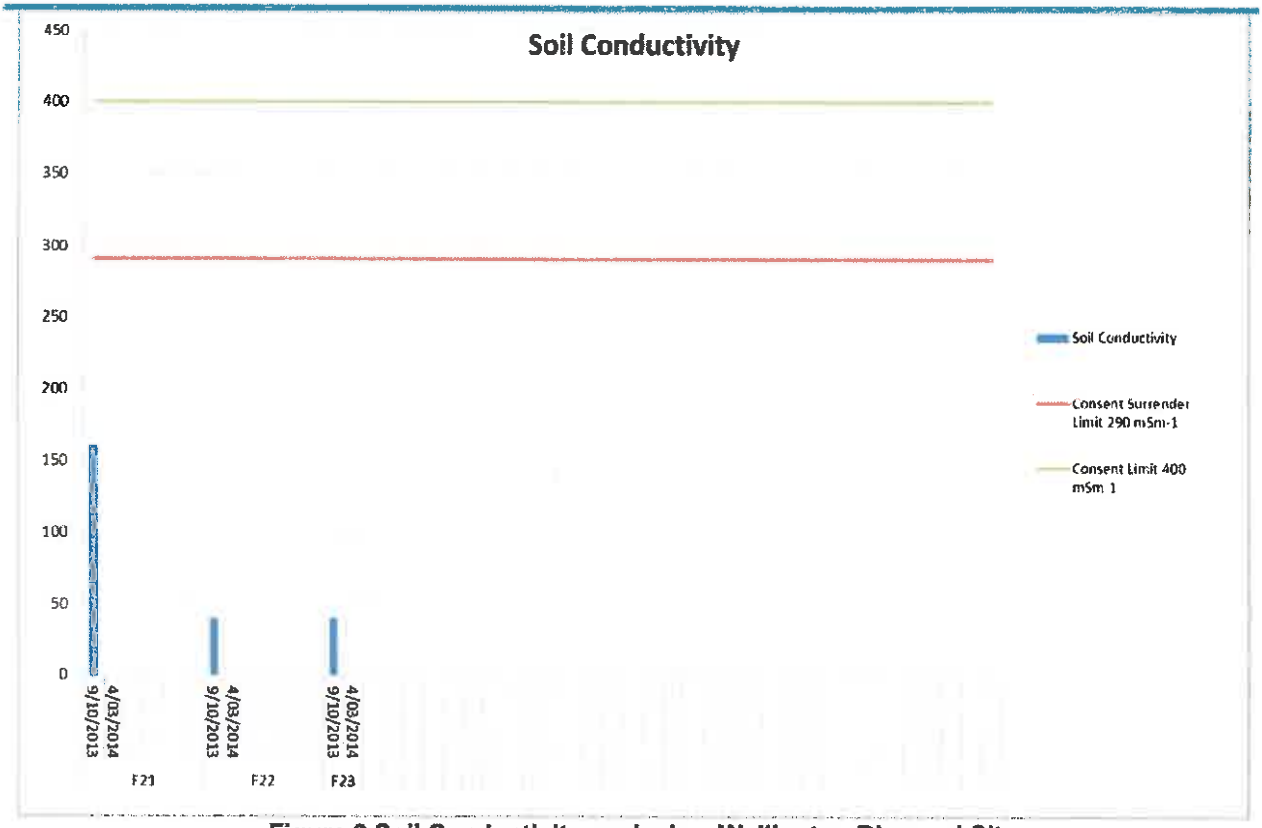


Figure 2 Soil Conductivity analysis – Wellington Disposal Site

Over the year in review, the consent limit for Soil Conductivity of 400 mS / m has now been met for all landfarmed areas as shown in figure 1 & 2 above.

4.2.2 Condition 24 – SAR

Condition 24 requires:

24. 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 the Figure 3 & 4 below, SAR limits have generally been low and all areas have met surrender criteria throughout the sampling regime to date.

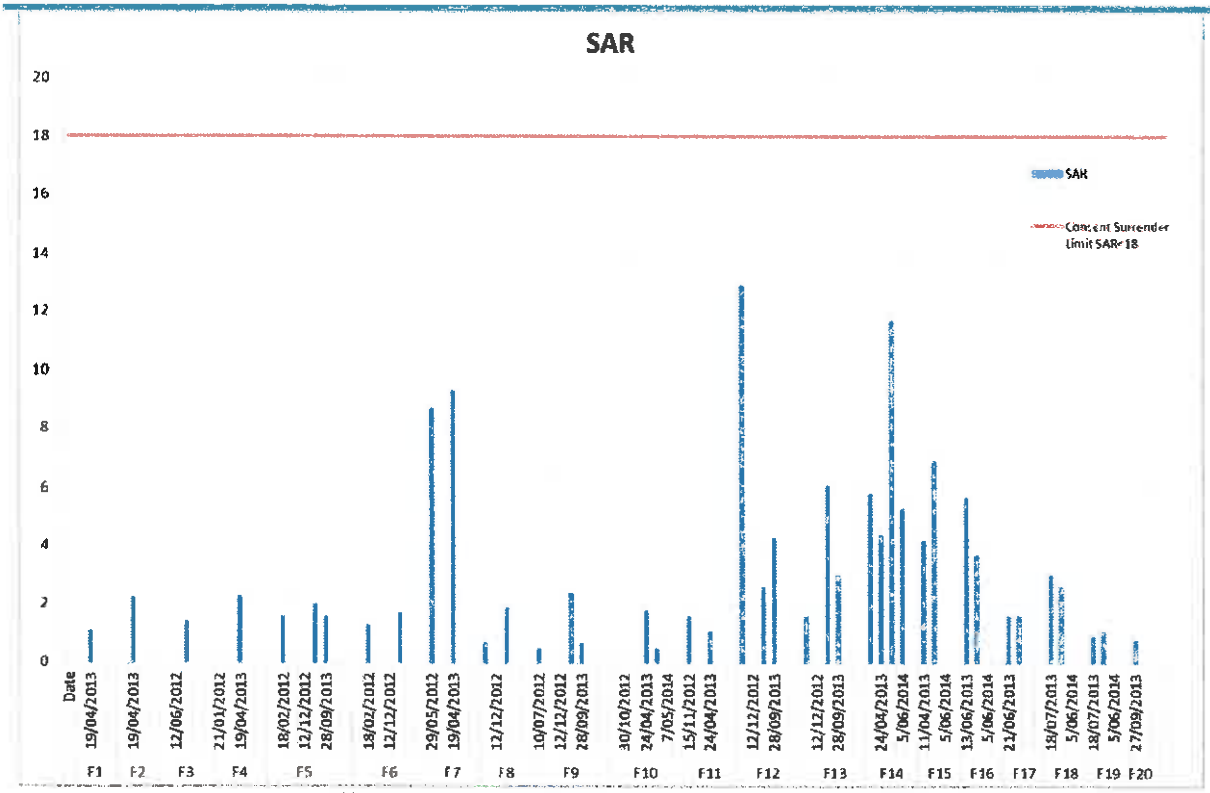


Figure 3 SAR analysis – Wellington Disposal Site

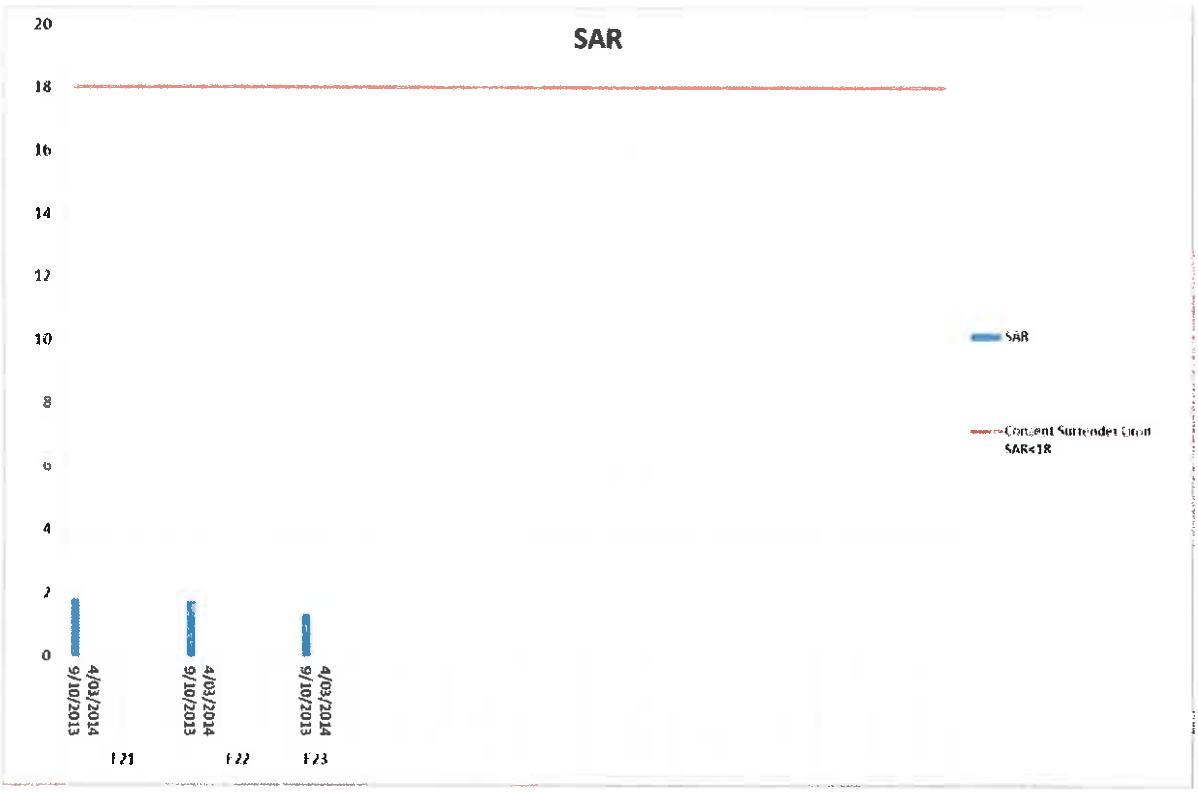


Figure 4 SAR analysis – Wellington Disposal Site

4.2.3 Condition 25 – Heavy Metals

Condition 25 requires:

25. The concentration of metals in the soil shall as 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 complaint 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 26 and 27 – Constituent Closure Criteria

Condition 26 requires:

26. From 1 March 2027 (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 Closure Criteria – Condition 26

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

MAHs – benzene, toluene, ethylbenzene, xylenes
PAHs – naphthalene, non coarc. (Pyrene) benzo(a)pyrene eq.
TPH – Total petroleum hydrocarbons (C_7-C_9, C_{10}-C_{14}, and C15-C_{36}).

The requirement to meet these standards shall not apply if, before 1 March 2027, the consent holder applies for a new consent to replace this consent when it expires, and that application is not subsequently withdrawn.

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

The following presents a series of figures detailing results from the landfarm monitoring in respect to meeting surrender criteria.

4.2.5 Conductivity

Figures 1 & 2 (above) overviews the soil conductivity results and identifies all sites met the consent surrender limit of 290 mS / m.

Area/s not within surrender limits: None

4.2.6 Chloride

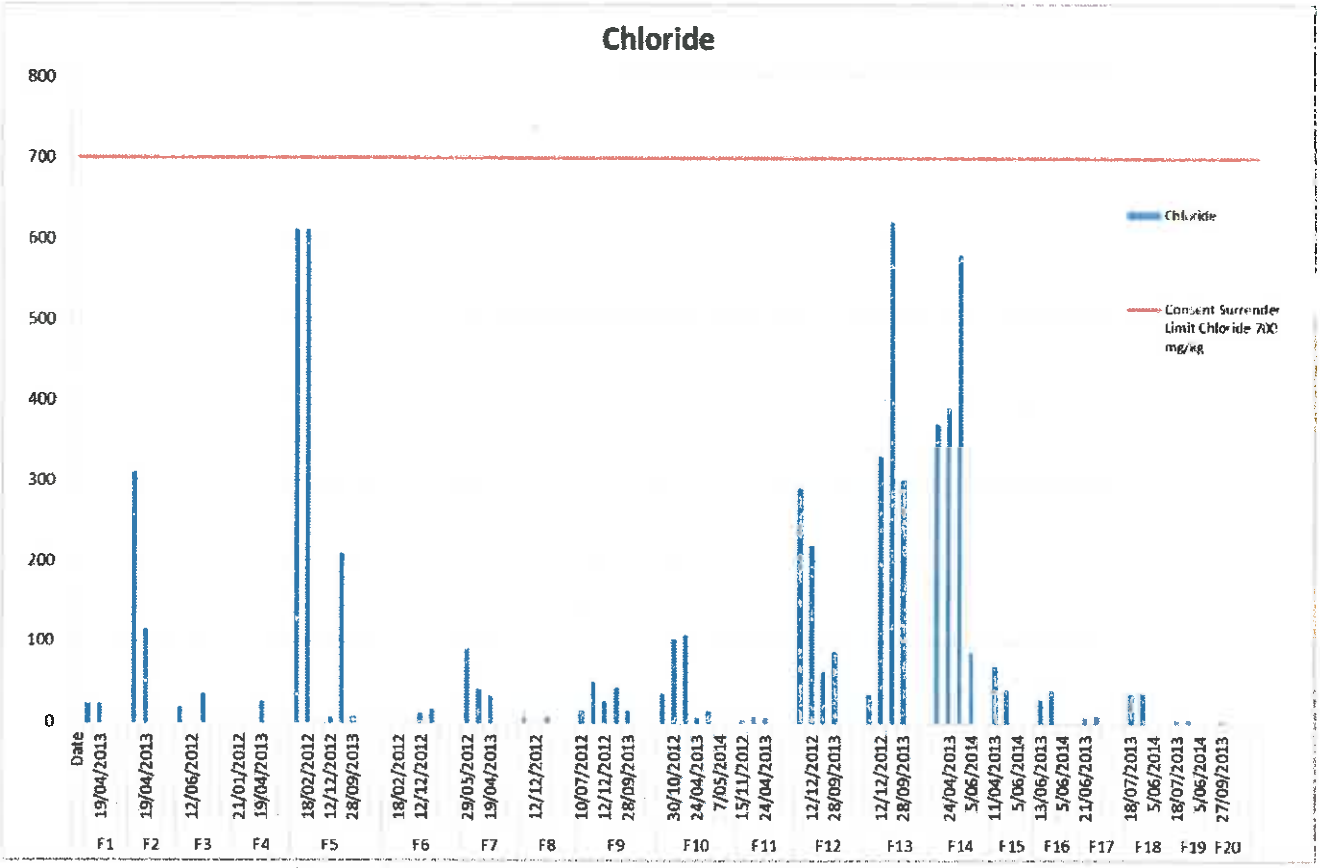


Figure 5 Chloride analysis – Wellington Disposal Site

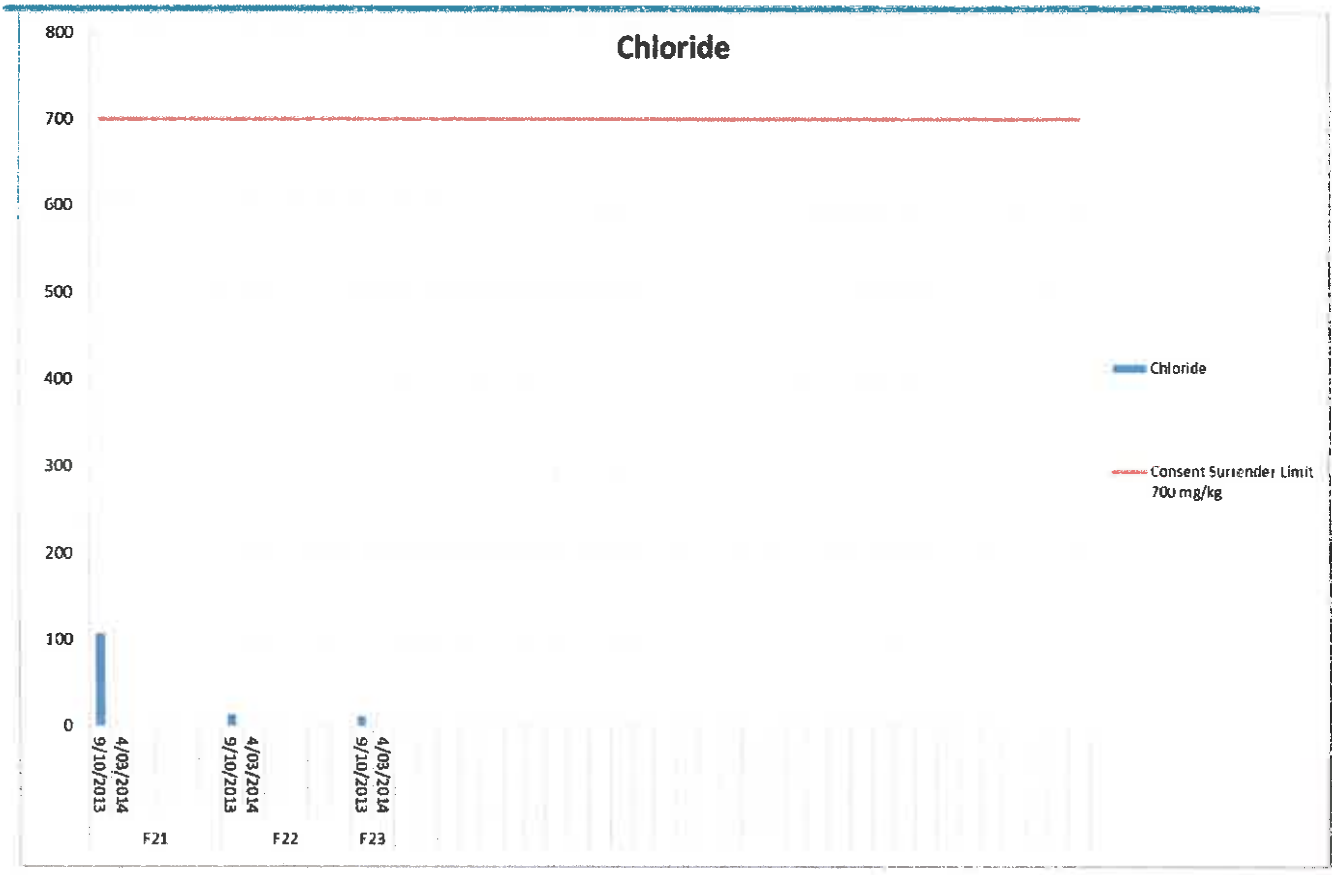


Figure 6 Chloride analysis – Wellington Disposal Site

As shown in Figure 5 & 6, consent surrender requirements for Chloride have been met for all monitored areas of the landfarm.

4.2.7 Sodium

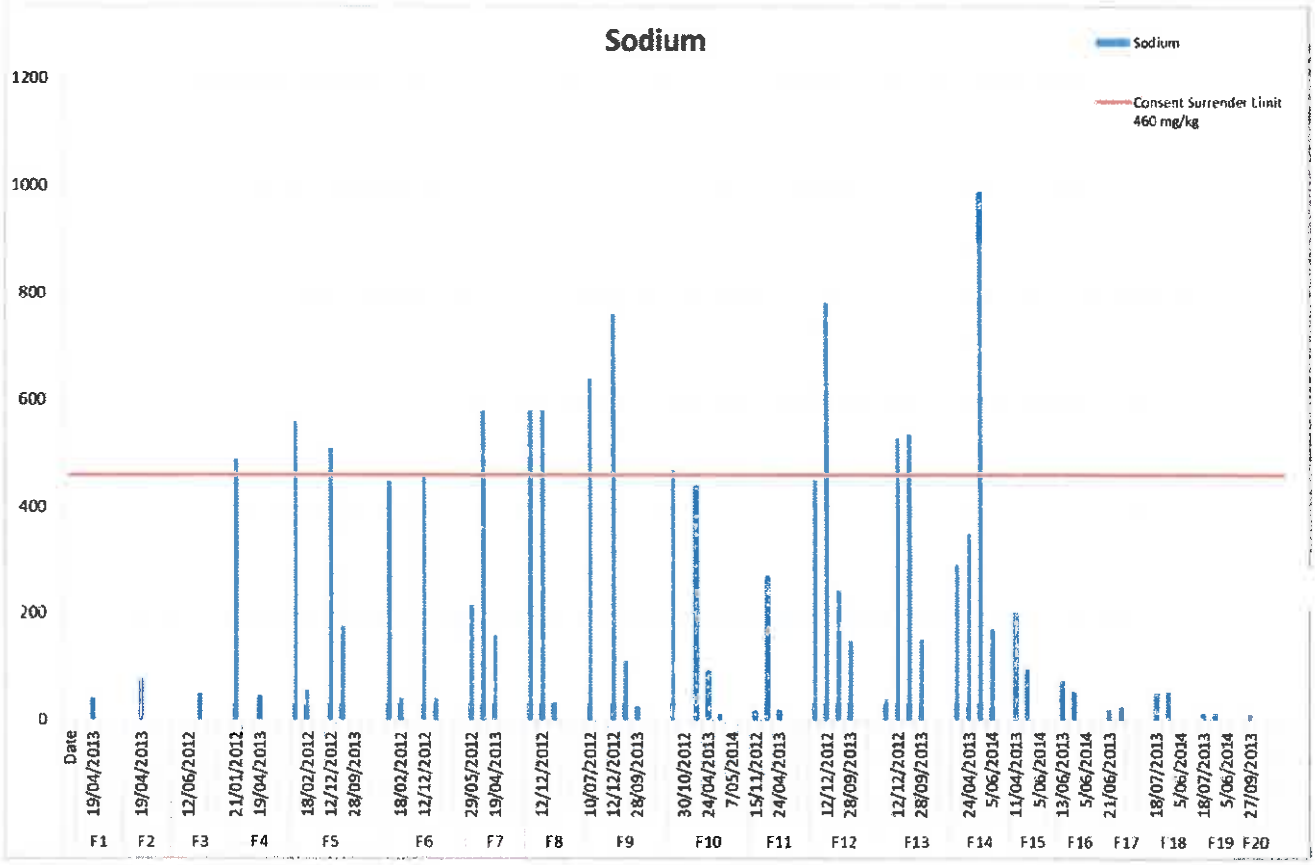


Figure 7 Sodium analysis – Wellington Disposal Site

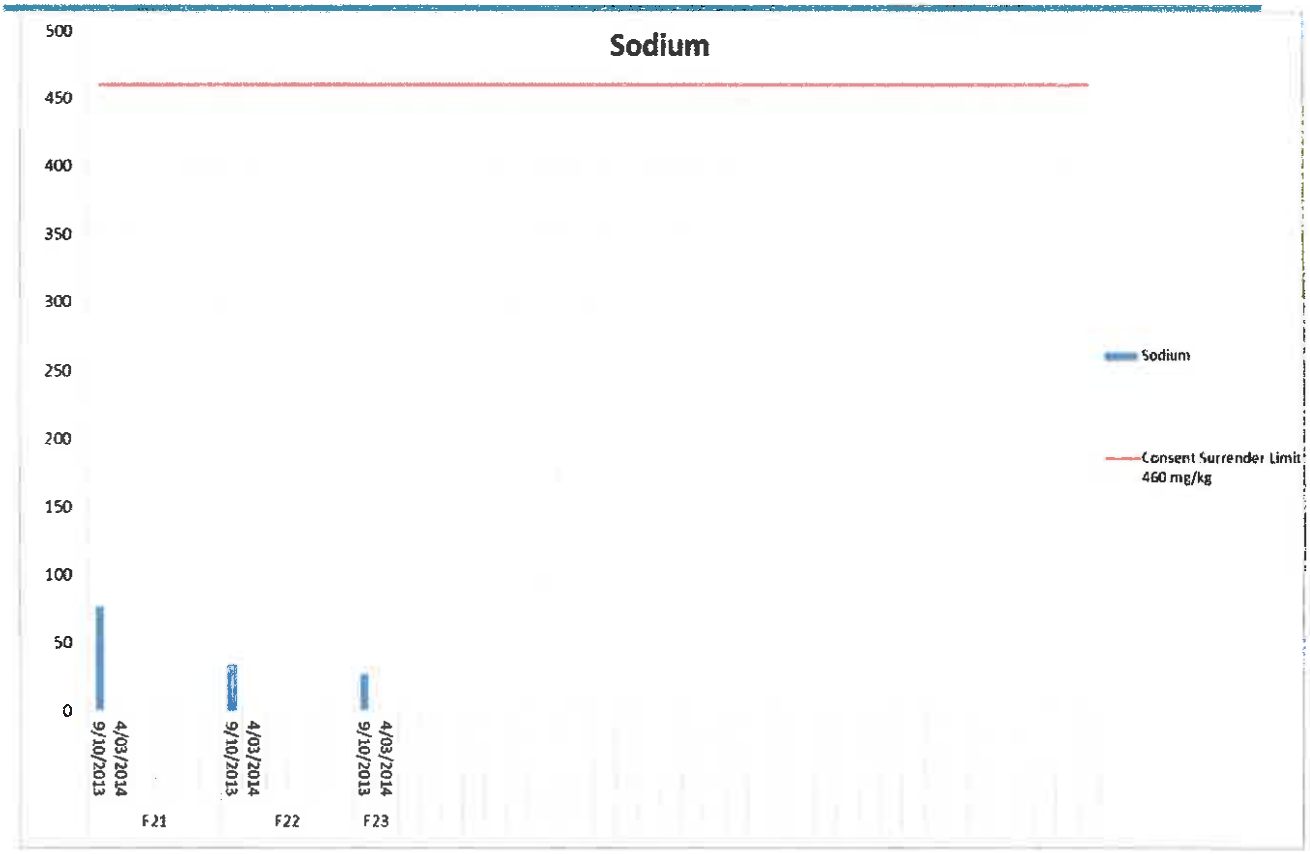


Figure 8 Sodium analysis – Wellington Disposal Site

Figures 7 & 8 provide an overview of sodium results across the landfarming areas. The results demonstrate that exceedance of the sodium criteria has significantly reduced in all areas that had shown in the past sodium levels above the surrender criteria. All landfarmed areas now meet the surrender criteria for sodium.

Area/s not within surrender limits: None

4.2.8 Dissolved Salts

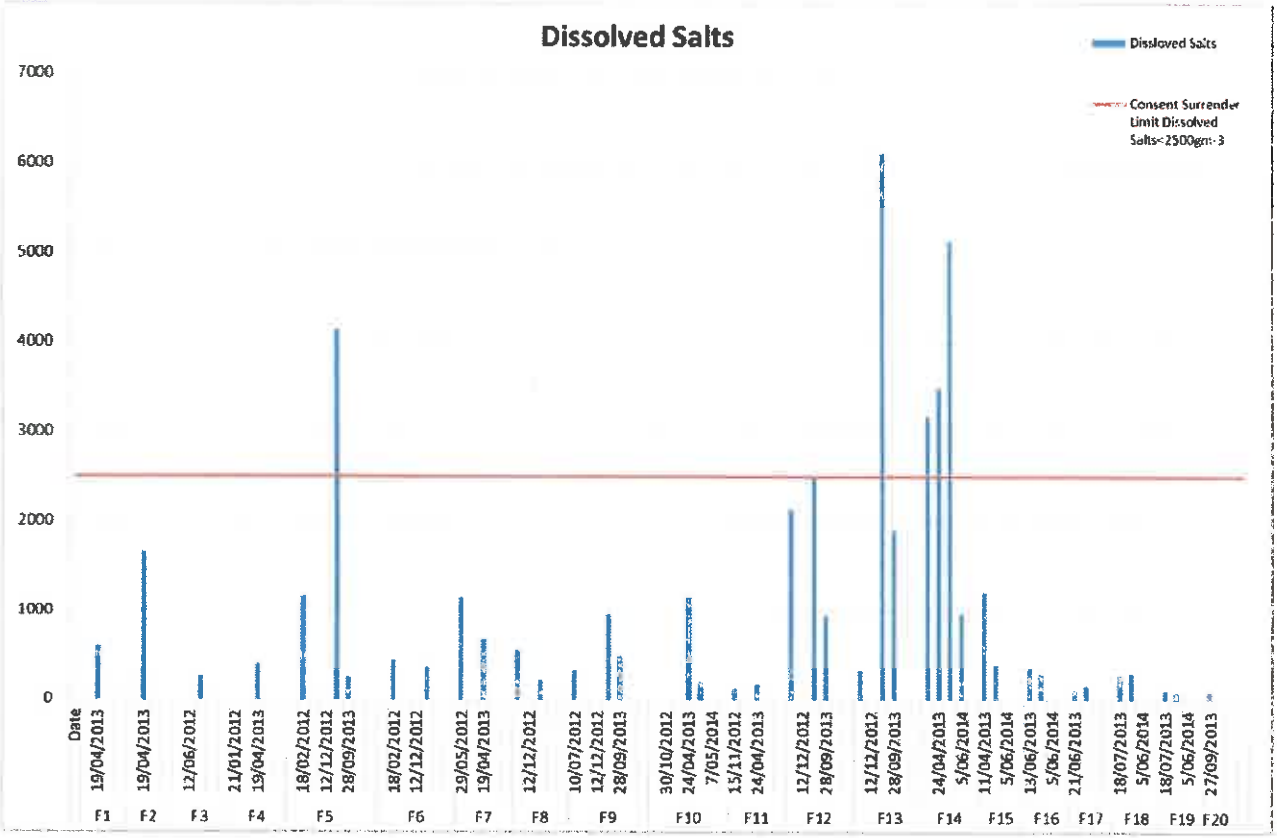


Figure 9 Dissolved Salts analysis – Wellington Disposal Site

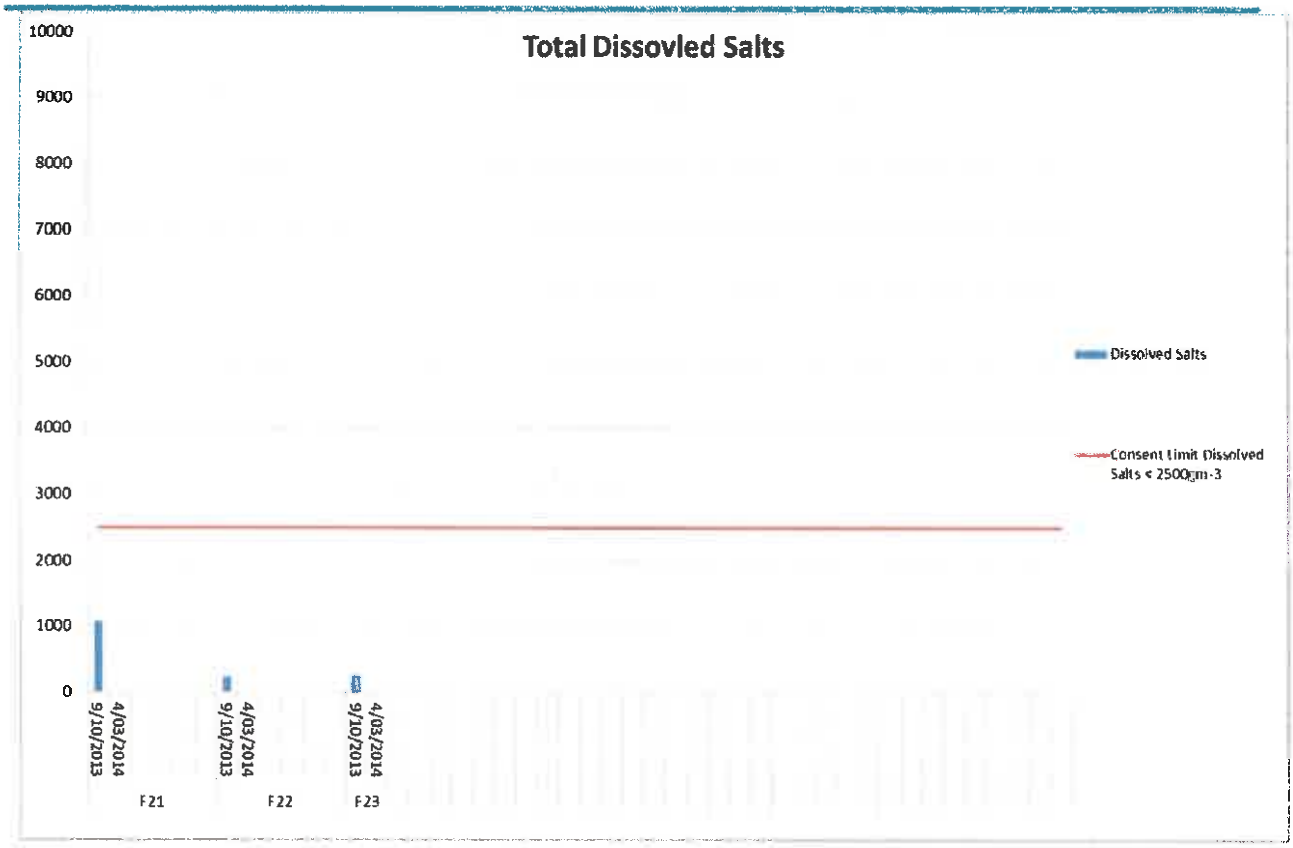


Figure 10 Dissolved Salts analysis – Wellington Disposal Site

Dissolved salt concentrations in the past for areas F5, F13 and F14 have been quite elevated, however overtime have reduced, and now all areas met the consent surrender criteria for dissolved salts.

Area/s not within surrender limits: None.

4.2.9 TPH C7 – C9

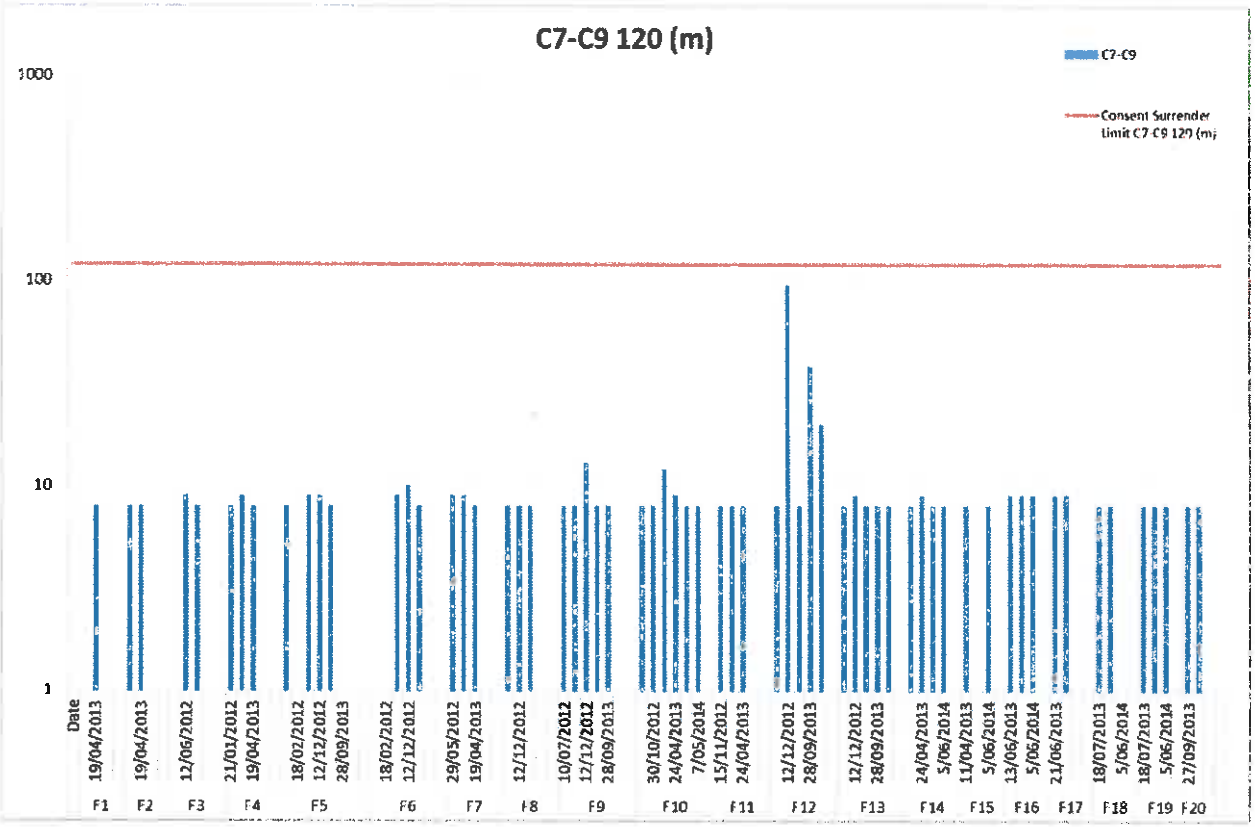


Figure 11 TPH C7-C9 – Wellington Disposal Site

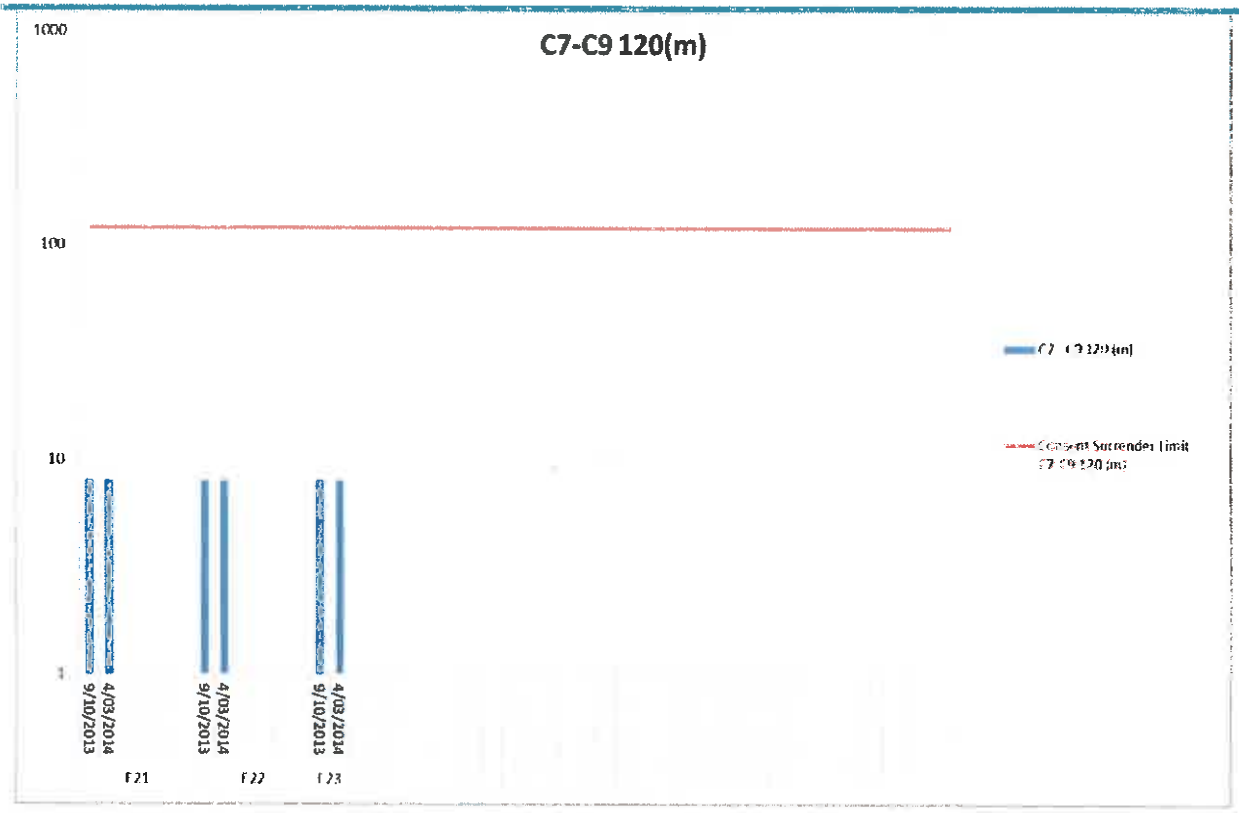


Figure 12 TPH C7-C9 – Wellington Disposal Site

As demonstrated in figures 11 & 12 all areas have been compliant with consent surrender limits throughout all soil sampling testing regimes to date for the hydrocarbon chains C7 to C9.

Area/s not within surrender limits: None.

4.2.10 TPH C10 – C14

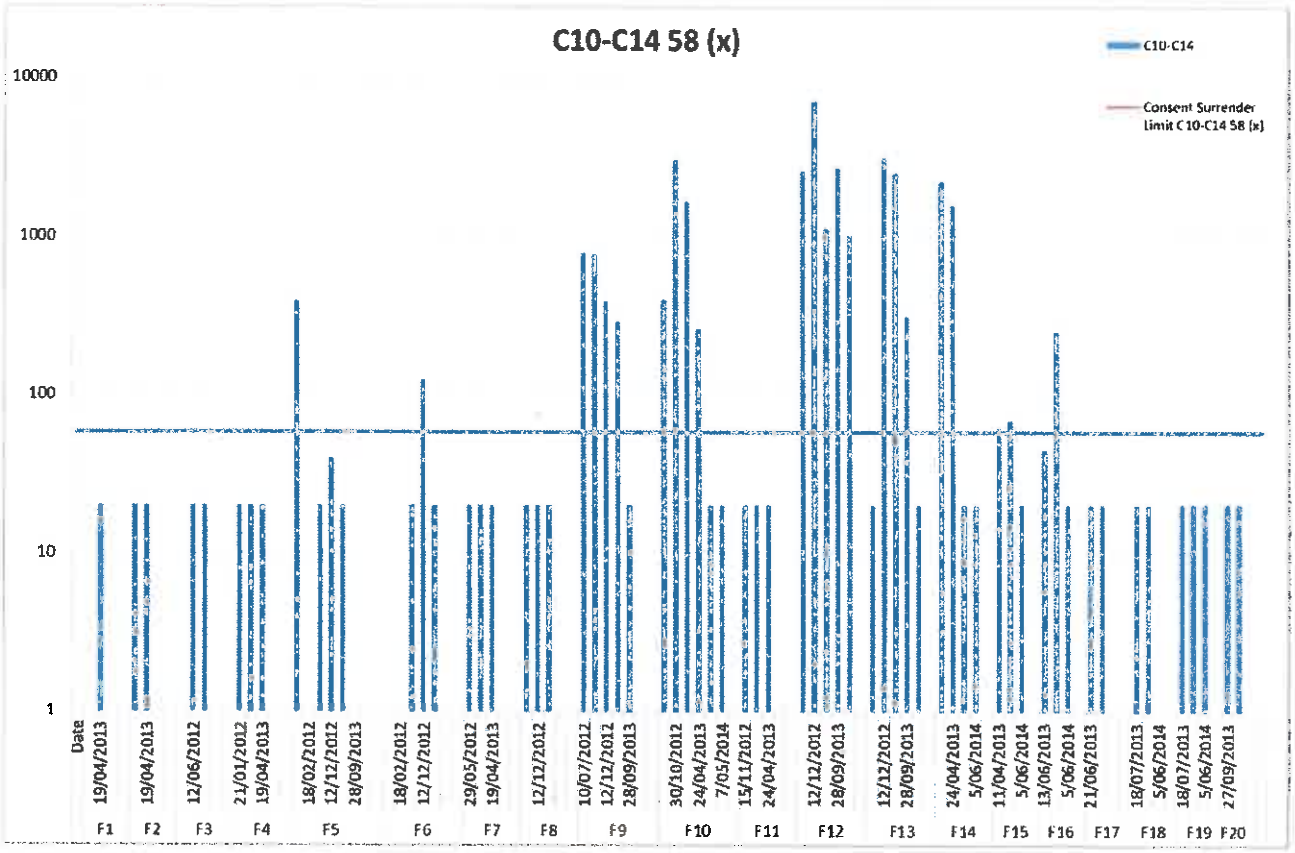


Figure 13 TPH C10-14 – Wellington Disposal Site

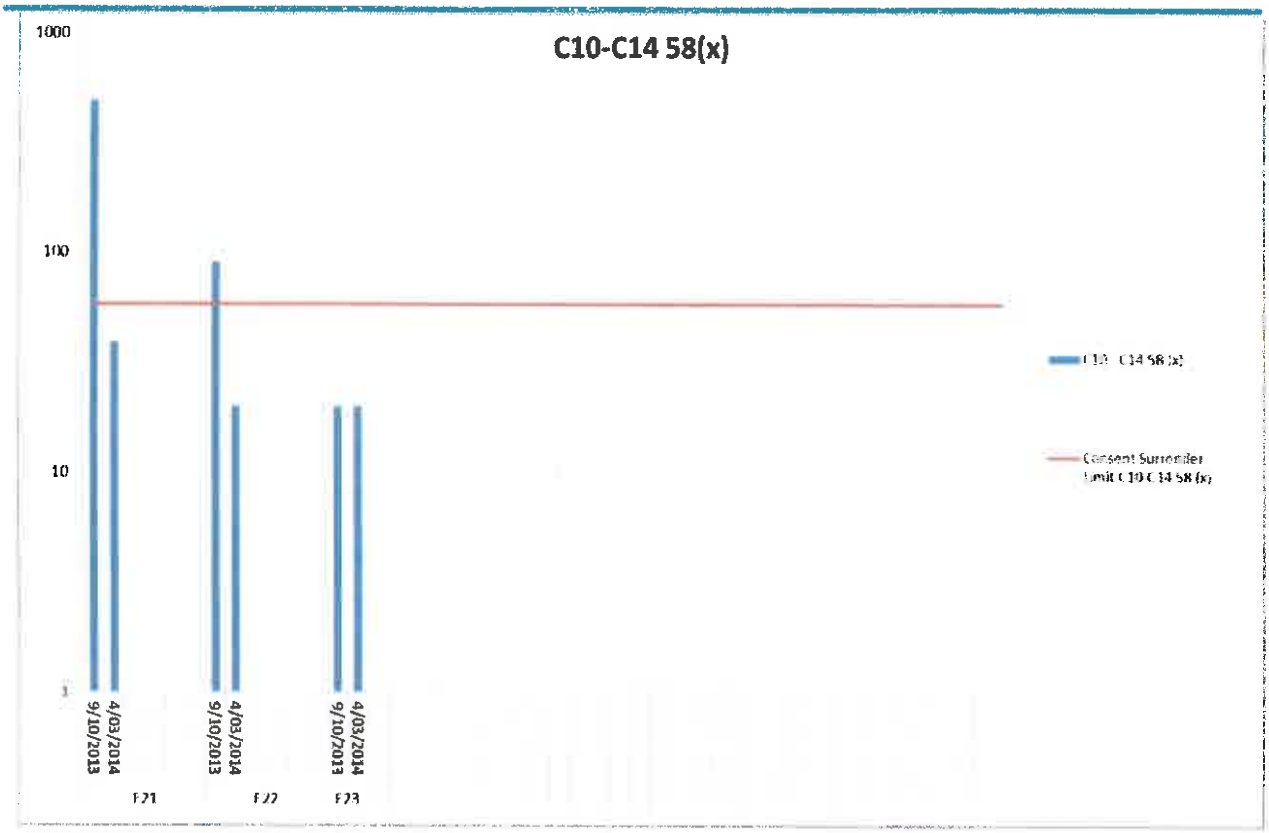


Figure 14 TPH C10-14 – Wellington Disposal Site

The hydrocarbon chain C10-C14 has been the chain of hydrocarbons which has been elevated in a number of landfarming areas. Obviously this chain is dependent on the waste source, however from our results it is generally elevated within synthetic based muds. Hydrocarbons are biodegradable and do break down over time and the sampling results over time reflect this.

From the last round of sampling only one area (F12) has elevated hydrocarbons in the C10-C14 chain. The levels are elevated however meet consent requirement, however not consent surrender requirements. All other area meet consent surrender requirements for the C10-C14 chain of hydrocarbons.

Area/s not within surrender limits: F12

4.2.11 TPH C15 – C36

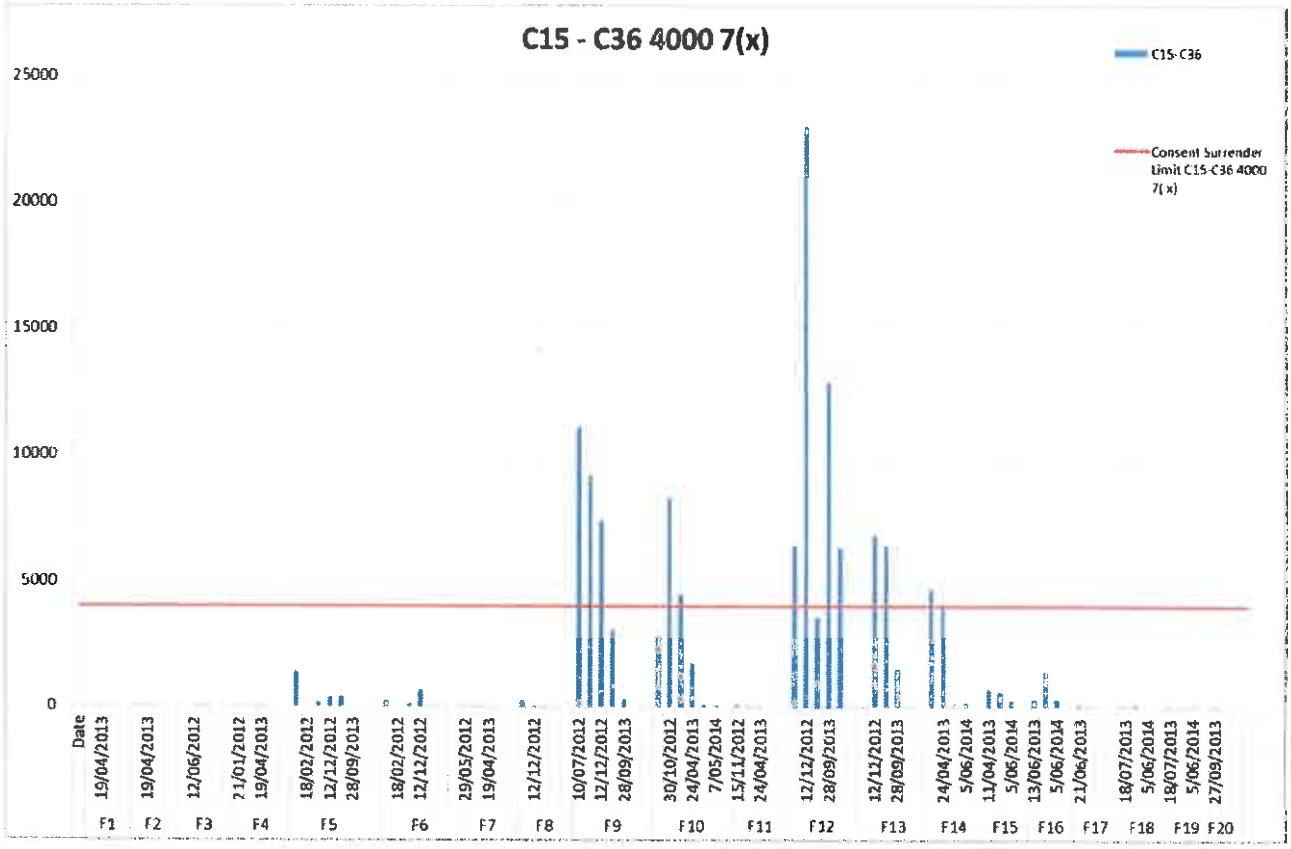


Figure 15 TPH C15-36 – Wellington Disposal Site

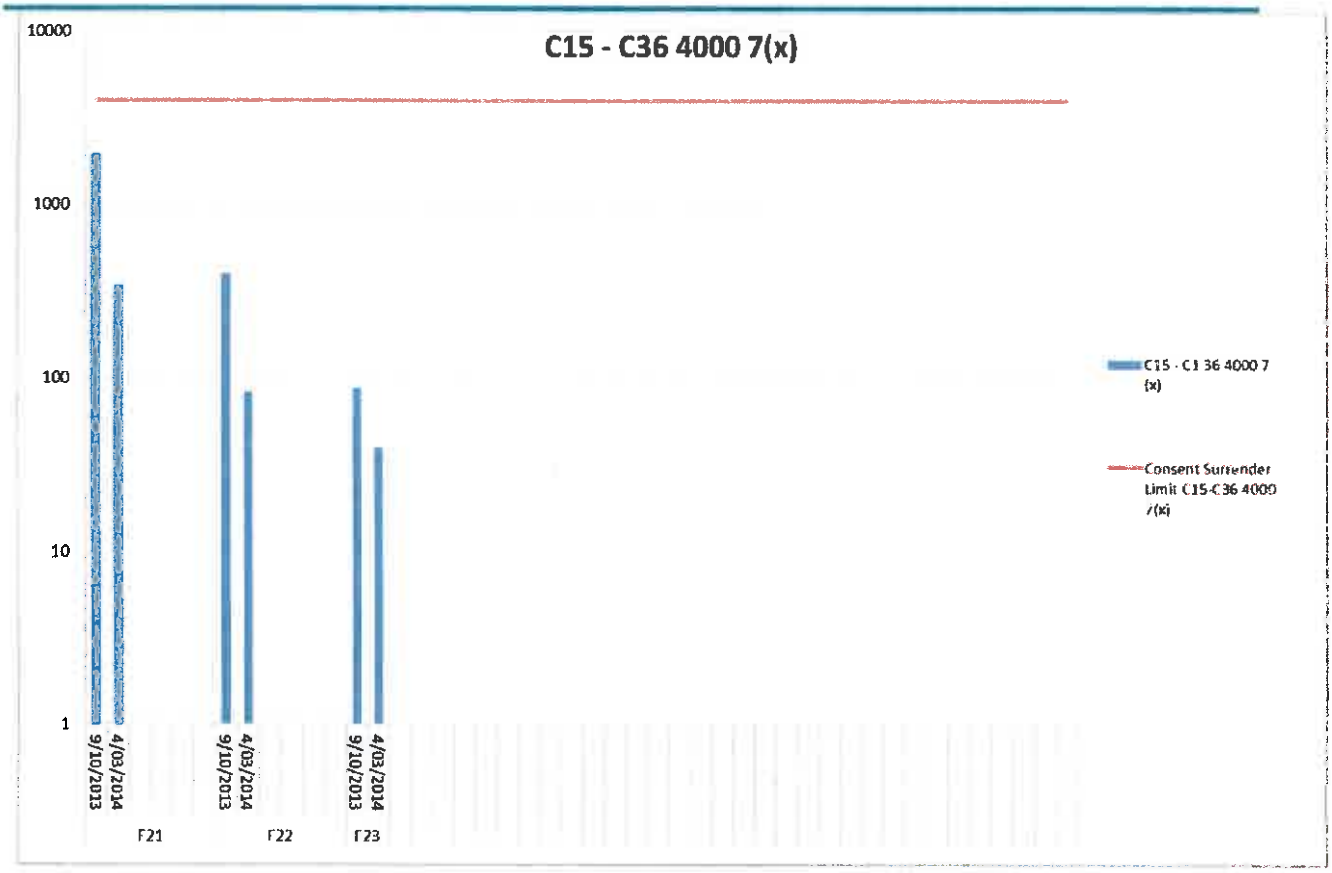


Figure 16 TPH C15-36 – Wellington Disposal Site

Of the sampled sites only F12 remains above the consent surrender limits. F12 is an area of concern due to high levels of TPH in the soil. The levels meet consent requirements; however are still above consent surrender limits after approximately 18 months. It is likely this area would require additional aeration to assist the breakdown of this hydrocarbon chain. All other areas have significantly reduced, even areas that initially had high levels of the hydrocarbon chain C15-C36. Table 4.4 below demonstrated the reduction in TPH C15-C36 over areas that had high levels of TPH C15-C36 initially during application. The results are positive except for the F12 area.

Table 4.3: 5 Reduction in TPH C15-C36 over sampling time frames.

Site	*Time Period*	*Months*	*% Reduction*
F9	10/7/2012 to 28/09/13	14	98%
F10	10/7/2012 to 7/05/14	22	100%
F12	15/11/2012 to 7/05/14	18	2%
F21	9/10/14 to 5/6/14	8	92%

Area/s not within surrender limits: F12

4.2.12 Summary

Over the monitoring year we have generally seen a reduction of contaminates in the soil. The site which has 23 individual landfarmed areas now only has two areas (F12 & F18) that don't meet surrender criteria for the consent. All areas that have been landfarmed during the 2013/2014 monitoring year meet surrender criteria for the consent, which is a stringent standard to meet and largely follows the Ministry for the Environment guidelines for assessing and managing petroleum hydrocarbons on contaminated site in New Zealand.

The results for the F18 area have shown a trace of benzo pyrene which is likely to be associated with the burning of some trees on-site due to incomplete combustion and the by-product of charcoal forming. Charcoal was observed at the surface during sampling this area. Therefore it would be fair to conclude this area has been affected by external influences in regards to recent soil sampling.

The F12 area still has elevated hydrocarbons in isolated areas; these hotspots are quite obvious from a site walk over, however are small and isolated. From soil sampling of these hotspots there has been very little reduction in the hydrocarbon levels. Even though the levels in the soil meet the consent requirements it is the intension of the consent holder to reduce these levels to surrender limits in the next monitoring year. The likely solution is to lightly drill these hot spot areas, which will aerate the soil at these locations. The aeration will accelerate microbial activity needed to break down the elevated hydrocarbons in this area. Monitoring of this area will be closely observed by the consent holder over the next year.

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

Overall the soil sampling results have demonstrated a significant reduction in any elevated constituents from initial application of the waste sources. We expect levels to continue to bio remediate over time to background levels.

APPENDIX A COMPOSITION OF WASTE

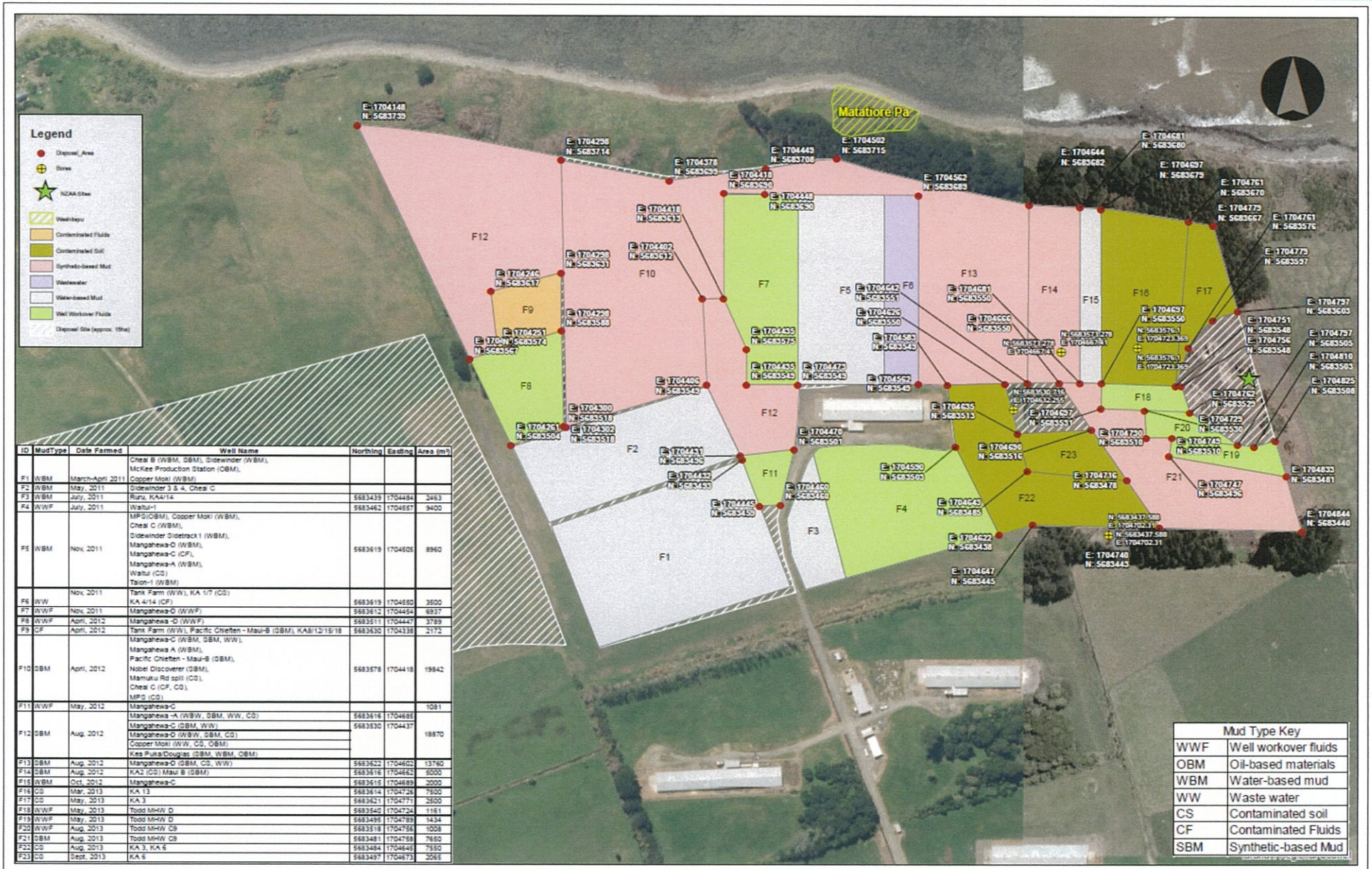
BTW COMPANY		Section of Regulations		Test Certificates					Emergency Management														Sched 4
		Sub-section		Location & Transit	manufacture and Use	Approved Handler	Hazardous atmosphere zone	Tracking	EM Level 1	EM Level 2	EM Level 3	Fire Extinguisher	Fire Extinguisher	Documentation	Signage	Signage	Separation	Separation	Separation	Incompatibility	Disposal		Bunding
		Reference		4.2	4.2	4.3	4.4	4.5	5.2.1	5.2.2	5.2.3	5.2.5	5.2.5	5.3.1	5.3.2	5.3.2	5.4.1	5.4.1	5.4.1	5.4.1	5.5		
		Schedule Table reference from Regulations		Table 1	Table 1	Table 2	Table 3	Table 4	Table 5	Table 6	Table 7	Table 8	Table 8	Table 9	Table 10	Table 10	Table 11	Table 11	Table 11	Table 12	Table 13	Table 14	Sched 4
		Description of what the numbers relate to in table below		Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Number of Extinguishers	Threshold level	Emergency Regulations	Identification Requirements	Low Intensity Land Use Threshold VOLUME	Low Intensity Land Use Separation Distance	Separation required from	Incompatible substances	Information Requirements	Documentation Requirements	Threshold
Asphasol (4-5% Crystalline Silica)	Solid/ Powder	6.7A Substances that are carcinogenic	0	-	-	10L	-	-	-	0.1L	1000L	-	-	0.1L	-	-	-	-	-	-	Any	0.1L	1000L
		6.9A (Inhalation) Toxic to human target organs or systems		-	-	-	-	-	-	0.1L	10000L	-	-	0.1L	-	-	-	-	-	-	Any	0.1L	10000L
Calcium Carbonate (Omyacal 16/100, 15 & 25)	Solid	6.4A Irritating to the eye	47500kg	-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-
Caustic Soda	Solid	6.1D (Oral) Acutely toxic	125kg	-	-	-	-	-	0.1kg	3.0kg	1000kg	-	-	30.kg	10000kg	10000kg	-	-	-	-	0.1kg	3.0kg	1000kg
		8.2A Metallic corrosive		-	-	-	-	-	Any	1.0kg	-	-	-	2.0kg	1000kg	1000kg	-	-	-	-	-	2.0kg	-
		8.2B Skin corrosive		-	-	-	-	-	Any	1.0kg	1000kg	-	-	1.0kg	250kg	250kg	-	-	-	-	Any	1.0kg	1000kg
		8.3A Corrosive to eyes		-	-	-	-	-	0.1kg	1.0kg	10000kg	-	-	2.0kg	1000kg	1000kg	-	-	-	-	0.1kg	2.0kg	10000kg
		9.1D Slightly harmful to the aquatic environment or otherwise designed for biocidal action.		-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	10000kg	10000kg	-	-	-	-	1.0kg	50kg	10000kg
		9.3C Harmful to terrestrial vertebrates																					
Ecotrol RD	Solid	3.1C Flammable (Medium hazard)	1225kg	-	-	-	-	-	1.0kg	5.0kg	-	-	-	5.0kg	10000kg	10000kg	-	-	-	-	1.0kg	5.0kg	-
				-	-	-	-	-	-	-	-	-	-	-	1000kg	1000kg	-	-	-	Class 1 Class 2 Class 3.2 Class 4 Class 5	-	-	-
		6.1C Acutely toxic (Inhalation)		-	-	Any	-	[illegible]	ANY	0.5kg	100kg	-	-	0.5kg	1000kg	1000kg	-	-	-	-	Any	0.5kg	100kg
		6.1E Acutely toxic (Oral)		-	-	-	-	-	1.0kg	50kg	-	-	-	50kg	-	-	-	-	-	-	1.0kg	50kg	-
		6.3B Skin irritant		-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	1.0kg	50kg	-
		6.4A Eye irritant		-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.2kg	50kg	-
		6.6B Suspected human mutagen		-	-	-	-	-	-	3.0kg	-	-	-	30.kg	-	-	-	-	-	-	0.1kg	3.0kg	-
		6.8B Suspected human reproductive or developmental toxicant		-	-	-	-	-	-	3.0kg	-	-	-	30.kg	-	-	-	-	-	-	-	3.0kg	-
		6.9B Harmful to human target organs or systems (Inhalation)		-	-	-	-	-	-	3.0kg	-	-	-	30.kg	-	-	-	-	-	-	0.1kg	3.0kg	-
		9.1D Slightly harmful to the aquatic environment or otherwise designed for biocidal action.																					
Frac Attack	Powder	TBC	5000kg	-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	10000kg	10000kg	-	-	-	-	1.0kg	50kg	10000kg
Glute 25	Liquid	6.1D (Oral) Acutely toxic	25L	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	1000L
		6.5B Contact sensitiser		-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	-	-	-	-	-	-	Any	1.0L	1000L
		8.2C Corrosive to dermal tissue		-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1kg	1.0L	10000L
		8.3A Corrosive to eyes		-	-	-	-	-	0.2L	1.0L	10000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1L	1.0L	10000L
Glydril LC	Liquid	6.1D (Oral) Acutely toxic	0	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	1000L
		6.4A Irritating to the eye		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	1.0L	5.0L	-
Glydril MC	Liquid	6.1D (Oral) Acutely toxic	0	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	1000L
		6.4A Irritating to the eye		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	1.0L	5.0L	-
G-Seal	Solid/ Powder	6.1E Acutely toxic	4000kg	-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	1.0L	5.0L	-
		6.3B Mildly irritating to the skin		-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	1.0kg	50kg	-
		6.4A Irritating to the eye		-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-
		9.1D Slightly harmful to the aquatic environment or otherwise designed for biocidal action.		-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	10000kg	10000kg	-	-	-	-	1.0kg	50kg	10000kg
HRP	Liquid	6.3A Skin irritant	835L	-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-
Kleen Up	Liquid	6.3A Skin irritant	1875L	-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-
		6.4A Irritating to the eye		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-
Lime	Powder/ Dust	8.2C Corrosive to dermal tissue	2000kg	-	-	-	-	-	0.1kg	1.0kg	10000kg	-	-	2.0kg	1000kg	1000kg	-	-	-	-	-	2.0kg	10000kg
		8.3A Corrosive to eyes		-	-	-	-	-	0.1kg	1.0kg	10000kg	-	-	2.0kg	1000kg	1000kg	-	-	-	-	0.1kg	2.0kg	10000kg
		9.1D Slightly harmful to the aquatic environment or otherwise designed for biocidal action.		-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	10000kg	10000kg	-	-	-	-	1.0kg	50kg	10000kg
M-I Barite	Powder	6.1D (Oral) Acutely toxic	40000kg	-	-	-	-	-	0.1kg	3.0kg	1000kg	-	-	30.kg	10000kg	10000kg	-	-	-	-	0.1kg	3.0kg	1000kg
		6.7A Substances that are carcinogenic		-	-	10kg	-	-	-	0.5kg	1000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	1000kg
		6.9A (Inhalation) Toxic to human target organs or systems		-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	1.0kg	5.0kg	-	-	-	5.0kg	10000kg	10000kg	-	-	-	-	1.0kg	5.0kg	-
M-I Gel Supreme (Bentonite)	Powder	6.7A Substances that are carcinogenic	181kg	-	-	10kg	-	-	-	0.5kg	1000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	1000kg
		6.9A (Inhalation) Toxic to human target organs or systems		-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg
MIX II (Coarse & Fine)	Powder	6.7A Substances that are carcinogenic	4000kg	-	-	10kg	-	-	-	0.5kg	1000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	1000kg
		6.9A (Inhalation) Toxic to human target organs or systems		-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg
Novamul	Liquid	3.1D Flammable liquids: low hazard	3200L	-	-	-	-	-	5.0L	50L	10000L	500L	2	50L	10000L	10000L	-	-	-	Class 1 Class 2 Class 3.2 Class 4 Class 5	5.0L	50L	10000L
Novatec F	Liquid	6.1D (Oral) Acutely toxic	4095L	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	1000L
		6.5A Respiratory sensitiser		-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	-	-	-	-	-	-	Any	1.0L	1000L
		6.5B Contact sensitiser		-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	-	-	-	-	-	-	Any	1.0L	1000L
		8.2C Corrosive to dermal tissue		-	-	-	-	-	0.2L	1.0L	10000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1kg	1.0L	10000L
		8.3A Corrosive to eyes		-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.2L	1.0L	10000L
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	1.0L	5.0L	-
KCl	Powder	6.1E Acutely toxic	24075kg	-	-	-	-	-	1.0kg	50kg	-	-	-	50kg	-	-	-	-	-	-	1.0kg	50kg	-
		6.3B Mildly irritating to the skin.		-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	1.0kg	50kg	-
		6.4A Irritating to the eye		-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-
		9.3B Ecotoxic to terrestrial vertebrates.		-	-	-	-	-	0.2kg	5.0kg	-	-	-	5.0kg	1000kg	1000kg	-	-	-	-	0.2kg	5.0kg	-

BTW COMPANY		Section of Regulations		Test Certificates					Emergency Management														Sched 4
		Sub-section		Location & Transit	manufacture and Use	Approved Handler	Hazardous atmosphere zone	Tracking	EM Level 1	EM Level 2	EM Level 3	Fire Extinguisher	Fire Extinguisher	Documentation	Signage	Signage	Separation	Separation	Separation	Incompatibility	Disposal		Bunding
		Reference																					
		Schedule Table reference from Regulations		4.2	4.2	4.3	4.4	4.5	5.2.1	5.2.2	5.2.3	5.2.5	5.2.5	5.3.1	5.3.2	5.3.2	5.4.1	5.4.1	5.4.1	5.4.1	5.5		
		Description of what the numbers relate to in table below		Table 1	Table 1	Table 2	Table 3	Table 4	Table 5	Table 6	Table 7	Table 8	Table 8	Table 9	Table 10	Table 10	Table 11	Table 11	Table 11	Table 12	Table 13	Table 14	Sched 4
				Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Number of Extinguishers	Threshold level	Emergency Regulations	Identification Requirements	Low Intensity Land Use Threshold VOLUME	Low Intensity Land Use Separation distance	Separation required from	Incompatible substances	Information Requirements	Documentation Requirements	Threshold
Safe Cide	Liquid	6.1D (Oral) Acutely toxic		-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1L	1.0L	1000L
		6.5B Contact sensitiser		-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	-	-	-	-	-	-	Any	1.0L	1000L
		9.3C Harmful to terrestrial vertebrates	0	-	-	-	-	-	1.0L	5.0L	-	-	-	1.0L	-	-	-	-	-	-	1.0L	5.0L	-
Safe Solv E	Liquid	6.1E Acutely toxic		-	-	-	-	-	1.0L	50L	-	-	-	5.0L	1000L	1000L	-	-	-	-	Any	1.0L	1000L
		6.5A Respiratory Sensitiser		-	-	-	-	-	1.0L	1.0L	1000L	-	-	1.0L	-	-	-	-	-	-	1.0L	50L	-
		6.5B Contact sensitiser		-	-	-	-	-	1.0L	2.0L	1000L	-	-	1.0L	-	-	-	-	-	-	Any	1.0L	1000L
		8.2C Corrosive to dermal tissue	835L	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	-	Any	1.0L	1000L
		8.3A Corrosive to eyes		-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1kg	1.0L	10000L
		9.1D Slightly harmful to the aquatic environment or otherwise designed for biocidal action.		-	-	-	-	-	1.0L	50L	10000L	-	-	50L	10000L	10000L	-	-	-	-	0.1L	1.0L	10000L
Safe Surf O	Liquid	6.1D (Oral) Acutely toxic		-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	1000L	1000L	-	-	-	-	Any	1.0L	1000L
		6.3A Skin Irritant		-	-	-	-	-	1.0L	50L	10000L	-	-	50L	10000L	10000L	-	-	-	-	0.1L	1.0L	10000L
		8.3A Corrosive to eyes		-	-	-	-	-	0.2L	1.0L	1000L	-	-	2.0L	10000L	10000L	-	-	-	-	1.0L	50L	10000L
		9.1D Slightly harmful to the aquatic environment or otherwise designed for biocidal action.	835L	-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	2.0L	1000L
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	1000L	10000	-	-	-	-	0.1L	50L	-
Salt PVD	Solid	6.1E Acutely toxic		-	-	-	-	-	1.0L	50L	10000L	-	-	50L	10000L	10000L	-	-	-	-	0.1L	1.0L	10000L
		6.4A Irritating to the eye	4200kg	-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	1.0L	50L	10000L
Saraline 185V	Liquid			-	-	-	-	-	1.0kg	50kg	-	-	-	50kg	-	-	-	-	-	-	1.0L	5.0L	-
				50L	-	-	1.0L	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	1.0kg	50kg	-
									1.0L	1.0L	1000L	250L	2	1.0L	250L	250L	-	-	-	Class 1 Class 2 Class 3.2 Class 4 Class 5	0.1kg	50kg	-
		3.1B Flammable Liquids: high hazard	0																		1.0L	1.0L	1000L
		6.1E Acutely toxic																					
		6.3B Mildly irritating to the skin		-	-	-	-	-															
Soda Ash	Solid	6.1B Acutely toxic		-	-	-	-	-	1.0L	50L	-	-	-	50L	-	-	-	-	-	-	1.0L	50L	-
		6.3A Skin Irritant		-	-	Any	-	REQUIRED	ANY	any	100kg	-	-	50L	-	-	-	-	-	-	1.0L	50L	-
		6.4A Irritating to the eye	450KG	-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	Any	Any	100kg
		6.9B Toxic to human target organs or systems		-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-
Sodium Formate	Liquid	6.1E Acutely toxic.		-	-	-	-	-	-	3.0kg	-	-	-	30kg	-	-	-	-	-	-	0.1kg	50kg	-
Sodium Formate	Solid	6.1E Acutely toxic.	80000L	-	-	-	-	-	1.0L	50L	-	-	-	50L	-	-	-	-	-	-	0.1kg	3.0kg	-
Versawet	Liquid	6.9B Toxic to human target organs or systems	2500kg	-	-	-	-	-	1.0kg	50kg	-	-	-	50kg	-	-	-	-	-	-	1.0L	50L	-
		8.3A Corrosive to eyes		-	-	-	-	-	-	1.0L	-	-	-	1.0L	-	-	-	-	-	-	1.0kg	50kg	-
		9.1D Slightly harmful to the aquatic environment or otherwise designed for biocidal action.	18921	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.2L	1.0L	-
		9.2B Ecotoxic to soil environment		-	-	-	-	-	1.0L	50L	10000L	-	-	50L	10000L	10000L	-	-	-	-	0.1L	1.0L	10000L
		9.2B Ecotoxic to terrestrial vertebrates		-	-	-	-	-	0.2L	5.0L	-	-	-	5.0L	1000L	1000L	-	-	-	-	1.0L	50L	10000L
				-	-	-	-	-	0.2L	5.0L	-	-	-	5.0L	1000L	1000L	-	-	-	-	0.2L	5.0L	-
HALLIBURTON CHEMICALS																							
A3-L	Liquid	6.1D Acutely Toxic		-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	1000L
		8.2C Corrosive to skin		-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1kg	1.0L	10000L
		8.3A Corrosive to eyes	1000L	-	-	-	-	-	0.1L	1.0L	10000L	-	-	2.0L	1000L	1000L	-	-	-	-	0.1L	1.0L	10000L
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	0.1L	1.0L	10000L	-	-	5.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	10000L
AS-S	Liquid	6.1D (oral) Acutely toxic		-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	1.0L	5.0L	-
		3.1B Flammable Liquids: high hazard		50L	-	-	1.0L	-	1.0L	1.0L	1000L	250L	2	1.0L	250L	250L	-	-	-	Class 1 Class 2 Class 3.2 Class 4 Class 5	1.0L	1.0L	1000L
		6.1E (oral) Acutely toxic																					
		6.3A Irritating to the skin	1000L	-	-	-	-	-	1.0L	50L	10000L	-	-	50L	-	-	-	-	-	-	1.0L	50L	-
		6.3B Mildly irritating to the skin		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-
		6.4A Irritating to the eye		-	-	-	-	-	1.0L	50L	10000L	-	-	50L	-	-	-	-	-	-	1.0L	50L	-
		8.3A Corrosive to ocular tissue		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-
		9.1D (fish, crustacea, algae) Slightly harmful to the aquatic environment or are otherwise designed for biocidal action		-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1L	50L	-
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	1.0L	50L	10000L	-	-	5.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	10000L
Calcium Chloride	Solid	6.1D (oral) Acutely toxic		-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	1.0L	5.0L	-
		6.3A Irritating to the skin		-	-	-	-	-	0.1kg	3.0kg	1000kg	-	-	5.0L	10000L	10000L	-	-	-	-	0.1kg	3.0kg	1000kg
		6.4A Irritating to the eye	1000kg	-	-	-	-	-	0.1kg	50kg	10000kg	-	-	30kg	10000kg	10000kg	-	-	-	-	1.0L	5.0L	-
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	3.0kg	1000kg
CFR-3	Solid	6.1E Acutely toxic (oral)		-	-	-	-	-	1.0kg	50kg	-	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-
CFR-3L	Liquid	6.3A Irritating to the skin	1000kg	-	-	-	-	-	1.0kg	5.0kg	-	-	-	5.0kg	10000kg	10000kg	-	-	-	-	0.1kg	50kg	-
		6.4A Irritating to the eye	1000L	-	-	-	-	-	1.0kg	50kg	-	-	-	50kg	-	-	-	-	-	-	1.0kg	5.0kg	-
Class G Cement	Solid	6.1D(oral) Acutely toxic		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	1.0kg	50kg	-
		6.5A Respiratory sensitisers		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-
		6.5B Contact sensitisers		-	-	-	-	-	0.1kg	3.0kg	1000kg	-	-	30kg	10000kg	10000kg	-	-	-	-	0.1L	50L	-
		8.2C Corrosive to dermal tissue	1000kg	-	-	-	-	-	2.0kg	3.0kg	1000kg	-	-	30kg	-	-	-	-	-	-	0.1kg	3.0kg	1000kg
		8.3A Corrosive to eyes		-	-	-	-	-	1.0kg	3.0kg	1000kg	-	-	30kg	-	-	-	-	-	-	Any	3.0kg	1000kg
Cleanbore_6	Liquid	6.1D (oral) Acutely toxic		-	-	-	-	-	0.1kg	1.0kg	10000kg	-	-	2.0kg	10000kg	1000kg	-	-	-	-	Any	3.0kg	1000kg
		6.3A Irritating to the skin		-	-	-	-	-	0.1kg	1.0kg	10000kg	-	-	2.0kg	10000kg	1000kg	-	-	-	-	-	2.0kg	10000kg
		8.3A Corrosive to ocular tissue	1000L	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1kg	2.0kg	10000kg
		9.1D (fish, crustacea, algae) Slightly harmful to the aquatic environment or are otherwise designed for biocidal action		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	1.0L	1000L
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	1000L	1000L	-	-	-	-	0.1L	50L	-
D-Air 3000	Liquid	6.5B Mildly irritating to the skin		-	-	-	-	-	1.0L	50L	10000L	-	-	50L	10000L	10000L	-	-	-	-	0.1L	1.0L	10000L
		6.4A Irritating to the eye	1000L	-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	1.0L	50L	10000L
Econolite Liquid	Liquid	6.1D (oral) Acutely toxic		-	-	-	-	-	1.0L	50L	10000L	-	-	50L	-	-	-	-	-	-	1.0L	5.0L	-
		8.2C Corrosive to dermal tissue		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	1.0L	50L	-
		8.3A Corrosive to ocular tissue	1000L	-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	50L	-
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.2L	1.0L	1000L
				-	-	-	-	-	0.1L	1.0L	10000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1kg	1.0L	10000L
				-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	10000L
																					1.0L	5.0L	-

BTW COMPANY		Section of Regulations		Test Certificates					Emergency Management															Sched 4
		Sub-section		Location & Transit	manufacture & and Use	Approved Handler	Hazardous atmosphere zone	Tracking	EM Level 1	EM Level 2	EM Level 3	Fire Extinguisher	Fire Extinguisher	Documen-tation	Signage	Signage	Separation	Separation	Separation	Incom-patibility	Disposal		Bonding
		Reference		4.2	4.2	4.3	4.4	4.5	5.2.1	5.2.2	5.2.3	5.2.5	5.2.5	5.3.1	5.3.2	5.3.2	5.4.1	5.4.1	5.4.1	5.4.1	5.5		
		Schedule Table reference from Regulations		Table 1	Table 1	Table 2	Table 3	Table 4	Table 5	Table 6	Table 7	Table 8	Table 8	Table 9	Table 10	Table 10	Table 11	Table 11	Table 11	Table 12	Table 13	Table 14	Sched 4
		Description of what the numbers relate to in table below		Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Number of Extinguishers	Threshold level	Emergency Regulations	Identification Requirements	Low Intensity Land Use Threshold VOLUME	Low Intensity Land Use Separation Distance	Separation required from	Incompatible substances	Information Requirements	Documen-tation Requirements	Threshold
Fly Ash	Solid	6.1E Acutely toxic (oral)		-	-	-	-	-	1.0kg	50kg	-	-	-	50kg	-	-	-	-	-	-	1.0kg	50kg	-
		6.4A Irritating to the eye		-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	1.0kg	50kg	-
		6.7A Substances that are carcinogenic		-	-	-	-	-	-	0.5kg	1000kg	-	-	0.5kg	-	-	-	-	-	-	0.1kg	50kg	-
		6.9A (Inhalation) Toxic to human target organs or systems	1000kg	-	-	10kg	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg
		6.2C Corrosive to dermal tissue		-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg
		9.1D (fish, crustacea, algae) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action		-	-	-	-	-	0.1kg	1.0kg	10000kg	-	-	2.0kg	1000kg	1000kg	-	-	-	-	Any	0.5kg	10000kg
Gascon 469	Liquid	6.1E (oral) Acutely toxic		-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	10000kg	10000kg	-	-	-	-	1.0kg	50kg	10000kg
		6.3A Irritating to the skin		-	-	-	-	-	1.0L	50L	-	-	-	50L	-	-	-	-	-	-	1.0L	50L	-
		6.4A Irritating to the eye	1000L	-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	1.0L	50L	-
		6.7A Substances that are carcinogenic		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-
		6.9A (Inhalation) Toxic to human target organs or systems		-	-	10L	-	-	-	0.1L	1000L	-	-	0.1L	-	-	-	-	-	-	0.1L	50L	-
Goldseal Bentonite	Liquid	6.7A Substances that are carcinogenic		-	-	-	-	-	-	0.1L	10000L	-	-	0.1L	-	-	-	-	-	-	Any	0.1L	2000L
		6.9B Toxic to human target organs or systems	1000L	-	-	10L	-	-	-	0.1L	1000L	-	-	0.1L	-	-	-	-	-	-	Any	0.1L	20000L
HAI 404	Liquid	3.1B Flammable Liquids: high hazard		50L	-	-	1.0L	-	1.0L	1.0L	1000L	250L	2	1.0L	250L	250L	-	-	-	Class 3 Class 2 Class 3.2 Class 4 Class 5	1.0L	1.0L	1000L
		6.1D (oral) Acutely toxic		-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	1000L
		6.3B Mildly irritating to the skin	1000L	-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	1.0kg	50kg	-
		6.4A Irritating to the eye		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-
		6.8B Suspected human reproductive or developmental toxicants		-	-	-	-	-	-	1.0L	-	-	-	1.0L	-	-	-	-	-	-	-	1.0L	-
		6.9A (Inhalation) Toxic to human target organs or systems		-	-	-	-	-	-	0.1L	10000L	-	-	0.1L	-	-	-	-	-	-	-	1.0L	-
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	-	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	1000L
Halad 344	Solid	6.1C (oral) Acutely toxic		-	-	Any	-	1.0kg/day	ANY	0.5kg	100kg	-	-	0.5kg	1000kg	1000kg	-	-	-	-	Any	0.5kg	100kg
		6.1D (dermal & inhalation) Acutely toxic		-	-	-	-	-	0.1kg	3.0kg	1000kg	-	-	30.kg	10000kg	10000kg	-	-	-	-	0.1kg	3.0kg	1000kg
		6.3A Irritating to the skin		-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-
		6.4A Irritating to the eye		-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-
		6.5B (contact) Contact sensitisers		-	-	-	-	-	1.0kg	3.0kg	1000kg	-	-	30.kg	-	-	-	-	-	-	Any	3.0kg	1000kg
		6.6A Known or presumed human mutagens	1000kg	-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg
		6.7A Known or presumed human carcinogens		-	-	10kg	-	-	-	0.5kg	1000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg
		6.8B Suspected human reproductive or developmental toxicants		-	-	-	-	-	-	3.0kg	-	-	-	30.kg	-	-	-	-	-	-	-	3.0kg	-
		6.9A Toxic to human target organs or systems		-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg
		9.3B Ecotoxic to terrestrial vertebrates		-	-	-	-	-	-	5.0kg	-	-	-	5.0kg	1000kg	1000kg	-	-	-	-	Any	0.5kg	10000kg
Halad 688	Solid	6.1D (oral) Acutely toxic		-	-	-	-	-	0.2kg	5.0kg	-	-	-	5.0kg	1000kg	1000kg	-	-	-	-	0.2kg	5.0kg	-
		6.7A Known or presumed human carcinogens		-	-	-	-	-	0.1kg	3.0kg	1000kg	-	-	30.kg	10000kg	10000kg	-	-	-	-	0.1kg	3.0kg	1000kg
		6.9A (inhalation) Toxic to human target organs or systems		-	-	10kg	-	-	-	0.5kg	1000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg
		8.1A Corrosive to metals		-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg
		8.2C Corrosive to dermal tissue	1000kg	-	-	-	-	-	Any	1.0kg	-	-	-	2.0kg	1000kg	1000kg	-	-	-	-	-	2.0kg	-
		8.3A Corrosive to ocular tissue		-	-	-	-	-	0.1kg	1.0kg	10000kg	-	-	2.0kg	1000kg	1000kg	-	-	-	-	-	2.0kg	10000kg
		9.1C Harmful in the aquatic environment		-	-	-	-	-	0.1kg	1.0kg	10000kg	-	-	2.0kg	1000kg	1000kg	-	-	-	-	0.1kg	2.0kg	10000kg
		9.3B Ecotoxic to terrestrial vertebrates		-	-	-	-	-	1.0kg	5.0kg	-	-	-	5.0kg	1000kg	1000kg	-	-	-	-	1.0kg	5.0kg	1000kg
HI1500M	Liquid	6.1E (oral) Acutely toxic		-	-	-	-	-	0.2kg	5.0kg	-	-	-	5.0kg	1000kg	1000kg	-	-	-	-	0.2kg	5.0kg	-
		6.4A Irritating to the eye		-	-	-	-	-	1.0L	50L	-	-	-	50L	-	-	-	-	-	-	1.0L	50L	-
		6.9A (oral) Toxic to human target organs or systems	1000L	-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg
Microsilica 600	Solid	6.7A Carcinogenic		-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	1.0L	5.0L	-
		6.9A Target Organ Toxicant	1000kg	-	-	10kg	-	-	-	0.5kg	1000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	1000kg
SSA-1 Silica Flour	Powder	6.7A Carcinogenic		-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg
		6.9A Target Organ Toxicant	1000kg	-	-	10kg	-	-	-	0.5kg	1000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg
Super CLB	Solid	4.3B Flammable Solids - Dangerous when wet		25kg	-	100kg	-	-	0.5kg	0.5t	1000t	250kg	2	0.5kg	250kg	250kg	45000 5000-50000kg 10000-100000kg 100000-500000kg 500000kg+	1m 3m 4m 5m NSC ASSAT	Low Intensity Land Use	Class 1 Class 2 Class 3 Class 4.1.1, 4.1.2, 4.1.3 & 4.2 Class 5 Class 8 Water	0.5kg	0.5kg	1000kg
		6.9B Toxic to human target organs or systems	1000kg	-	-	-	-	-	-	3.0kg	-	-	-	30.kg	-	-	-	-	-	-	Any	0.5kg	10000kg
		9.1D (fish, crustacea, algae) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action		-	-	-	-	-	-	50kg	10000kg	-	-	50kg	10000kg	10000kg	-	-	-	-	0.1kg	3.0kg	-
Tuned Spacer III	Powder	6.7A Carcinogenic		-	-	10kg	-	-	-	0.5kg	1000kg	-	-	0.5kg	-	-	-	-	-	-	1.0kg	50kg	10000kg
		6.9A Target Organ Toxicant	1000L	-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	1000kg
Versaset	Solid	6.3A Irritating to the skin		-	-	-	-	-	-	0.5kg	10000kg	-	-	0.5kg	-	-	-	-	-	-	Any	0.5kg	10000kg
		6.4A Irritating to the eye	1000kg	-	-	-	-	-	0.1kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	0.1kg	50kg	-
Well life 684	Solid	4.2C Flammable Solids - spontaneously combustible (self heating)		25kg	-	-	-	-	1.0kg	3.0kg	10000kg	500kg	2	3.0kg	1000kg	1000kg	45000 5000-50000kg 10000-100000kg 100000-500000kg 500000kg+	1m 3m 4m 5m NSC ASSAT	Low Intensity Land Use	Class 1 Class 2 Class 3 Class 4.1.1, 4.1.2, 4.1.3 & 4.2 Class 5 Class 8 Air Oxygen	1.0kg	-	10000kg
Zonesealant 2000	Liquid	3.1B Flammable Liquids: high hazard		50L	-	-	1.0L	-	1.0L	1.0L	1000L	250L	2	1.0L	250L	250L	-	-	-	Class 3 Class 2 Class 3.2 Class 4 Class 5	1.0L	1.0L	1000L
		6.1E Acutely toxic	1000L	-	-	-	-	-	1.0L	50L	-	-	-	50L	-	-	-	-	-	-	1.0L	50L	-
		6.3B Mildly irritating to the skin		-	-	-	-	-	1.0L	50L	10000L	-	-	50L	-	-	-	-	-	-	1.0L	50L	-
		6.4A Irritating to the eye		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	50L	-

BTW COMPANY		Section of Regulations		Test Certificates					Emergency Management														Sched 4
		Sub-section		Location & Transit	manufacture and Use	Approved Handler	Hazardous atmosphere zone	Tracking	EM Level 1	EM Level 2	EM Level 3	Fire Extinguisher	Fire Extinguisher	Documentation	Signage	Signage	Separation	Separation	Separation	Incompatibility	Disposal		Bunding
		Reference																					
		Schedule Table reference from Regulations		4.2	4.2	4.3	4.4	4.5	5.2.1	5.2.2	5.2.3	5.2.5	5.2.5	5.3.1	5.3.2	5.3.2	5.4.1	5.4.1	5.4.1	5.4.1	5.5		
		Description of what the numbers relate to in table below		Table 1	Table 1	Table 2	Table 3	Table 4	Table 5	Table 6	Table 7	Table 8	Table 8	Table 9	Table 10	Table 10	Table 11	Table 11	Table 11	Table 12	Table 13	Table 14	Sched 4
				Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Threshold level	Number of Extinguishers	Threshold level	Emergency Regulations	Identification Requirements	Low Intensity Land Use Threshold VOLUME	Low Intensity Land Use Seperation Distance	Separation required from	Incompatible Substances	Information Requirements	Documentation Requirements	Threshold
GENERAL CHEMICALS																							
Methanol	Liquid	3.1B Flammable Liquids: high hazard		50L	-	-	1.0L	-	1.0L	1.0L	1000L	250L	2	1.0L	250L	250L	-	-	-	Class 1 Class 2 Class 3.2 Class 4 Class 5	1.0L	1.0L	1000L
		6.1D (oral) Acutely toxic	1500L	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	0.1L	1.0L	1000L
		6.4A Irritating to the eye		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	1.0L	1000L
		6.8B Suspected human reproductive or developmental toxicants		-	-	-	-	-	-	1.0L	-	-	-	1.0L	-	-	-	-	-	-	0.1L	50L	-
		6.9A (inhalation) Toxic to human target organs or systems		-	-	-	-	-	-	0.1L	10000L	-	-	0.1L	-	-	-	-	-	-	-	1.0L	-
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	Any	0.1L	10000L
LPG	Gas	2.1.1A Flammable Gases : high hazard	100m3	100m3	-	100m3	30m3	-	0.2m3	0.2m3	200m3	30m3	1	0.2m3	100m3	100m3	-	-	-	-	1.0L	5.0L	-
Diesel	Liquid	3.1D Flammable liquids: low hazard.	20000L	-	-	-	-	-	5.0L	50L	10000L	500L	2	50L	10000L	10000L	-	-	-	Class 1 Class 2 Class 3.2 Class 4 Class 5	0.2m3	0.2m3	-
		6.1E Acutely toxic.		-	-	-	-	-	1.0L	50L	-	-	-	50L	-	-	-	-	-	-	5.0L	50L	20000L
		6.3B Mildly irritating to the skin.		-	-	-	-	-	1.0kg	50kg	10000kg	-	-	50kg	-	-	-	-	-	-	1.0L	50L	-
		6.7B Carcinogenic		-	-	-	-	-	-	1.0L	10000L	-	-	1.0L	-	-	-	-	-	-	1.0kg	50kg	-
		9.1B Harmful to acquatic ecosystems		-	-	-	-	-	0.2L	5.0L	-	-	-	5.0L	1000L	1000L	-	-	-	-	Any	1.0L	10000L
Produced Hydrocarbons	Liquid	3.1B Flammable Liquids: high hazard	15000L	50L	-	-	1.0L	-	1.0L	1.0L	1000L	250L	2	1.0L	250L	250L	-	-	-	Class 1	0.2L	5.0L	10000L
		6.1E Acutely toxic.		-	-	-	-	-	1.0L	50L	-	-	-	50L	-	-	-	-	-	-	1.0L	1.0L	1000L
		6.6A Mutagenic properties		-	-	-	-	-	-	0.1L	10000L	-	-	0.1L	-	-	-	-	-	-	1.0L	50L	-
		6.7A Substances that are carcinogenic		-	-	10L	-	-	-	0.1L	10000L	-	-	0.1L	-	-	-	-	-	-	Any	0.1L	10000L
		6.9B Toxic to human target organs or systems		-	-	-	-	-	-	1.0L	-	-	-	1.0L	-	-	-	-	-	-	Any	0.1L	1000L
		9.1C Harmful to acquatic ecosystems		-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	1000L	1000L	-	-	-	-	0.1L	1.0L	-
Monoethylene Glycol	Liquid	6.1D Toxic	1500L	-	-	-	-	-	0.1L	1.0L	1000L	-	-	1.0L	10000L	10000L	-	-	-	-	1.0L	5.0L	1000L
		6.4A Irritating to the eye		-	-	-	-	-	0.1L	50L	10000L	-	-	50L	-	-	-	-	-	-	0.1L	1.0L	1000L
		6.9A Target Organ		-	-	-	-	-	-	0.1L	10000L	-	-	0.1L	-	-	-	-	-	-	0.1L	50L	-
		9.3C Harmful to terrestrial vertebrates		-	-	-	-	-	1.0L	5.0L	-	-	-	5.0L	10000L	10000L	-	-	-	-	Any	0.1L	10000L
																					1.0L	5.0L	-

APPENDIX B SITE MAPS



ID	MudType	Date Farmed	Well Name	Northing	Easting	Area (m²)
F1	WBM	March-April 2011	Cheal B (WBM, SBM), Sidewinder (WBM), McKee Production Station (OBM), Copper Moki (WBM)			
F2	WBM	May, 2011	Sidewinder 3 & 4, Cheal C			
F3	WBM	July, 2011	Ruru, KA4/14	5683439	1704484	3463
F4	WWF	July, 2011	Waitui-1	5683462	1704567	9400
F5	WBM	Nov, 2011	MPS(OBM), Copper Moki (WBM), Cheal C (WBM), Sidewinder Sidetrack 1 (WBM), Mangahewa-D (WBM), Mangahewa-C (CF), Mangahewa-A (WBM), Waitui (CS) Talon-1 (WBM)	5683619	1704605	8960
F6	WW	Nov, 2011	Tank Farm (WW), KA 1/7 (CS) KA 4/14 (CF)	5683619	1704680	3600
F7	WWF	Nov, 2011	Mangahewa-D (WWF)	5683612	1704464	6937
F8	WWF	April, 2012	Mangahewa -D (WWF)	5683511	1704447	3789
F9	CF	April, 2012	Tank Farm (WW), Pacific Chieften - Maui-B (SBM), KA8/12/15/18	5683630	1704338	2172
F10	SBM	April, 2012	Mangahewa-C (WBM, SBM, WW), Mangahewa A (WBM), Pacific Chieften - Maui-B (SBM), Nobel Discoverer (SBM), Mamuku Rd spill (CS), Cheal C (CF, CS), MPS (CS)	5683578	1704418	19842
F11	WWF	May, 2012	Mangahewa-C			1081
F12	SBM	Aug, 2012	Mangahewa -A (WBW, SBM, WW, CS) Mangahewa-C (SBM, WW) Mangahewa-D (WBW, SBM, CS) Copper Moki (WW, CS, OBM) Kea Puka/Douglas (SBM, WBM, OBM)	5683616 5683530	1704686 1704437	19870
F13	SBM	Aug, 2012	Mangahewa-D (SBM, CS, WW)	5683622	1704602	13790
F14	SBM	Aug, 2012	KA2 (CS) Maui B (SBM)	5683616	1704662	5000
F15	WBM	Oct, 2012	Mangahewa-C	5683615	1704689	2000
F16	CS	Mar, 2013	KA 13	5683614	1704726	7500
F17	CS	May, 2013	KA 3	5683621	1704771	2600
F18	WWF	May, 2013	Todd MHW D	5683540	1704724	1161
F19	WWF	May, 2013	Todd MHW D	5683496	1704789	1434
F20	WWF	Aug, 2013	Todd MHW C9	5683518	1704756	1008
F21	SBM	Aug, 2013	Todd MHW C9	5683481	1704758	7650
F22	CS	Aug, 2013	KA 3, KA 6	5683484	1704645	7550
F23	CS	Sept, 2013	KA 6	5683497	1704673	2065

Mud Type Key	
WWF	Well workover fluids
OBM	Oil-based materials
WBM	Water-based mud
WW	Waste water
CS	Contaminated soil
CF	Contaminated Fluids
SBM	Synthetic-based Mud

btw company
surveyors
planners
engineers
land & GIS services

BTW Company Ltd
Cnr. Courtenay & Elliot Sts.
PO Box 551, NEW PLYMOUTH 4340
Ph (06) 759 5040
Ph 0800 289787 Fax (06) 759 5049
Email survey@btwcompany.co.nz
www.btwcompany.co.nz

GENERAL NOTES
1. Coordinates are in terms of New Zealand Transverse Mercator
DISCLAIMER
Boundary information and aerial imagery has been imported from external sources. Areas and dimensions may be subject to scale error. Use of this drawing for other purposes is at the user's risk.

1:2,500

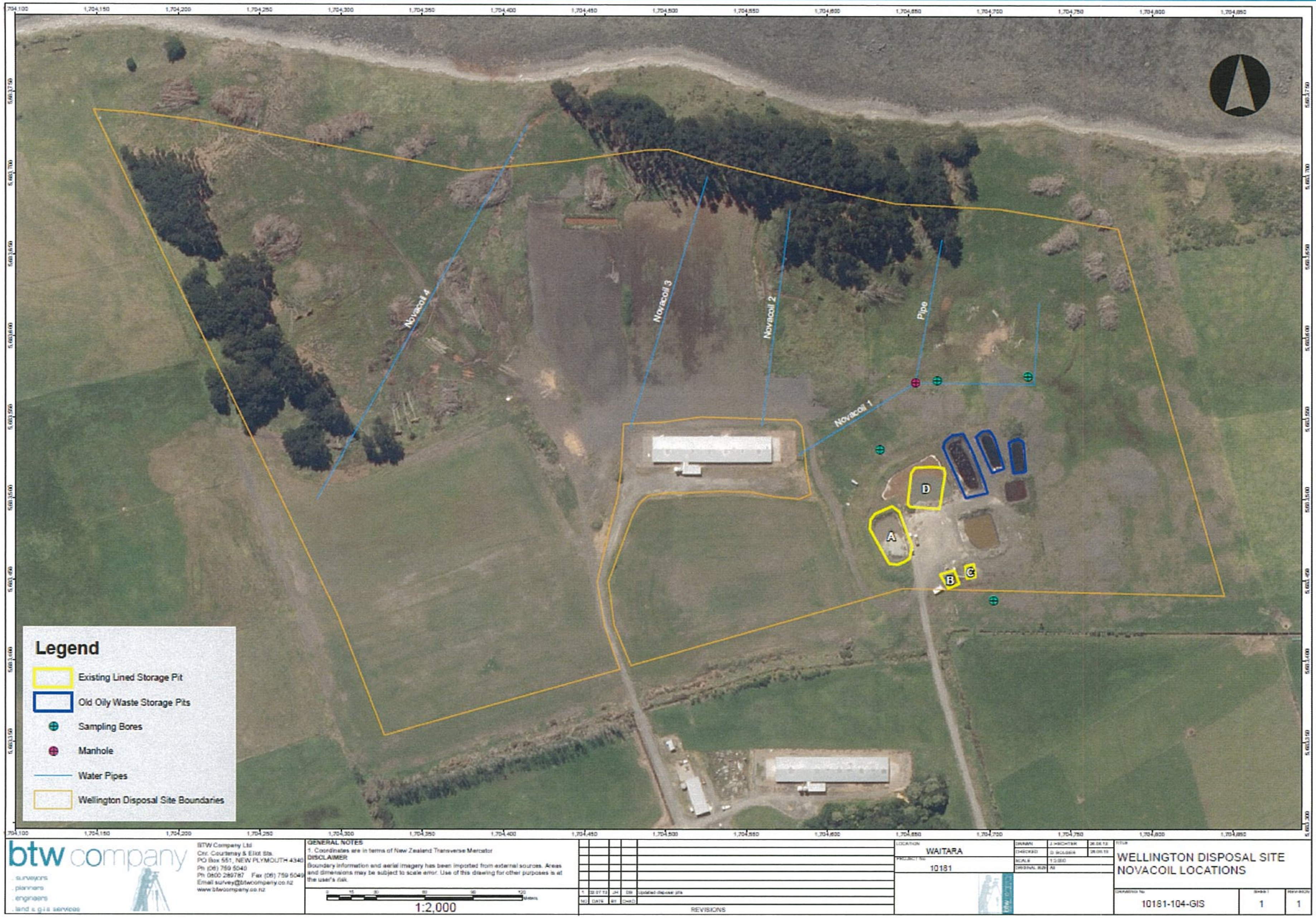
REVISIONS

LOCATION: WAITARA
PROJECT NO: 10181

DRAWN: THOMPSON 21.04.10
CHECKED: RILEY 21.04.10
SCALE: 1:2,500
ORIGINAL SIZE: A0

TITLE: WELLINGTON LANDFARM

DRAWING No: 10181-01-GIS
SHEET: 1
REVISION: 40


Novacoil 4
Novacoil 3
Novacoil 2
Pipe
Novacoil 1
A
B
C
D
Legend
Existing Lined Storage Pit
Old Oily Waste Storage Pits
Sampling Bores
Manhole
Water Pipes
Wellington Disposal Site Boundaries
btw company
. surveyors
. planners
. engineers
. land & g.i.s services
BTW Company Ltd
Cnr. Courtenay & Elliot Sts.
PO Box 551, NEW PLYMOUTH 4340
Ph (06) 759 5040
Ph 0800 289787 Fax (06) 759 5049
Email survey@btwcompany.co.nz
www.btwcompany.co.nz
GENERAL NOTES
1. Coordinates are in terms of New Zealand Transverse Mercator
DISCLAIMER
Boundary information and aerial imagery has been imported from external sources. Areas and dimensions may be subject to scale error. Use of this drawing for other purposes is at the user's risk.
1:2,000
REVISIONS
LOCATION
WAITARA
10181
WELLINGTON DISPOSAL SITE
NOVACOIL LOCATIONS
10181-104-GIS
1
1

APPENDIX C NOVA COIL & SURFACE DRAIN MONITORING RESULTS

Hill Laboratories
BETTER TESTING BETTER RESULTS

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

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

ANALYSIS REPORT

Client:	BTW Company Ltd	**Lab No:**	1223497 SPnn
Contact:	Dave Bolger	**Date Registered:**	15-Jan-2014
	C/- BTW Company Ltd	**Date Reported:**	21-Jan-2014
	PO Box 551	**Quote No:**	45045
	NEW PLYMOUTH 4340	**Order No:**	
		Client Reference:	Tank Water
		Submitted By:	Dave Bolger

Sample Type: Aqueous

		Sample Name:	Drain - Brown 14-Jan-2014 2:00 pm			
		Lab Number:	1223497.1			
Individual Tests						
pH	pH Units		6.5	-	-	-
Electrical Conductivity (EC)	mS/m		37.8	-	-	-
Total Dissolved Solids (TDS)	g/m³		240	-	-	-
Specific Gravity*	20°C/20°C		1.00	-	-	-
Total Potassium	g/m³		17.0	-	-	-
Total Sodium	g/m³		34	-	-	-
Chloride	g/m³		78	-	-	-
Total Nitrogen	g/m³		0.27	-	-	-
Nitrate-N + Nitrite-N	g/m³		0.039	-	-	-
Total Kjeldahl Nitrogen (TKN)	g/m³		0.23	-	-	-
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Arsenic	g/m³		< 0.0011	-	-	-
Total Cadmium	g/m³		< 0.000053	-	-	-
Total Chromium	g/m³		< 0.00053	-	-	-
Total Copper	g/m³		0.00087	-	-	-
Total Lead	g/m³		< 0.00011	-	-	-
Total Nickel	g/m³		< 0.00053	-	-	-
Total Zinc	g/m³		0.0118	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m³		< 0.0010	-	-	-
Toluene	g/m³		< 0.0010	-	-	-
Ethylbenzene	g/m³		< 0.0010	-	-	-
m&p-Xylene	g/m³		< 0.002	-	-	-
o-Xylene	g/m³		< 0.0010	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m³		< 0.10	-	-	-
C10 - C14	g/m³		< 0.2	-	-	-
C15 - C36	g/m³		< 0.4	-	-	-
Total hydrocarbons (C7 - C36)	g/m³		< 0.7	-	-	-

SUMMARY OF METHODS

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

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, trace level	-	1

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	-	1
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines [KBIs:2803,10734]	-	1
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total Digestion	Boiling nitric acid digestion. APHA 3030 E 22nd ed. 2012 (modified).	-	1
Total Kjeldahl Digestion	Sulphuric acid digestion with copper sulphate catalyst.	-	1
pH	pH meter. APHA 4500-H^+ B 22nd ed. 2012.	0.1 pH Units	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 22nd ed. 2012.	0.1 mS/m	1
Total Dissolved Solids (TDS)	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 22nd ed. 2012.	10 g/m³	1
Specific Gravity*	Calculation: weight of sample / weight of equivalent volume of water at 20°C. Gravimetric determination.	0.01 20°C/20°C	1
Total Potassium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.053 g/m³	1
Total Sodium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.021 g/m³	1
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cl^- E (modified from continuous flow analysis) 22nd ed. 2012.	0.5 g/m³	1
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N.	0.05 g/m³	1
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I 22nd ed. 2012.	0.002 g/m³	1
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D. (modified) 4500 NH_3 F (modified) 22nd ed. 2012.	0.10 g/m³	1

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

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

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

Hill Laboratories
BETTER TESTING BETTER RESULTS

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

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

ANALYSIS REPORT

Client:	BTW Company Limted	**Lab No:**	1278966 SPv1
Contact:	Dave Bolger	**Date Registered:**	23-May-2014
	C/- BTW Company Limted	**Date Reported:**	03-Jun-2014
	PO Box 551	**Quote No:**	60977
	NEW PLYMOUTH 4340	**Order No:**	10181
		Client Reference:	Stormwater testing
		Submitted By:	Dave Bolger

Sample Type: Aqueous

Sample Name:		Brown - Nova 22-May-2014 12:00 pm				
Lab Number:		1278966.1				
Individual Tests						
pH	pH Units	6.4	-	-	-	-
Total Suspended Solids	g/m³	9	-	-	-	-
Chloride	g/m³	90	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m³	< 0.0010	-	-	-	-
Toluene	g/m³	< 0.0010	-	-	-	-
Ethylbenzene	g/m³	< 0.0010	-	-	-	-
m&p-Xylene	g/m³	< 0.002	-	-	-	-
o-Xylene	g/m³	< 0.0010	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m³	< 0.10	-	-	-	-
C10 - C14	g/m³	< 0.2	-	-	-	-
C15 - C36	g/m³	< 0.4	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m³	< 0.7	-	-	-	-

SUMMARY OF METHODS

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

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m³	1
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines [KBIs:2803,10734]	0.10 - 0.7 g/m³	1
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
pH	pH meter. APHA 4500-H⁺ B 22nd ed. 2012.	0.1 pH Units	1
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D 22nd ed. 2012.	3 g/m³	1
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cl⁻ E (modified from continuous flow analysis) 22nd ed. 2012.	0.5 g/m³	1

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

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

Peter Robinson MSc (Hons), PhD, FNZIC
Client Services Manager - Environmental Division

APPENDIX D PHOTOGRAPHIC RECORD OF LANDFARMING

July 2013

November 2013 - F21 Area

May 2014

APPENDIX E EXAMPLE OF COMPLETE SOIL SAMPLING INDIVIDUAL TESTS (ENVIRONMENTAL & AGRICULTURAL)

Hill Laboratories
BETTER TESTING BETTER RESULTS
R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240 New Zealand
Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client: BTW Company Ltd
Contact: Dave Bolger
C/- BTW Company Ltd
PO Box 551
NEW PLYMOUTH 4340

Lab No: 1148060
Date Registered: 21-Jun-2013
Date Reported: 01-Jul-2013
Quote No: 36604
Order No:
Client Reference: Receiving Environment -Soil
Submitted By: Dave Bolger

Sample Type: Soil

		Sample Name:	F17-Brown 19-Jun-2013
		Lab Number:	1148060.1
Individual Tests			
Dry Matter	g/100g as rcvd		83
Total Recoverable Barium	mg/kg dry wt		95
Total Recoverable Boron	mg/kg dry wt		< 20
Total Recoverable Vanadium	mg/kg dry wt		118
Chloride*	mg/kg dry wt		6
Total Nitrogen*	g/100g dry wt		0.11
Heavy metals, screen As Cd Cr Cu Ni Pb Zn Hg			
Total Recoverable Arsenic	mg/kg dry wt		< 2
Total Recoverable Cadmium	mg/kg dry wt		< 0.10
Total Recoverable Chromium	mg/kg dry wt		10
Total Recoverable Copper	mg/kg dry wt		12
Total Recoverable Lead	mg/kg dry wt		1.6
Total Recoverable Mercury	mg/kg dry wt		< 0.10
Total Recoverable Nickel	mg/kg dry wt		6
Total Recoverable Zinc	mg/kg dry wt		42
BTEX in Soil by Headspace GC-MS			
Benzene	mg/kg dry wt		< 0.05
Toluene	mg/kg dry wt		< 0.05
Ethylbenzene	mg/kg dry wt		< 0.05
m&p-Xylene	mg/kg dry wt		< 0.10
o-Xylene	mg/kg dry wt		< 0.05
Polycyclic Aromatic Hydrocarbons Screening in Soil			
Acenaphthene	mg/kg dry wt		< 0.03
Acenaphthylene	mg/kg dry wt		< 0.03
Anthracene	mg/kg dry wt		< 0.03
Benzo[a]anthracene	mg/kg dry wt		< 0.03
Benzo[a]pyrene (BAP)	mg/kg dry wt		< 0.03
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt		< 0.03
Benzo[g,h,i]perylene	mg/kg dry wt		< 0.03
Benzo[k]fluoranthene	mg/kg dry wt		< 0.03
Chrysene	mg/kg dry wt		< 0.03
Dibenzo[a,h]anthracene	mg/kg dry wt		< 0.03
Fluoranthene	mg/kg dry wt		< 0.03
Fluorene	mg/kg dry wt		0.03
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt		< 0.03
Naphthalene	mg/kg dry wt		< 0.14

Sample Type: Soil

		Sample Name:	F17-Brown 19-Jun-2013
		Lab Number:	1148060.1
Polycyclic Aromatic Hydrocarbons Screening in Soil			
Phenanthrene	mg/kg dry wt		0.08
Pyrene	mg/kg dry wt		< 0.03
Total Petroleum Hydrocarbons in Soil			
C7 - C9	mg/kg dry wt		< 9
C10 - C14	mg/kg dry wt		< 20
C15 - C36	mg/kg dry wt		75
Total hydrocarbons (C7 - C36)	mg/kg dry wt		75

Hill Laboratories
BETTER TESTING BETTER RESULTS

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

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

ANALYSIS REPORT

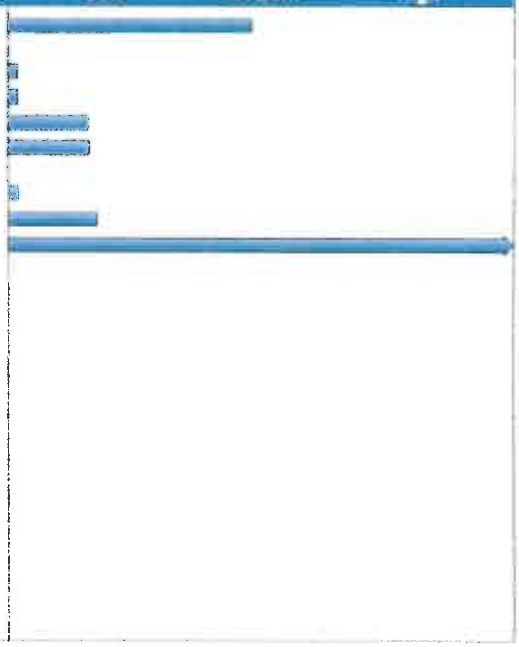
Client: BTW Company Ltd
Address: PO Box 551
NEW PLYMOUTH 4340

Phone: 06 759 5040

Lab No: 1147909
Date Registered: 21-Jun-2013
Date Reported: 28-Jun-2013
Quote No: 36604
Order No:
Client Reference:
Submitted By: Dave Bolger

Sample Name: F17 - Brown 19-Jun-2013 **Lab Number:** 1147909.1
Sample Type: SOIL General, Outdoor (S10)

Analysis		Level Found	Medium Range
pH	pH Units	6.0	5.8 - 6.3
Potassium	me/100g	0.10	0.50 - 0.80
Calcium	me/100g	1.1	6.0 - 12.0
Magnesium	me/100g	0.57	1.00 - 3.00
Sodium	me/100g	0.08	0.20 - 0.50
CEC	me/100g	5	12 - 25
Total Base Saturation	%	36	50 - 85
Volume Weight	g/mL	1.57	0.60 - 1.00
Total Soluble Salts*	mg/L	105.6	
Electrical Conductivity (Sat Paste)*	mS/cm	0.2	
Nitrate-N (Sat Paste)*	mg/L	1	
Ammonium-N (Sat Paste)*	mg/L	< 1	
Phosphorus (Sat Paste)*	mg/L	< 1	
Potassium (Sat Paste)*	mg/L	8	
Calcium (Sat Paste)*	mg/L	8	
Magnesium (Sat Paste)*	mg/L	2	
Sodium (Sat Paste)*	mg/L	19	
Sodium Absorption Ratio*		1.6	
Lime Requirement (7.5cm)	tonne/ha	1.1	



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

Appendix III

Marine ecological surveys

Internal Memorandum

To: Science Manager – Hydrology/Biology, Regan Phipps
From: Scientific Officer, Emily Roberts and Technical Officer, Abbie Bates
File: #1389140
Date: 18 August 2014

BTW Wellington Land Farm – Marine Ecological Survey September/October 2013

Introduction

A marine ecological survey was carried out at four sites as part of the 2013-2014 monitoring programme for the BTW Wellington Land Farm. The survey was carried out at three potential impact sites in the vicinity of the land farm, and one control sites between 19 September and 17 October 2013. The objective of the survey was to determine any change in species abundance and community structure attributable to the presence of the BTW Wellington Land Farm.

Methods

Field Work

The survey was conducted at four sites. The potential impact sites were: Orapa B (SEA 901043), Turanga Reef (SEA 901052), and 500m E of the Brixton Outfall (SEA 901055). The control site was at Turangi Reef (SEA 900095) see (Photographs 1-3). Orapa B was not photographed in 2013.

Photograph 1 Potential impact site 500m east of the Brixton Outfall (SEA 901055)

Photograph 2 Potential impact site at the Turanga Reef (SEA 901052)

Photograph 3 Control site at Turangi Reef (SEA 900095)

At each site, a 50 m transect was laid parallel to the shore. This transect was used to establish five 5 m x 3 m blocks. Within each block, 5 random 0.25 m^2 quadrats were laid giving a total of 25 random quadrats. For each quadrat the percentage cover of algal and encrusting animal species was estimated using a grid. For all other animal species, individuals larger than 3 mm were counted. Under boulder biota was counted where rocks and cobbles were easily overturned.

Data Analysis

For the data collected during the spring 2013 survey the following analyses was undertaken: The mean number of species per quadrat and Shannon-Weiner diversity indices per quadrat were calculated at each site. Assumptions of normality were tested using the Lilliefors test. One-way analysis of variance (ANOVA) was used to determine any significant differences between means. The Tukey's multiple comparison test was used to determine which means were significantly different from one another.

Results

The mean number of species per quadrat and the mean Shannon-Weiner diversity index per quadrat are presented in Table 1. 500m E (potential impact) had the highest number of species, followed by Turangi (potential impact) and Turanga (control). Orapa B (potential impact) had the lowest number of species. 500m E had the highest diversity, followed by Turanga, Orapa B and Turangi respectively.

Table 1 Summary statistics – September/October 2014

Site	No. of Quadrats	Mean number of species per quadrat			Mean Shannon Weiner Index per quadrat		
		Algae	Animals	Total Species	Algae	Animals	Total Species
Turangi Reef	25	4.40	12.08	16.48	0.40	0.70	0.86
Orapa B	25	4.80	9.84	14.64	0.52	0.76	0.90
Turanga Reef	25	5.00	11.36	16.36	0.49	0.83	0.97
500m E	25	5.24	12.36	17.60	0.50	0.84	0.98

Number of Species per Quadrat

Figure 1 shows the total number of species per quadrat at each site as a box and whisker plot. The notched area of the box represents the median plus and minus the 95% confidence interval. This form of graphical representation allows a quick comparison to be made between sites. Generally, if the notched areas of the boxes for the different sites do not overlap you would expect to obtain a significantly different result with ANOVA.

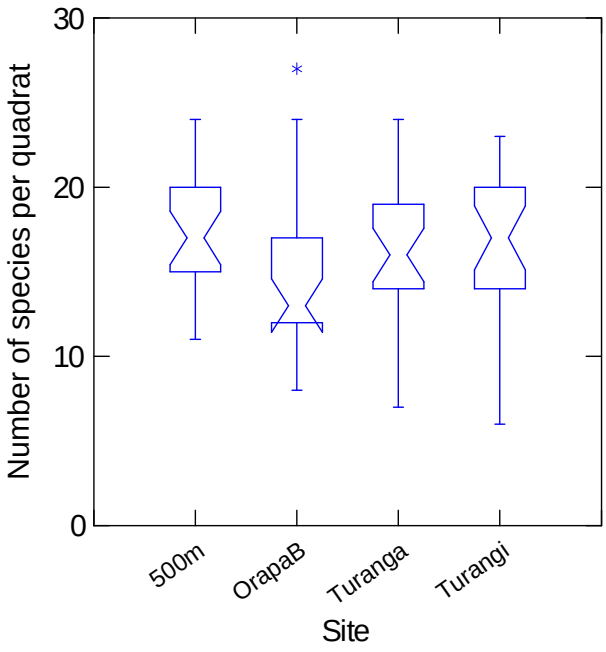


Figure 1 Box and whisker plot of total number of species per quadrat

For all sites, there was no significant deviation from normal distribution at the 95% confidence level (Lilliefors test, n = 25, P >0.05). The significant differences between sites were determined using Tukey's multiple comparison test. There were no significant differences between sites.

Shannon-Weiner Diversity Index

Figure 2 shows the Shannon-Weiner index per quadrat at each site as a box and whisker plot.

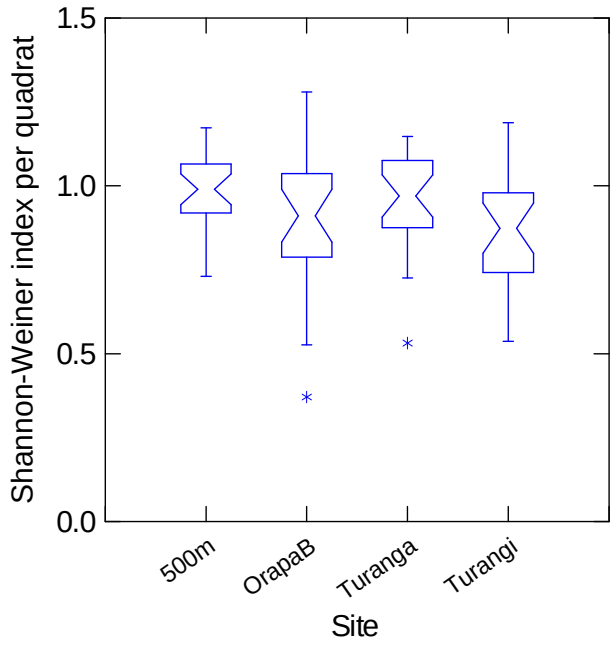


Figure 2 Box and whisker plots of mean Shannon-Weiner index per quadrat

Turangi Reef was the only site with a significant deviation from normal distribution at the 95% confidence level (Lilliefors test, n = 25, P = 0.001). Significant differences between sites were determined using Tukey's multiple comparison test. There were no significant differences between sites.

Sand Cover

The percent cover of sand was recorded (Table 4) because high sand levels can significantly impact marine communities.

Table 4 Mean percent cover of sand per quadrat

Site	% sand and silt per quadrat*
Turangi Reef	3
Orapa B	31
Turanga Reef	22
500m E	1

** Sand coverage >30% can significantly impact marine communities.*

Both Turangi and 500m E had relatively low sand levels, which would not have adversely affected ecological diversity of the reefs. At Orapa B and Turanga, the mean sand cover per quadrat was 31% and 22% respectively. Although there appeared to be no noticeable effects of sand cover at Turanga, sand cover might have contributed to the significantly lower number of species recorded at Orapa B. At the Orapa B site, there was a high density of the colonial polychaete worm, *Neosabellaria kaiparaensis* (previously *Sabellaria kaiparaensis*). This species traps sand to build a worm case, preventing most other species from growing on either the substrate or the worm cases.

Photograph 4 Polychaete worm *Neosabellaria kaiparaensis*

Discussion

The concept of ecological diversity consists of two basic components; *species richness* (the number of different species present in an ecological community) and the *relative abundance* of species. These two measures of ecological diversity are used in this report to assess the effect of the BTW Wellington land farm on the local intertidal community. The first measure used is the mean number of species per quadrat and this is essentially a measure of species richness. The second diversity measure used is the mean Shannon-Weiner diversity index per quadrat. This statistic incorporates both the number of different species present (species richness) and the relative abundance of those species into one statistic.

As this was only the forth survey undertaken for this programme, potential impact of the BTW Wellington land farm on the local intertidal community was assessed through comparing the results from potential impact sites with those from the control site.

Impacts of the BTW Wellington Land Farm on the local intertidal community were not evident from the spring 2013 survey results. There was no significant difference in Shannon-Weiner index per quadrat between sites.

The most evident factor impacting the intertidal communities at the sites surveyed was sand inundation. Sand can cause smothering and scouring of intertidal communities and significant volumes of sand can be deposited as a result of storm events or seasonal oceanographic processes. Within Taranaki, sand deposition appears to be a dominant driver of species richness and diversity amongst intertidal reef communities. Long term monitoring of intertidal rocky reefs around the Taranaki coastline has revealed the abundance and diversity of these communities can be adversely affected when sand levels exceed 30% coverage. However, historical results from certain sites around the Waitara area (e.g. Orapa A and Airedale Reef) indicate that Tranaki intertidal communities can recover relatively rapidly (within the year) from heavy sand inundation providing that high sand deposition is not continuous.

At Orapa B the sand percentage coverage had increased >30% since 2012. This reef has become dominated by the colonial tube worm *Neosabellaria kaiparaensis* (Photograph 4).

Although generally uncommon in New Zealand, large colonies of this endemic polychaete occur around the Taranaki coastline. *Neosabellaria kaiparaensis* thrives in sand rich environments, and domination of this species can prevent other rock dwelling organisms from colonising the area. The factors driving temporal variation in community composition at Orapa B require further investigation. It must be stressed, however, that there is no evidence that the increase in sand cover and lower species richness and diversity at this site is in anyway related to the BTW Wellington Land Farm.

Conclusions

In order to assess the effects of the BTW Wellington Land Farm on the nearby intertidal communities, ecological surveys were conducted between 19 September and 17 October 2013 at four sites. These surveys included three potential impact sites and one control sites. Potential adverse effects of the BTW Wellington Land Farm on the intertidal communities were assessed by comparing species richness and diversity at the potential impact sites relative to the control site.

As both species richness and diversity were similar at the control sites and potential impact sites, the results indicate that the BTW Wellington Land Farm was not having detectable adverse effects on the intertidal reef communities. Natural environmental factors, in particular sand inundation, appeared to be the dominant driver of species richness and diversity for the sites surveyed.

Emily Roberts
Marine Ecologist

Abbie Bates
Technical Officer