BTW Company Ltd
Wellington Landfarm
Monitoring Programme
Annual Report
2015-2016

Technical Report 2016-87

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Executive summary

BTW Company Ltd (the Company) operates a landfarm (Wellington Landfarm) located on Brown Road, Waitara, in the Waitara catchment. This report for the period July 2015 to June 2016 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess the Company's environmental performance during the period under review, and the results and environmental effects of the Company's activities.

The Company holds one resource consent, which includes a total of 31 conditions setting out the requirements that the Company must satisfy. The Company holds consent 7884-1.1 which allowed the Company to discharge waste from hydrocarbon exploration, well work over, production and storage activities, onto and into land via landfarming.

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

The Council's monitoring programme for the year under review included five inspections, 24 water samples collected for physicochemical analysis, and four composite soil samples.

The monitoring indicated in similarity to the previous monitoring period, the 2014-15 year, the groundwater in the immediate vicinity of the former storage cell is still impacted by elevated salinity concentrations and trace benzene. The saline plume may be migrating slowly northwards, as a down gradient bore had detailed an elevation in saline parameters as well as trace benzene. At the same time, the up gradient bore had indicated a slight decrease in salinity concentration. As in previous monitoring years, the Council will continue to monitor the degradation of these parameters. Of note, there are likely to be no significant adverse effect due to the elevated salinity in the groundwater or the trace benzene, as both analytes detail concentrations below MfE guidelines for stock watering. In terms of the soils, area F18 is now within surrender criteria while F12 is not. F12 will continue to be monitored.

Overall, the exercise of the resource consent 7884-1.1 during the 2015-16 period has led to less than minor environmental effects. There still exists the legacy issue in terms of salinity concentration as well as the trace hydrocarbons; however these will continue to be monitored.

There were no unauthorised incidents (UI/s) recording non-compliance in respect of this consent holder during the period under review.

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

For reference, in the 2015-2016 year, 71% 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 24% demonstrated a good level of environmental performance and compliance with their consents.

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

This report includes recommendations for the 2016-2017 year.

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1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2015 to June 2016 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consent held by BTW Company Ltd (BTW) (The Company). The Company operates a drilling and production waste landfarm situated on Brown Road, Waitara, in the Waitara catchment. This is the forth report to be prepared by the Council to cover the Company's discharges and their effect on the site.

The BTW Wellington Landfarm was the second site in this area, the first, Brown Road Landfarm was completed and surrendered in the 2013-2014 monitoring period, where it had originally begun stockpiling in 2006. The Wellington Landfarm came to fruition during the 2010-2011 monitoring year, whereby it was an expansion of the then operational Brown Road landfarm. During the year of its inception the Wellington site became the primary disposal site for the Company.

During 2011-2012, the Council required the Company to apply for additional resource consent to explicitly provide for the disposal of well work-over and production fluids, including hydraulic fracturing return fluids. This consent (7884-1) 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 (7670-1) 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 site in terms of deliveries of landfarmable material ceased during the 2013-2014 period. The site has since moved into a monitoring stage, whereby material, post application and incorporation will slowly bio-remediate. The Company and the Council both monitor the degree of the bio-remediation. During the 2014-2015 period the Company applied for a change of conditions to the consent. The Company provided sufficient information to allow for the Council to make an informed decision to limit the area of the site which the consent applied to, effectively surrendering the areas of the site which had met the conditional surrender criteria.

In order to meet the surrender criteria the Company had to provide analytical evidence to support the notion that contaminant levels in the soils were within limits specified in the Ministry for the Environment's 'Guidelines for assessing and managing petroleum hydrocarbon contaminated sites in New Zealand' (MfE, 1999). As well as hydrocarbon related analysis, further analysis in terms of specific salt concentrations was required. These requirements for surrender are attached in the form of the Resource Consent (7884-1.1) in Appendix I of this report.

Post partial surrender of the site, two areas remained above the required surrender criteria, these area (F12 and F18), formed the basis for monitoring in this monitoring period 2015-2016.

The report includes the results and findings of the monitoring programme implemented by the Council in respect of the consent held by the Company that relate to discharges of waste from hydrocarbon exploration, well work over, production and storage activities onto and into land via landfarming within the Waitara catchment.

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

1.1.2 Structure of this report

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

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

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

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

Section 4 presents recommendations to be implemented in the 2016-2017 monitoring year.

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

1.1.3 The Resource Management Act 1991 and monitoring

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

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

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

1.1.4 Evaluation of environmental and administrative performance

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

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

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

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

Environmental Performance

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

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

For example:

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

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

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

Administrative performance

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

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

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

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

For reference, in the 2015-2016 year, 71% 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 24% 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.

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 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 An example of a landfarmed area Wellington Landfarm 2013

The landfarming process utilised at this 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 7884-1.1 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 is re-instated and the consents surrendered once proven to be suitable for uses such as grazing, following stabilisation and re-grassing. It is proven by providing analytical evidence which will satisfy the specific consented conditions that dictate the acceptable level of certain contaminants in the soil.

1.2.3 Site description

The landfarm is located on Brown Road, Waitara, 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 1,383 mm (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).

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)

Figure 1 Aerial photograph detailing the lay out of Wellington Landfarm

1.3 Resource consents

1.3.1 Discharges of wastes to land

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

BTW holds discharge permit **7884-1.1** 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 RMA. 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 9 deal with notifications, monitoring and reporting.

Conditions 10 to 12 relate to storage of wastes.

Conditions 13 to 21 deal with discharge limits.

Conditions 22 and 23 set limits on contaminants in receiving waters.

Conditions 24 to 28 deal with contaminants in soil.

Condition 29 relates to any archaeological remains found.

Conditions 30 and 31 deal with lapse and review of the consent.

The permit is attached to this report 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 Wellington site consisted of four 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 site was visited five times during the monitoring period. As discussed the site was not operational during this monitoring period and was decommissioned during the previous monitoring period. As such the main crux of the monitoring in this period was focused on the final degradation of the remaining parameters within the soil profile, as well as the degree of revegetation post application and reinstatement. The neighbourhood was also surveyed for environmental effects.

1.4.4 Chemical sampling

Four composite soil samples from the Wellington site were collected for analysis during the monitoring period. The methodology utilised was compositing 10-15 soil cores (400 mm+/- depth to encompass the zone of application) 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 one occasion in the monitoring year, samples of surface water were collected upstream and downstream of the former storage pits located on the Wellington

property. These were analysed for barium, chloride, conductivity, hydrocarbons, pH, and total dissolved salts.

A total of 16 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.

One water sample was collected from the perforated pipe running through the site.

2. Results

2.1 Inspections

06 July 2015
The inspection was conducted in conjunction with surface and groundwater sampling. The weather was overcast with heavy showers and a moderate north westerly wind. All four groundwater bores were sampled. Odour was encountered in GND2282 and 2285. No sheen or foaming was noted in any of the groundwater samples.

05 November 2015
An inspection was conducted in conjunction with groundwater and soil sampling. Four groundwater bores were sampled. Foaming and a slight odour was encountered in GND2285. Flecks of orange iron oxides were present in 3 of the 4 bores.

Two soil transects were sampled, these were collected from areas F12 and F18 respectively. Drilling muds were encountered in 6 of the 10 cores collected from the F12 transect. Old muds were encountered in 2 of 10 cores in F18 transect.

05 February 2016
The inspection was conducted in conjunction with groundwater sampling which was undertaken in overcast, windy conditions.

The existing groundwater monitoring network of four groundwater monitoring wells were sampled. During the sampling a slight sulphur odour was noticeable in wells GND2282 and GND2284. A noticeable hydrocarbon odour and foaming was encountered in GND2285. At the time of the inspection the site was unoccupied, with temporary fencing still in place.

13 May 2016
No recent storage or spreading activities have occurred at the site and no storage facilities are present. The historic spreading areas were observed to have good pasture cover which appeared stable. There was the small area which was historically bare of pasture at the eastern end of the site. The shoreline was inspected, and no effects were observed on the foreshore or reef. Iron oxides were prevalent where the ground water was escaping the cliff face and discharging onto the beach.

19 May 2016
The inspection was conducted in conjunction with chemical sampling. Samples of groundwater, soil and surface water were collected in overcast showery conditions with a gusty westerly wind.

All four groundwater bores were sampled. A strong sulphur odour was encountered in GND2283 and GND2284, while a strong hydrocarbon odour and foaming was observed in well GND2285.

Two soil samples were collected during this inspection, whereby the locations F12 and F18 were sampled. Area F18, upon observation and sample collection was described as having poor pasture cover with dry brown/grey sands and a distinct layer of clays at approximately 200 mm below ground level (bgl). No odour was noted.
The other sample collection location was F12, this was described as containing good pasture cover, with the core samples described as moist grey sands with a layer of clays

at approximately 200 mm bgl. However in comparison to the previous sampled area, F12, F18 contained a noticeable hydrocarbon odour.

Surface water samples collected from the two perforated Novaflow pipes in the paddock. No odour, sheen or foaming was present in either, although iron oxides were visible and partially blocking the flow from GND2363.

2.2 Results of abstraction and discharge monitoring

The Wellington Landfarm was completely decommissioned during the 2013-14 monitoring period. The storage cells were removed and the land reinstated, no new deliveries were received during this monitoring period (2015-2016). The site was processed for a partial surrender of consent in March of 2015 and the Company supplied analytical evidence to support their proposal. However two areas, F12 and F18, were still above the criteria prescribed in the consent. As such soil sampling was centered on these two areas for the remainder of the monitoring period.

In the previous monitoring period (2014-15) the Company undertook additional remedial work with an aim to increase the rate of bio degradation for the area F12. They did so by aerating the soil in area F12 and also by adding straw and clean top soil. This technique will help to further degrade the total petroleum hydrocarbon (TPH) concentration which is above the consented surrender criteria[1]. The Council will continue to monitor this location until it has met its conditional compliance limit.

The other location, F18, was not surrendered (in the pervious monitoring period) due to the level of contaminate benzo (a) pyrene (BaP) analysed above the prescribed surrender criteria. The condition for surrender as stipulated by the consent states that the level of benzo (a) pyrene must be below 0.027 mg/kg. The analysed value is very close to the limit for surrender, with a decreasing value observed over the course of a two year period (0.1 mg/kg in September 2013 to 0.04 mg/kg in January 2015), further monitoring will dictate if this parameter is reducing.

It is also noteworthy to mention that the original site of the Wellington Landfarm was initially covered in pine trees; these were subsequently cut down and sold while some were also burned. BaP is produced from wood burning; as such the Council is aware that this analysed limit for BaP may be in fact baseline. However, as it has a required limit as stipulated by the Resource Consent, Condition 27, it will continue to be measured until a consistent low level has been achieved.

[1] Consent condition 27 from Resource Consent 7884-1.1 Appendix II

2.4 Results of receiving environment monitoring

2.4.1 Council soil results

Throughout the monitoring year (2015-16) the Council collected four composite soil samples. These soil samples were collected via a soil corer which was inserted to a nominal depth of 400mm+/- bgl to encapsulate the zone of application. The procedure for soil sample collection is adapted from the Safe Application of Biosolids to land New Zealand (2003), whereby ten soil cores are collected at 10 m intervals across a spread area and then composted to gain one representative sample of the area of application.

As previously discussed, the only areas which required monitoring in this period were areas F12 and F18. Thus the soil sampling was aimed at these areas in this monitoring period. Two of the four samples which were collected by the Council at the end of the monitoring period were submitted to RJ Hill Laboratory in Hamilton for additional analysis.

The main rationale for the additional analysis was centered on the consent conditions, whereby specific parameters are selected and analysed. In terms of the two outstanding areas, F12 and F18, specific consent conditions were required to be met.

Area F12: As in the previous monitoring period this area contained a high concentration of Total Petroleum Hydrocarbons (TPH). Analysis undertaken by the Council detailed a sample result for total TPH; this means it includes the speciated hydrocarbon chains into one number. While this is a good tool to gain qualitative information in terms of the sum of the total hydrocarbons, it does not allow the reader to ascertain which fractions are present in the soil and which are decreasing.

Thus, in order to better understand the characteristic of the compound, additional analysis was required. The additional analysis requirement was for a speciated hydrocarbon analysis (TPH), mono aromatic hydrocarbon (MAH) and poly aromatic hydrocarbon analysis (PAH). The TPH analysis splits the carbon chain into three distinct groups.

These groups as defined by the Ministry for the Environment's Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand, Revised 2011, form the basis of the Council's surrender criteria with respect to specific concentrations within the soil. Thus the surrender criteria with respect to petroleum compounds are as follows:

Table 1 Petroleum compound surrender criteria

Soil Type: Sand	**Depth (<1m)**
Total Petroleum Hydrocarbons [2]	
C_7-C_9	120 mg/kg
C_{10}-C_{14}	58 mg/kg
C_{15}-C_{36}	4,000 mg/kg
Mono Aromatic Hydrocarbons	

[2] Extracted from the Ministry for the Environment's Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand, Revised 2011, Table 4.12 and 4.15

Soil Type: Sand	Depth (<1m)
Benzene	2.7 mg/kg
Toluene	320 mg/kg
Ethylbenzene	160 mg/kg
Xylenes	250 mg/kg
Poly Aromatic Hydrocarbons	
Naphthalene	7.2 mg/kg
Non-Carc Pyrene	160 mg/kg
Benzo (a) pyrene eq	0.027 mg/kg

The analysis of area F12 in the 2015-16 monitoring period detailed a decrease in concentrations of TPH when compared to the analysis of the area post application of material, which was first analysed by the Council in October 2013 (Table 2).

The analysis results of this area denote a decrease in total TPH concentrations (C7-C36) from 23,000 mg/kg in October 2013, to 9,200 mg/kg in May of 2016. While this location is still above the conditional limit for surrender with respect to hydrocarbons (Table 1), it will continue to be monitored moving forward, until it has reached its conditional limit for surrender (Table 2). Specifically, C_{10}-C_{14} must reduce from 1,540 mg/kg to 58 mg/kg and C_{15}-C^{36} from 7,700 mg/kg to 4,000 mg/kg.

It is also interesting to note that area F12 contains a significant amount of variation, analysis undertaken by the Council through out the monitoring period details as such, Table 3. This supports the rationale for sampling an area more than once to quantify the degree of bio-remediation of the landfarming operation.

The other actively monitored location on this site is area F18. As discussed in the previous section, F18 contained a measurable detection of BaP and due to the low concentration requirement set by the Ministry for the Environment it has been continually monitored (Table 1).

The consent conditions dictate a surrender criteria concentration of 0.027 mg/kg and the laboratory limit of detection is 0.03 mg/kg, as such the Council would consider two separate analyses from the same area which were consistently below the limit of detection of this analyte to allow it to be surrendered.

The analysis of area F18 in this monitoring period dictated that the concentration of BaP within area F18 has decreased to below the limit of detection in the last sample collected in this monitoring period (Table 2).

Table 2 TPH MAH and PAH soil testing

Sample Type: Soil	Sample Name:	F12 24 Oct 2013	F12 19 May 2016	F18 23 Sep 2015	F18 19 May 2016
	Lab Number:	**1195350**	**1587116**	**1479611**	**1587116**
Dry Matter	g/100g as rcvd	86	90	80	93
BTEX in Soil by Headspace GC-MS					
Benzene	mg/kg dry wt	<0.05	< 0.05	n/a	< 0.05
Toluene	mg/kg dry wt	0.07	< 0.05	n/a	< 0.05
Ethylbenzene	mg/kg dry wt	<0.05	< 0.05	n/a	< 0.05
m&p-Xylene	mg/kg dry wt	0.43	1.36	n/a	< 0.10
o-Xylene	mg/kg dry wt	0.21	0.85	n/a	< 0.05
Polycyclic Aromatic Hydrocarbons Screening in Soil					
Acenaphthene	mg/kg dry wt	1.2	< 0.03	<0.03	< 0.03
Acenaphthylene	mg/kg dry wt	<0.3	< 0.03	<0.03	< 0.03
Anthracene	mg/kg dry wt	<0.3	< 0.03	<0.03	< 0.03
Benzo[a]anthracene	mg/kg dry wt	<0.3	0.06	0.03	< 0.03
Benzo[a]pyrene (BAP)	mg/kg dry wt	<0.3	0.03	0.03	< 0.03
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	<0.3	0.06	0.04	< 0.03
Benzo[g,h,i]perylene	mg/kg dry wt	<0.3	0.04	<0.03	< 0.03
Benzo[k]fluoranthene	mg/kg dry wt	<0.3	< 0.03	<0.03	< 0.03
Chrysene	mg/kg dry wt	<0.3	0.06	<0.03	< 0.03
Dibenzo[a,h]anthracene	mg/kg dry wt	<0.3	< 0.03	<0.03	< 0.03
Fluoranthene	mg/kg dry wt	<0.3	0.08	0.03	< 0.03
Fluorene	mg/kg dry wt	<0.3	0.32	<0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	<0.3	0.04	<0.03	< 0.03
Naphthalene	mg/kg dry wt	<1.3	1.1	<0.14	< 0.12
Phenanthrene	mg/kg dry wt	0.3	0.61	<0.03	< 0.03
Pyrene	mg/kg dry wt	0.4	0.12	0.12	< 0.03
Total Petroleum Hydrocarbons in Soil					
C_7 - C_9	mg/kg dry wt	14	15	n/a	< 8
C_{10} - C_{14}	mg/kg dry wt	**5,400**	**1,540**	n/a	< 20
C_{15} - C_{36}	mg/kg dry wt	**18,000**	**7,700**	n/a	< 40
Total hydrocarbons (C_7 - C_{36})	mg/kg dry wt	**23,000**	**9,200**	n/a	< 70

Table 3 Council analysed soil samples 2015-16 monitoring period

		BTW Wellington Landfarm	BTW Wellington Landfarm	BTW Wellington Landfarm	BTW Wellington Landfarm
		05 Nov 2015	19 May 2016	05 Nov 2015	19 May 2016
Parameter	**Unit**	**F18**	**F18**	**F12**	**F12**
Calcium	mg/kg	10.6	6.2	80.1	90.9
Chloride	mg/kg	14.8	23.3	62.0	66.5
Conductivity	mS/m@20°C	19.4	15.7	76.6	117.9
Total Hydrocarbon	mg/kg	242	44	2,217	9,095
Potassium	mg/kg	8.7	19.2	66.5	119.9
Moisture factor	nil	1.152	1.071	1.167	1.116
Magnesium	mg/kg	2.7	3.3	5.8	14.2
Sodium	mg/kg	16.3	17.7	51.9	94
Ammonia	mgN/kg	0.23	1.82	1.22	2.4
Nitrite/ Nitrate Nitrogen	mgN/kg	0.05	1.57	0.35	0.3
pH	pH	6.4	5.9	7.6	7.9
Sodium Adsorption Ratio	None	1.15701	1.42	1.50942	2.421
Total Soluble Salts	mg/kg	151.8	122.9	599.5	922.7

2.4.2 Council groundwater results

The site includes four active groundwater monitoring wells. These wells; situated in close proximity to the former storage pit area (Figure 2), are located up gradient, GND2282 and down gradient, GND2283, 2284 and 2285. The monitoring wells were installed to monitor the quality of the groundwater and to ascertain for any potential effects which may have resulted from the storage of material in the historic unlined storage cells.

The locations of the monitoring wells are detailed in Figure 2. The Council undertook the analysis of the monitoring well network on four occasions throughout the monitoring year, this is undertaken to quantify the seasonal variation across the site.

Analysis undertaken by the Council is discussed in Section 1.4.4 and also tabulated in the following Tables 4-7 respectively.

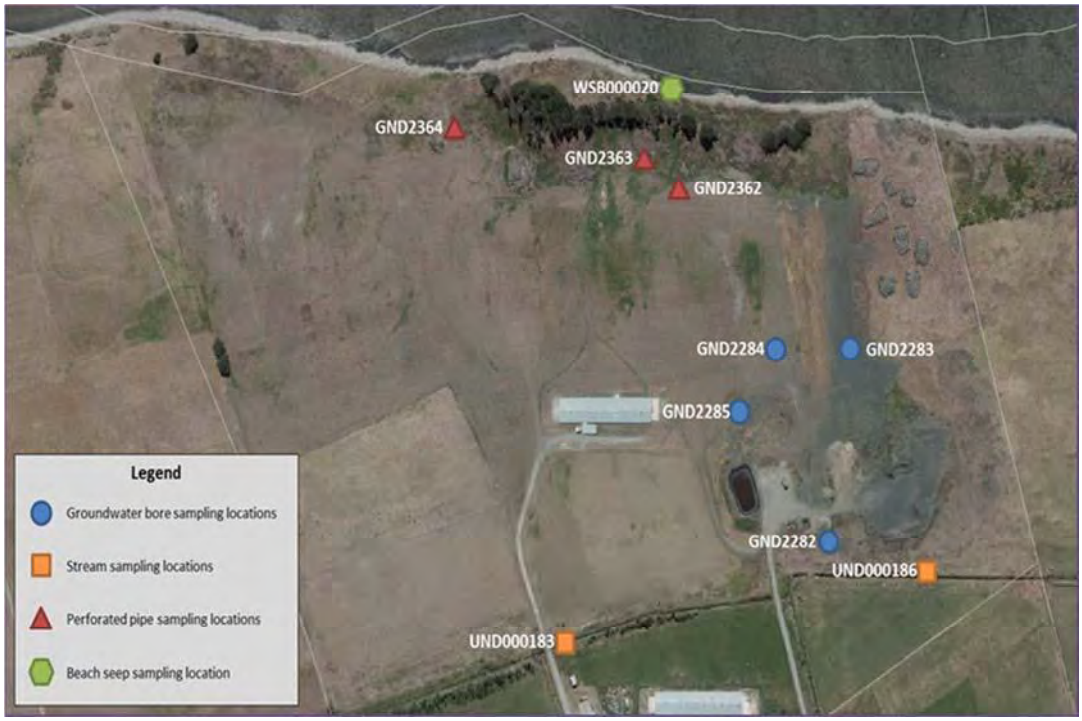


Figure 2 Groundwater and surface water monitoring locations

Table 4 Groundwater monitoring well results GND2282

		GND2282	GND2282	GND2282	GND2282
		MW1	MW1	MW1	MW1
Parameter	**Unit**	**06 Jul 2015**	**05 Nov 2015**	**05 Feb 2016**	**19 May 2016**
Acid soluble barium	g/m^3	0.14	0.14	0.13	0.14
Dissolved barium	g/m^3	0.14	0.14	0.12	0.14
Benzene	g/m^3	0.0026	0.0031	0.0025	0.0014
Chloride	g/m^3	404	355	347	301
Conductivity	mS/m@20°C	204	189	163	149
Ethylbenzene	g/m^3	<0.0010	<0.0010	<0.0010	<0.0010
Total hydrocarbon	g/m^3	<0.7	<0.7	<0.7	<0.10
C_7-C_9	g/m^3	<0.10	<0.10	<0.10	<0.4
C_{10}-C_{14}	g/m^3	<0.2	<0.2	<0.2	<0.7
C_{15}-C_{36}	g/m^3	<0.4	<0.4	<0.4	<0.2
Water level	m	2.028	2.272	2.435	2.54
Sodium	g/m^3	232	214	196	166
pH	pH	6.7	6.7	6.6	6.7
Total dissolved salts	g/m^3	1,578.4	1,462.3	1,261.1	1,152.8
Temperature	°C	16.7	15.4	17.2	16.7

		GND2282	GND2282	GND2282	GND2282
		MW1	MW1	MW1	MW1
Parameter	**Unit**	**06 Jul 2015**	**05 Nov 2015**	**05 Feb 2016**	**19 May 2016**
Toluene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
XYLENE-M	g/m³	<0.002	<0.002	<0.002	<0.002
XYLENE-O	g/m³	<0.0010	<0.0010	<0.0010	<0.0010

Table 5 Groundwater monitoring well results GND2283

		GND2283	GND2283	GND2283	GND2283
		MW2	MW2	MW2	MW2
Parameter	**Unit**	**06 Jul 2015**	**05 Nov 2015**	**05 Feb 2016**	**19 May 2016**
Acid soluble barium	g/m³	0.07	0.078	0.084	0.075
Dissolved barium	g/m³	0.069	0.08	0.073	0.072
Benzene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
Chloride	g/m³	77.8	82.5	94.7	81.8
Conductivity	mS/m@20°C	50.7	53.2	58.8	56.5
Ethylbenzene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
Total hydrocarbon	g/m³	<0.7	<0.7	<0.7	<0.10
C_7-C_9	g/m³	<0.10	<0.10	<0.10	<0.4
C_{10}-C_{14}	g/m³	<0.2	<0.2	<0.2	<0.7
C_{15}-C_{36}	g/m³	<0.4	<0.4	<0.4	<0.2
Water level	m	1.286	1.794	2.376	4.00
Sodium	g/m³	43.0	43.3	42.7	42.7
pH	pH	6.3	6.5	6.5	6.5
Total dissolved salts	g/m³	392.3	411.6	454.9	437.1
Temperature	°C	16.2	15.7	17.1	16.9
Toluene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
XYLENE-M	g/m³	<0.002	<0.002	<0.002	<0.002
XYLENE-O	g/m³	<0.0010	<0.0010	<0.0010	<0.0010

Table 6 Groundwater monitoring well results GND2284

		GND2284	GND2284	GND2284	GND2284
		MW3	MW3	MW3	MW3
Parameter	**Unit**	**06 Jul 2015**	**05 Nov 2015**	**05 Feb 2016**	**19 May 2016**
Acid soluble barium	g/m³	0.82	0.91	1.09	1.16
Dissolved barium	g/m³	0.82	0.91	1.09	1.16

		GND2284	GND2284	GND2284	GND2284
		MW3	MW3	MW3	MW3
Parameter	**Unit**	**06 Jul 2015**	**05 Nov 2015**	**05 Feb 2016**	**19 May 2016**
Benzene	g/m³	**0.042**	**0.065**	**0.074**	**0.067**
Chloride	g/m³	1,750	2,190	2,410	2,180
Conductivity	mS/m@20°C	513	582	655	669
Ethylbenzene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
Total hydrocarbon	g/m³	<0.7	<0.7	<0.7	<0.10
C_7-C_9	g/m³	<0.10	<0.10	<0.10	<0.4
C_{10}-C_{14}	g/m³	<0.2	<0.2	<0.2	<0.7
C_{15}-C_{36}	g/m³	<0.4	<0.4	<0.4	<0.2
Water level	m	1.015	1.508	1.914	2.00
Sodium	g/m³	364	432	542	584
pH	pH	6.3	6.1	6.1	6.1
Total dissolved salts	g/m³	**3,969.1**	**4,503.0**	**5,067.8**	**5,176.1**
Temperature	°C	16.7	15.8	17.6	17.7
Toluene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
XYLENE-M	g/m³	<0.0010	<0.002	<0.002	<0.002
XYLENE-O	g/m³	<0.0010	<0.0010	<0.0010	<0.0010

Table 7 Groundwater monitoring well results GND2285

		GND2285	GND2285	GND2285	GND2285
		MW4	MW4	MW4	MW4
Parameter	**Unit**	**06 Jul 2015**	**05 Nov 2015**	**05 Feb 2016**	**19 May 2016**
Acid soluble barium	g/m³	3.4	3.8	4.00	3.66
Dissolved barium	g/m³	3.4	3.75	3.96	3.66
Benzene	g/m³	**0.24**	**0.27**	**0.27**	**0.27**
Chloride	g/m³	**2,540**	**2,820**	**2,980**	2340
Conductivity	mS/m@20°C	746	792	817	771
Ethylbenzene	g/m³	0.0019	0.0018	0.0012	0.0013
Total hydrocarbon	g/m³	<0.7	<0.7	<0.7	<0.10
C_7-C_9	g/m³	<0.10	<0.10	<0.10	<0.4
C_{10}-C_{14}	g/m³	<0.2	<0.2	<0.2	<0.7
C_{15}-C_{36}	g/m³	<0.4	<0.4	<0.4	<0.2
Water level	m	0.918	1.492	1.834	1.97

		GND2285	GND2285	GND2285	GND2285
		MW4	MW4	MW4	MW4
Parameter	**Unit**	**06 Jul 2015**	**05 Nov 2015**	**05 Feb 2016**	**19 May 2016**
Sodium	g/m^3	853	973	1043	991
pH	pH	6.2	6.2	6.1	6.2
Total dissolved salts	g/m^3	**5,771.9**	**6,127.8**	**6,21.2**	**5,965.3**
Temperature	°C	16.5	15.5	18.3	18.0
Toluene	g/m^3	<0.0010	<0.0010	<0.0010	<0.0010
XYLENE-M	g/m^3	0.002	0.003	0.005	0.005
XYLENE-O	g/m^3	0.0020	0.0023	0.0034	0.0035

The analysis details a similar theme to the previous monitoring period in as much as the concentration of Total Dissolved Salts (TDS) in two of the four monitoring wells is still above the consent condition limit of 2,500g/m^3.

By way of background, this facility contained storage pits which were unlined, allowing for contamination as a result of the saline nature of the drilling mud; with a high concentrations of salts. This had resulted in localised effects on the groundwater in the direct vicinity of the storage cells.

The two wells which detail these high concentrations, GND2285 and 2284 are located down gradient of the former storage pits (Figure 2). In this period, both wells indicated an increase in salt concentrations. However, GND2285, which contained the highest concentration throughout the year (6,321 g/m^3) detailed a decline by the forth and final groundwater monitoring event (5,963 g/m^3). This location will continue to be monitored by the Council in the following monitoring period.

The other salt impacted well, GND2284, which is located further down gradient than GND2285, rose from a TDS concentration of 3,969 g/m^3 in July 2015, to a concentration of the 5,176 g/m^3 in May of 2016 (Figure 3).

The rationale for this increase is proposed due to the location of the well, down gradient from the storage pits, and down gradient from the GND2285. As such the saline plume which was first detected in GND2285 is now slowly moving north.

While this is a breech in the consent conditions, it is also minor, as there are minimal receptors which will be affected by the elevated salinity in the groundwater. This is part of the rationale why landfarms are located in close proximity to the marine environment, which is a dynamic saline environment. The salinity will have less than minor affects. If the concentration was over 8,000 mg/L[3] it would be unsuitable for stock watering purposes, however it is not above this value.

[3] Guidelines for Assessing and Managing Petroleum hydrocarbon Contaminated Sites in New Zealand, Revised 2011, Module 5 – Tier 1 Groundwater Acceptance Criteria, Table 5.1

Of note, the Company was infringed for the high saline groundwater when it became apparent in the 2012-13 year.

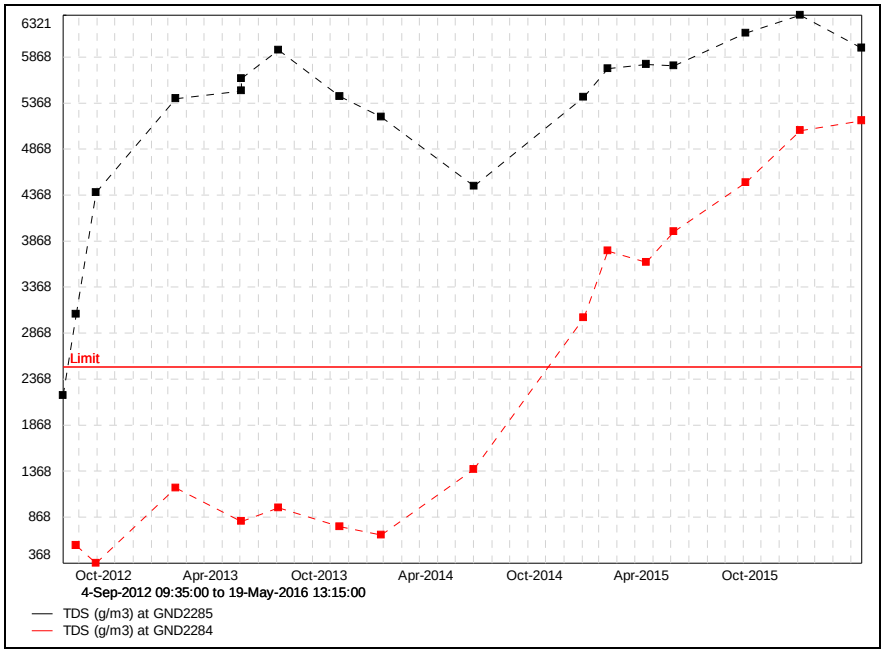


Figure 3 Total dissolved salt concentrations in GND2285 and 2284

As in the previous monitoring, benzene was detected in a concentration above the limit of detection in three of the four monitoring wells. While this concentration is a breech in one of the consent conditions which states:

Condition 23 of Consent 7884-1.1

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

Analysis of the long term monitoring record from the bore network detailed that the concentration of benzene is reducing. 0.3 mg/L is the value which should not be exceeded for the protection of aquatic ecosystems[4], and the concentrations are below this value.

The well with the highest concentration of benzene, is also correspondingly, the well with the highest TDS reading, GND2285. The concentration of benzene maintained a stable concentration of 0.27 g/m^3 in three of the four monitoring rounds throughout the year.

In similarity to the TDS concentration rise observed in GND2284 (Figure 3), it is proposed that the plume of saline water will flow down gradient. As this moves down gradient, the likely result will be a slight elevation in benzene concentrations observed in the down gradient well (GND2284) in the following monitoring period.

[4] Aquatic ecosystem guidelines ANZECC 1992

Again in similarity to the TDS, there are minimal receptors which may be affected by the concentration of benzene in the groundwater. While the water would not be acceptable for potable water with a benzene concentration of 0.27mg/L, it is still acceptable for stock water which has an MfE limit of 4 mg/L[5].

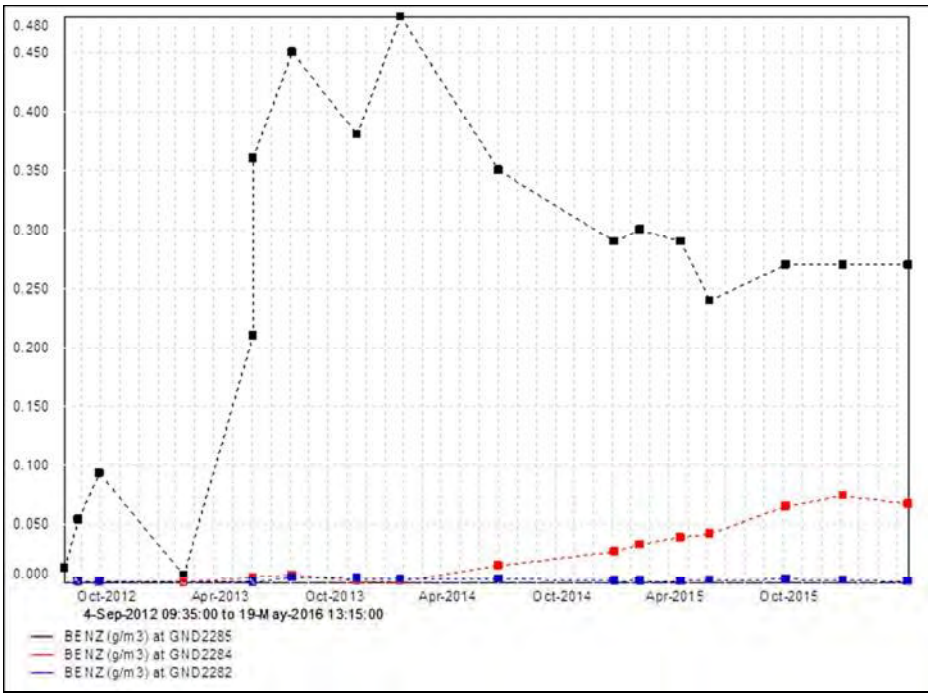


Figure 4 Long term record of Benzene analysis in the monitoring bore network

The Council will continue to monitor the groundwater monitoring network at the Wellington Landfarm in the up coming monitoring period, 2016-2017. The concentrations which are observed in the monitoring wells at the site are associated with a legacy issue of the historically unlined storage pits. Of note, the oil waste/well workover fluid cell was lined at this facility, while the other cells were not[6].

2.4.3 Council surface water results

The unnamed farm drain on the landward side of the site was sampled once during the monitoring period, both upstream and down stream, Figure 2. The rationale for the spot sample collection in this monitoring location was due to the long term analysis not returning any significant readings throughout the life of this monitoring site.

Table 8 Surface water sample results

		Downstream (UND000186)	Upstream (UND000183)
Parameter	**Unit**	**06 Jul 2015**	**06 Jul 2015**
Acid soluble barium	g/m³	0.015	0.009

[5] Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand Module 5 Tier 1 Groundwater Acceptance Criteria, Revised 2011.
[6] All operational landfarms in Taranaki are now equipped with fit for purpose, high grade synthetic liners for all storage cells.

		Downstream (UND000186)	Upstream (UND000183)
Parameter	**Unit**	**06 Jul 2015**	**06 Jul 2015**
Dissolved barium	g/m³	0.015	0.009
Benzene	g/m³	<0.0010	<0.0010
Chloride	g/m³	44.9	38.8
Conductivity	mS/m@20°C	22.3	20.3
Ethylbenzene	g/m³	<0.0010	<0.0010
Total hydrocarbon	g/m³	<0.7	<0.7
HC C10-C14	g/m³	<0.2	<0.2
HC C15-C36	g/m³	<0.4	<0.4
HC C7-C9	g/m³	<0.10	<0.10
Sodium	g/m³	24.0	23.0
pH	pH	6.6	6.6
Total dissolved salts	g/m³	172.5	157.1
Temperature	°C	14.4	14.6
Toluene	g/m³	<0.0010	<0.0010
XYLENE-1	g/m³	<0.0010	<0.0010
XYLENE-2	g/m³	<0.002	<0.002

No hydrocarbons were recorded in either of the samples collected. The slight differences which were observed between the upstream and downstream sample were mainly centred on the slight increase of chloride, although given the close proximity to the shoreline this is negligible, this is similarly echoed in the level of TDS.

The Wellington site also contains four Novaflows (Figure 2), two of which were sampled during this monitoring period. The rationale for the dual sample collection was centred on the lack of water to sample from the other coils.

In the 2013-2014 period, these four coils were each sampled to ascertain whether they had the potential to convey potentially contaminated water to the inter-tidal area.

The analysis undertaken during that monitoring period indicated no impacts to water from the site activities. The analysis undertaken during this monitoring period indicated the same, negligible impacts (Table 9).

Table 9 Council Novaflow sample results

		GND2364	GND2363
		Novaflow 4	Novaflow 3
Parameter	**Unit**	**19 May 2016**	**19 May 2016**
Acid soluble barium	g/m³	0.060	0.131
Dissolved barium	g/m³	0.060	0.131
Benzene	g/m³	<0.0010	<0.0010
Chloride	g/m³	75.5	46.3
Conductivity	mS/m@20°C	50.9	37.8
Ethylbenzene	g/m³	<0.0010	<0.0010
Total hydrocarbon	g/m³	<0.7	<0.7
HC C7-C9	g/m³	<0.10	<0.10
HC C10-C14	g/m³	<0.2	<0.2
HC C15-C36	g/m³	<0.4	<0.4
Sodium	g/m³	35.9	24.2
pH	pH	6.5	6.5
Total Dissolved Salts	g/m³	393.8	292.5
Temperature	°C	18.4	17.1
Toluene	g/m³	<0.0010	<0.0010
Meta-Xylene	g/m³	<0.002	<0.002
Ortha-Xylene	g/m³	<0.0010	<0.0010

2.4.4 Marine ecological survey

A marine ecological survey was not undertaken this year, as previous monitoring had indicated that the activities were not having a detectable adverse effect on the intertidal reef communities. This was echoed in the previous years' biomonitoring report, whereby its conclusions are provided below.

In order to assess the effects of the site on the nearby intertidal communities, ecological surveys were conducted between 10 September and 8 December 2014 at four sites (Photo 2 and 3). These surveys included three potential impact sites and one control site. Potential adverse effects of the site 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 site and potential impact sites, the results indicated that the site was not having detectable adverse effects on the intertidal reef communities. In addition, over the long term record, there has been no obvious decline in species number and Shannon-Weiner index at the potential impact sites relative to the control site. Natural factors, such as sand inundation, biotic competition for substrate, and nutrient supply appear to be important drivers of species richness and diversity for the sites surveyed.

Photo 2 Marine ecological sample sites

Photo 3 Control site Turangi Reef (2014)

2.5 Investigations, interventions, and incidents

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

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

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

In the 2015-2016 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans.

3. Discussion

3.1 Discussion of site performance

The site was completely decommissioned in the 2013-14 monitoring year; as such the last application of material to land occurred in September 2013. In March of last year the Company applied for a partial surrender, which effectively limited the areas of the site which required monitoring moving forward. This resulted in the two remaining areas, F12 and F18 respectively, with the requirement for ongoing monitoring.

In the previous monitoring period, the Company undertook additional remedial works to encourage bioremediation of the area F12, the initial analysis in that period suggested that the works had been effective; however results in this period suggest that they may be required to occur again if the Company would like to increase the speed of bio-remediation in this specific area. Analysis of area F18 indicated the analyte BaP has now remediated to below the limit of detection. This area will now be removed from future sampling.

The site did not require any additional inspections, nor did it receive any infringement or abatement notices in this period.

3.2 Environmental effects of exercise of consents

The environmental effects associated with the exercise of this consent are centred on a legacy issue which was first identified during the 2012-2013 monitoring period. The issue was described as minor but significant at the time, whereby the groundwater in the vicinity of the storage cells had been impacted by poor storage of fluid waste. This had resulted in high salinity in two of the four groundwater monitoring wells as well as trace benzene in three of the four wells. The legacy remained apparent in the groundwater monitoring undertaken by the Council during this reporting period (Figure 3 and 4).

The Company was infringed for this incident during the 2012-2013 year. While the effect had been adverse, it was also minor. The degree of salt concentration peaked at 6,321 mg/kg; this was observed in well GND2285. This is classified as acceptable for stock water[7] in the case of dissolved salts. Also given the close proximity of the site to the marine environment the effect should be negligible. The Council will continue to monitor the salt concentrations within these two wells until they have reached the conditional requirement of total dissolved salts below 2,500 mg/L.

While the well GND2285 detailed a slight decrease in concentrations of TDS in this period, conversely, and as already discussed in section 2.3.2, GND2284 detailed an increase in salinity, which rose from 3,969-1 to 5,176.1 g/m^3. This is proposed to be a result of the saline impacted groundwater moving slowly northwards towards the coast (Figure 2).

As well as high salinity concentrations, the groundwater analysis had also detected low concentrations of benzene; this is graphically presented in Figure 6. While the benzene

[7] Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Module 5 – Tier 1 Groundwater Acceptance Criteria, Table 5.1

had been detectable, it is also in very low concentrations, which is acceptable for irrigation or stock water in line with the MfE guidelines[8]. The highest recorded reading in this monitoring period was 0.27 mg/L, which is 0.03 mg/L below the trigger value for Aquatic ecosystem protection defined by the ANZEEC (1992); in comparison to the previous monitoring period.

While these two parameters have been highlighted it is noteworthy to mention that they do not have a measureable off site effect as they are localised. No offsite effects have to date been detected. From a groundwater perspective, both these parameters will be monitored until they have reached the concentrations specified in the consent.

Surface water analysis of samples collected from the farm drain on the southern end of the site and the Novacoil which bisects the site both indicated negligible effects from the site activities.

The Council did not undertake a marine ecological survey this monitoring period. The rationale for this annual marine survey was to ascertain whether the site was or had caused an adverse effect in terms of species diversity or richness. To date, over the long term record, there has been no obvious decline in species as a result of the site activities.

In terms of the application of material to land, the soils have been managed in an acceptable manner. One location remains, F12, which has not met the conditional requirement for surrender, the Company had undertaken remediation in this location to further stimulate the microbial activity which is responsible for the decreasing the degree of hydrocarbon in the soil. While this indicated a hands-on result in the previous monitoring period, the Company may wish to undertake the exercise again, if they would like to increase the bioremediation rate in this specific area.

Overall, the exercise of the resource consent 7884-1.1 during the 2015-16 period has led to less than minor environmental effects. There still exists the legacy issue in terms of salinity concentration as well as the trace hydrocarbons; however these will continue to be monitored.

[8] Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Module 5 – Tier 1 Groundwater Acceptance Criteria, Table 5.11

3.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Table 10.

Table 10 Summary of performance for consent 7884-1.1 during the 2015-16 monitoring year

Purpose: ***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. Consent application definition	Not applicable	N/A
2. Definitions which apply to the consent	Not applicable	N/A
3. Best practicable option to be adopted	Inspections and liaison with consent holder	Yes
4. Only specified wastes to be discharged	Information provided by consent holder	Yes
5. Notification 48 hours prior to stockpiling	Not applicable as no deliveries in this monitoring period	N/A
6. Notification 48 hours prior to landfarming	Not applicable as no landfarming operations in this monitoring period	N/A
7. Sample of wastes from each individual source to be collected and analysed	Not applicable as no landfarming operations in this monitoring period	N/A
8. Keep records relating to wastes, areas, compositions, volumes, dates, treatments and monitoring	Information provided by consent holder	Yes
9. Report on records in to Council by 31 August	Report received 31 August 2016	Yes
10. Well work-over fluids to be stored in tank or pit	Inspections and information provided by consent holder	N/A
11. Liquid oily wastes to be stored in tank or mixed into pit	None received during monitoring period	N/A
12. All wastes landfarmed ASAP or within 12 months	Inspections and information provided by consent holder	Yes
13. Well work-over fluids to be kept separate from other waste types	Inspections and information provided by consent holder	Yes
14. No waste to be discharged into F1 and F2 areas	Inspections and information provided by consent holder	Yes
15. Solid waste to be applied either 100mm or 50mm thick depending on hydrocarbon concentration	Inspections and information provided by consent holder	Yes
16. Parameters for rate of liquid waste application	Inspections and information provided by consent holder	Yes
17. Incorporation of solid wastes to a depth of at least 250mm ASAP	Inspections and information provided by consent holder	Yes
18. Hydrocarbon concentration shall not exceed 50,000 mg/kg dry weight	Sampling and information provided by consent holder	Yes
19. Single application of wastes to each area of land	Inspections and information provided by consent holder	Yes

Purpose: ***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?**
20. 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
21. Re-vegetate landfarmed areas as soon as practicable	Inspections and information provided by consent holder	Yes
22. Total dissolved salts in surface water or groundwater shall not exceed 2,500 g/m^3	Exceeded in two of four monitoring wells.	**No**
23. Contaminants in surface or groundwater not to exceed background concentrations	Trace benzene in three of four monitoring wells	**No, but reducing**
24. 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
25. 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
26. Concentration of metals in soil to comply with guidelines	Sampling	Yes
27. Levels of contaminants prior to expiry, cancellation, or surrender of consent		N/A
28. Consent may not be surrendered until condition 26 is satisfied		N/A
29. Notification of discovery of archaeological remains	None found	N/A
30. Consent to lapse in 2016 unless given effect to	Consent exercised	N/A
31. 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 **Good** level of environmental and **High** level of administrative performance with the resource consents as defined in reported Section 1.1.4.

3.4 Recommendations from the 2014-2015 Annual Report

In the 2014-2015 Annual Report, it was recommended:

1. THAT monitoring of consented activities at the Wellington landfarm in the 2015-2016 year be amended from that undertaken in 2014-2015, by the removal of the following facets:

    - Marine Ecological Survey ; and
    - Surface Water Sampling.

2. That monitoring of the two remaining locations, F12 and F18, continue until they have reached their conditional surrender value.

3. That the consent is not surrendered until the groundwater concentrations in terms of salinity and trace benzene are below the conditional value.

4. THAT the option for a review of resource consent in June 2016, as set out in condition 31 of the consent, not be exercised, on the grounds that the site has been decommissioned and it may reach it's conditional surrender value across the mediums of water and soil within this monitoring period.

These recommendations were implemented in the 2015-16 monitoring year with the exception of the review.

3.5 Alterations to monitoring programmes for 2016-2017

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

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

The Council also takes into account the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki emitting to the atmosphere/discharging to the environment. An amendment to this monitoring programme is proposed for 2016-2017.

- Surface water sample collection areas will be sampled for field readings only[9] with a YSI flow through cell. Field readings will include: pH, temperature, conductivity, dissolved oxygen and oxidation and reduction potential.

- Soil sampling will occur in area F12 only; area F18 does not require additional sample collection.

[9] If staff observe foaming, odour or a sharp change in readings then a sample will be collected and analysed for standard analytes.

4. Recommendations

1. THAT monitoring of consented activities at the Wellington Landfarm in the 2016-2017 year be modified to include field parameter collection for surface water samples, with the caveat for sample collection if required and that soil samples are limited to the area F12. Groundwater monitoring will continue.

Glossary of common terms and abbreviations

Al*	Aluminium.
As*	Arsenic.
BaP	Benzo (a) Pyrene.
Biomonitoring	Assessing the health of the environment using aquatic organisms.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
Bund	A wall around a tank to contain its contents in the case of a leak.
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
Cu*	Copper.
Cumec	A volumetric measure of flow- 1 cubic metre per second (1 m^3s^{-1}).
DO	Dissolved oxygen.
$g/m^2/day$	Grams/metre^2/day.
g/m^3	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
Incident Register	The Incident Register contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
L/s	Litres per second.
m^2	Square Metres.
MAH	Monocyclic Aromatic Hydrocarbons
mS/m	Millisiemens per metre.
NH_4	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH_3	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO_3	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
PAH	Polycyclic Aromatic Hydrocarbons

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

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

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

Bibliography and references

BTW Company Ltd, 2015: Annual Report – Wellington Landfarm Consent 7884 (10181) 2014-15

BTW Company Ltd, 2016: Annual Report – Wellington Landfarm Consent 7884 (10181) 2015-16

Ministry for the Environment 1999 (Revised 2011): Guidelines for assessing and managing petroleum hydrocarbon contaminated sites in New Zealand, Ministry for the Environment, Module 4 and 5

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

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

Taranaki Regional Council, 2014: BTW Company Ltd Brown Road Landfarm Monitoring Programme Annual Report 2013-14. Technical Report 14-66

Taranaki Regional Council, 2015: BTW Company Ltd Wellington Landfarm Monitoring Programme Annual Report 2014-15. Technical Report 15-67

Appendix I

Resource consents held by the Company

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

Discharge Permit

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

Name of Consent Holder:	BTW Company Limited PO Box 551 New Plymouth 4340	
Decision Date (Change):	19 March 2015	
Commencement Date (Change):	19 March 2015	(Granted 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
Expiry Date:	1 June 2027
Review Date(s):	June 2015. June 2016, June 2021
Site Location:	70 Brown Road, Waitara (Property owner: HV & MC Wellington)
Legal Description:	Lot 1 DP 5462 Blk III Paritutu SD (Discharge site)
Grid Reference (NZTM)	1704600E-5683480N
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 with section 36 of the Resource Management Act 1991.

Special conditions

1. This consent applies only to areas F12 and F18, as detailed in attached drawing no 10181-01-GIS Revision 40.

2. 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.

3. 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.

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

Notifications, monitoring and reporting

5. 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.

6. 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.

7. 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.

8. 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.

9. 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 8, for the period of the previous 12 months, 1 July to 30 June.

Storage

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

11. Liquid oily wastes shall be either:

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

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

Discharge limits

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

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

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

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

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

    a) at a rate 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.

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

18. The hydrocarbon concentration in the soil over the landfarming area shall not exceed 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.

19. Any areas of land used for the landfarming of wastes in accordance with conditions 15-17 of this consent, shall not be used for any subsequent discharges of waste.

20. 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.

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

Receiving environment limits - water

22. 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.

23. Other than as provided for in condition 22, 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

24. 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.

25. 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.

26. 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).

27. 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.

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

Archaeological remains

29. 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

30. 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.

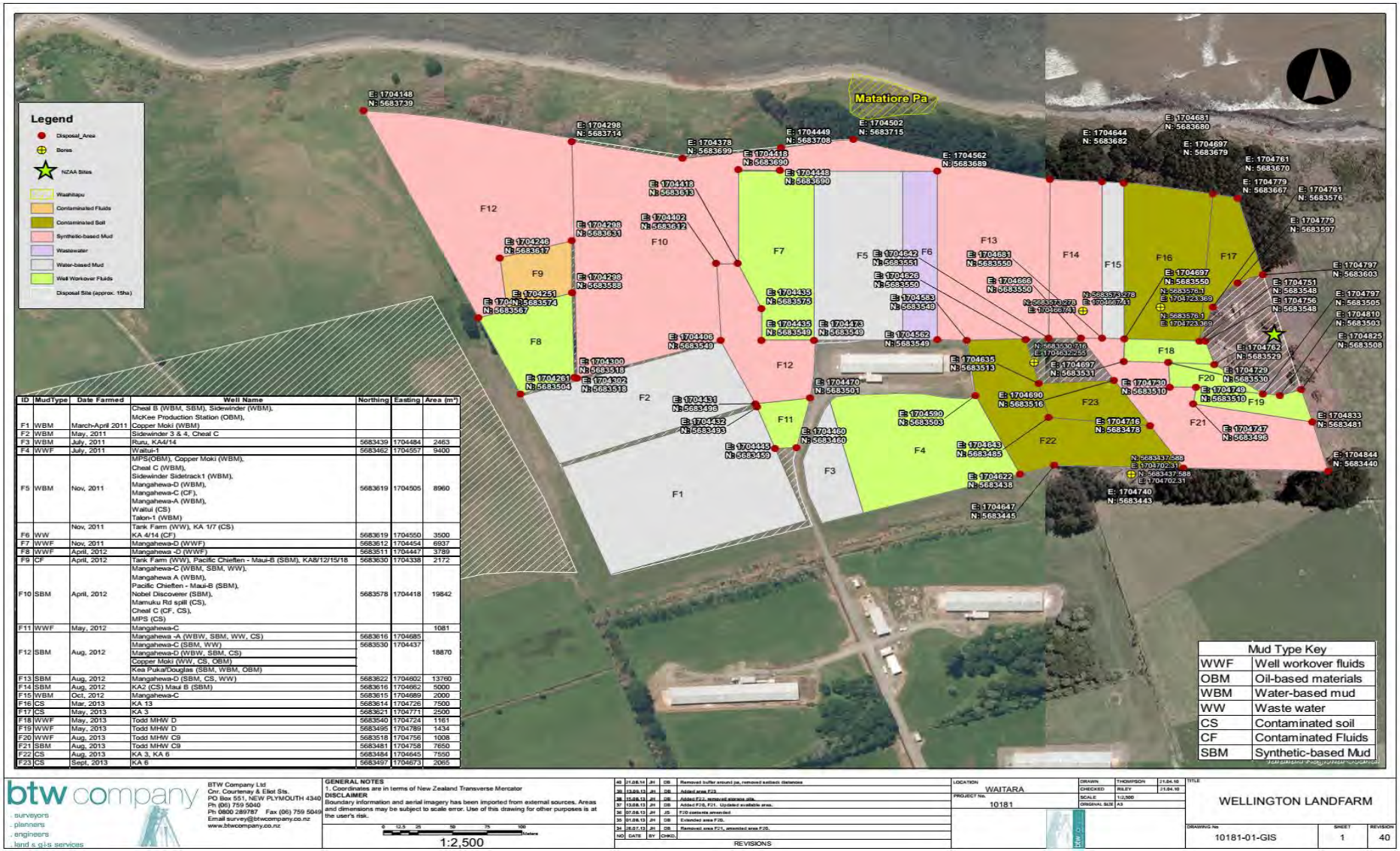
31. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2015 and/or June 2016 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 19 March 2015

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management



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	2463
F4	WWF	July, 2011	Waitui-1	5683462	1704557	9400
F5	WBM	Nov, 2011	MPS(OBM), Copper Moki (WBM), Cheal C (WBM), Sidewinder Sidetrack1 (WBM), Mangahewa-D (WBM), Mangahewa-C (CF), Mangahewa-A (WBM), Waitui (CS) Talon-1 (WBM)	5683619	1704505	8960
F6	WW	Nov, 2011	Tank Farm (WW), KA 1/7 (CS) KA 4/14 (CF)	5683619	1704550	3500
F7	WWF	Nov, 2011	Mangahewa-D (WWF)	5683612	1704454	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 5683630	1704685 1704437	18870
F13	SBM	Aug, 2012	Mangahewa-D (SBM, CS, WW)	5683622	1704602	13760
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	2500
F18	WWF	May, 2013	Todd MHW D	5683540	1704724	1161
F19	WWF	May, 2013	Todd MHW D	5683495	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

btw company
surveyors
planners
engineers
land & gis services

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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

NO	DATE	BY	CHKD	REVISIONS
40	21.08.14	JH	DB	Removed buffer around pa, removed setback distances
39	13.09.13	JH	DB	Added area F23.
38	15.08.13	JH	DB	Added F22, removed access site.
37	13.08.13	JH	DB	Added F20, F21. Updated available area.
36	07.08.13	JH	JS	F10 contents amended
35	01.08.13	JH	DB	Extended area F20.
34	26.07.13	JH	DB	Removed area F21, amended area F20.

LOCATION: WAITARA
PROJECT No.: 10181
DRAWN: THOMPSON 21.04.10
CHECKED: RILEY 21.04.10
SCALE: 1:2,500
ORIGINAL SIZE: A3

TITLE: WELLINGTON LANDFARM
DRAWING No: 10181-01-GIS
SHEET: 1
REVISION: 40

Appendix II

Company Annual report

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 Senior Environmental Scientist	30/8/16 Date
Reviewed by	Cameron Twigley Director, Planning and Environment	30/8/16 Date

btw company

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 2015 to 30 June 2016 as well as monitoring required under SC 21-27.

1.2 July 2015 to June 2016 - Summary

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

Pasture establishment has been excellent across the site, especially considering there has been minimal farm management of the site, which accounts for the abundant array of weed species within the vegetation cover.

The F18 area now has demonstrated compliance with the soil surrender criteria by both the consent holder's results and the Taranaki Regional Councils (TRC) sampling results. No further monitoring of this area will take place.

The F12 area which is of considerable size (18870m^2) has provided considerable variance of soil sampling results. The last sample taken by the consent holder did demonstrate compliance with consent surrender condition requirements. However we acknowledge a recent sample taken by the TRC has shown results above surrender criteria. This area had been re-worked in the previous monitoring years to assist in the bioremediation of hot spot areas; however we believe there are still hot spot areas within the F12 area at a depth of 300mm to 500mm. At a depth of greater than 300mm below the surface level, which is below the root structure, we consider the risk to livestock grazing on isolated hot spots of hydrocarbons to be negligible.

As the drilling muds appear to be deeper in the F12 area, this does slow the rate of any bioremediation of the drilling muds, and we also acknowledge the drilling muds in this area did have a high hydrocarbon content when they were landfarmed. We expect the drilling muds in F12 to slowly bio remediate over time to meet surrender criteria.

Overall it is considered the bioremediation of the soil overtime has been a positive outcome, especially considering the mixture of waste sources that were previously disposed of at the site.

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) The site was completely decommissioned during the 2013 -14 monitoring year. So no new records on the composition of waste are supplied, as this has been provided in previous annual monitoring reports.

  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 A 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 A.

- 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 23-27 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

No new material was disposed of or stockpiled during the monitoring year. The site was totally decommissioned during the monitoring period 2013 to 2014.

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

2.2 Sowing and treatments

No sowing or land treatments have taken place during the monitoring year.

2.3 Pasture Establishment

The site is completely vegetated. Photographic evidence of pasture establishment is contained in Appendix B.

3 MONITORING INFORMATION

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

3.1 Monitoring

Monitoring of the landfarmed area begins within the first month of topsoil being re-applied to the landfarmed area. At this point, an entire suite of tests (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

The consent holder's results demonstrate that all areas meet surrender criteria for this consent. However we acknowledge there are still likely some hot spot areas in the F12 area. 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.

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 A) 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 (5 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 5 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 been inactive since about November 2013, therefore no landfarming has taken place during the monitoring year.

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 by the TRC for this site.

3.6 Abatement Notices

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

4 ANALYSIS OF RESULTS

The following Table 4.1 provides a summary of the monitoring results undertaken over the reporting period. Analysis of the results of monitoring are required by SC7, condition j. Special Conditions 23-27 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 soil, the field is coloured red. The consent holder's results show compliance in all landfarm areas now. Acomplete table of soil sampling results for each individual area provides significant data and demonstrates the rate of breakdown of certain constituent's overtime at the landfarming site.

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

		Consent Surrender Met				Consent Surrender not met																			
	Date	Soil conductivity <290mS m-1 (see Consent if PD is greater than 400)	Sodium 460 mg/kg	SAR <18	Dissovled 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		490			<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		560			<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	380	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		510			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	2100	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		580			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	554	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		640	0.5	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	760	9,200	0.12	50	SBM
	12/12/2012		760			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	390	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	135	8	400	2,800	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	<0.06	<0.06	<0.11	<0.15	0.06	<0.03	<2	0.14	14	19	18.6	<0.10	8	90	12	1,650	4,500	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	451	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	7100	23000	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	0.05	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
	4/03/2015																				8	20	250			SBM
	4/03/2015																				8	24	830			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		530			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	3100	6800	0.11	330	SBM
	24/04/2013	920	535	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	1560	4100	1	390	SBM
	28/12/2013	780	989	11.7	5140	<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	62	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	0.1	<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
	27/01/2015									<0.11	0.04	0.04														
	23/09/2015									<0.14	0.03	0.03														
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 met			Consent Surrender limit not met																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				
	5/06/2014				<0.05	<0.05	<0.05	<0.05	<0.12	0.02	<0.03									8	20	164				
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 sampling had ceased last monitoring period, as no contaminant concentration had ever been detected above expected background levels for the subject site. The Taranaki Regional Council continues to monitor the four groundwater monitoring bores.

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.

Over the year in review, the consent limit for Soil Conductivity of 400 mS / m continues to be met, having been met for all landfarmed areas since 2014 as shown in table 4.1 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 table 4.1 above, SAR limits have generally been low and all areas have met surrender criteria throughout the sampling regime to date.

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 compliant with Table 7.1, Section 7 of the Ministry of the Environment and New Zealand Water and Wastes Association's Guidelines for the safe application of biosolids to land in New Zealand (2003).

4.2.4 Condition 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 carc. (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 sub sections provide details on constituent status in regards to consent surrender requirements.

4.2.5 Conductivity

As shown in table 4.1 above, all landfarmed areas meet the consent surrender limit of 290mS/m for conductivity.

Area/s not within surrender limits: None

4.2.6 Chloride

As shown in table 4.1 above, all landfarmed areas meet the consent surrender limit of 700 mg/Kg for Chloride.

Area/s not within surrender limits: None

4.2.7 Sodium

As shown in table 4.1 above, all landfarmed areas meet the consent surrender limit of 460 mg/kg for Sodium.

Area/s not within surrender limits: None

4.2.8 Dissolved Salts

As shown in table 4.1 above, all landfarmed areas meet the consent surrender limit of 2500mg/Kg for total soluble salts.

Area/s not within surrender limits: None.

4.2.9 TPH C7 – C9

The lighter fraction hydrocarbon chains (C7-C9) have shown to have met consent surrender criteria during soil sampling monitoring, this carbon band has essentially been under detection limits for these fractions of hydrocarbons through-out the monitoring. This is demonstrated in table 4.1 above.

Area/s not within surrender limits: None.

4.2.10 TPH C10 – C14

The carbon band of C10-C14 has often been elevated in the synthetic based muds. However the last remaining area (F12) has now shown a significant reduction in this band and now meets surrender criteria for the consent for the carbon band of C10 – C14 in the location BTW sampled. We note though the F12 area would appear to have still isolated hotspot areas that are above the consent surrender criteria. These hotspot areas are likely at a depth of greater than 300mm.

Area/s not within surrender limits: Still potentially some hotspot areas in the F12 area as identified by the TRC.

4.2.11 TPH C15 – C36

The carbon band of C15-C36 has in the past shown elevated levels in the synthetic based muds which is not surprising. All areas landfarmed have seen a significant reduction in this carbon band, and now all areas meet consent surrender criteria by the consent holder's results.

We note the F12 area has shown large variance in the soil sample results by the consent holder and the TRC. A sample taken by the TRC on the 5th of November 2015 demonstrated compliance with consent surrender conditions, however a subsequent sample taken on the 19th of November 2016 demonstrated that consent surrender levels had not been met for this area.

Area/s not within surrender limits: Still potentially some hotspot areas in the F12 area as identified by the TRC.

4.2.12 PAHs

A trace detection of Benzo (a) pyrene had been in the past identified in the F18 area. Sampling results by the consent holder and the TRC over the monitoring year have shown Benzo (a) pyrene to be below detection limits and consent surrender criteria met. No further sampling of the F18 will take place.

Area/s not within surrender limits: None

4.2.13 Summary

The site has been inactive during the monitoring year as the site was decommissioned and completed during the 2013-2014 monitoring year.

The site was partially surrendered on the 19th of March 2015 with only the F12 and F18 areas not meeting surrendering criteria at the time, all other areas had met the soil surrender criteria.

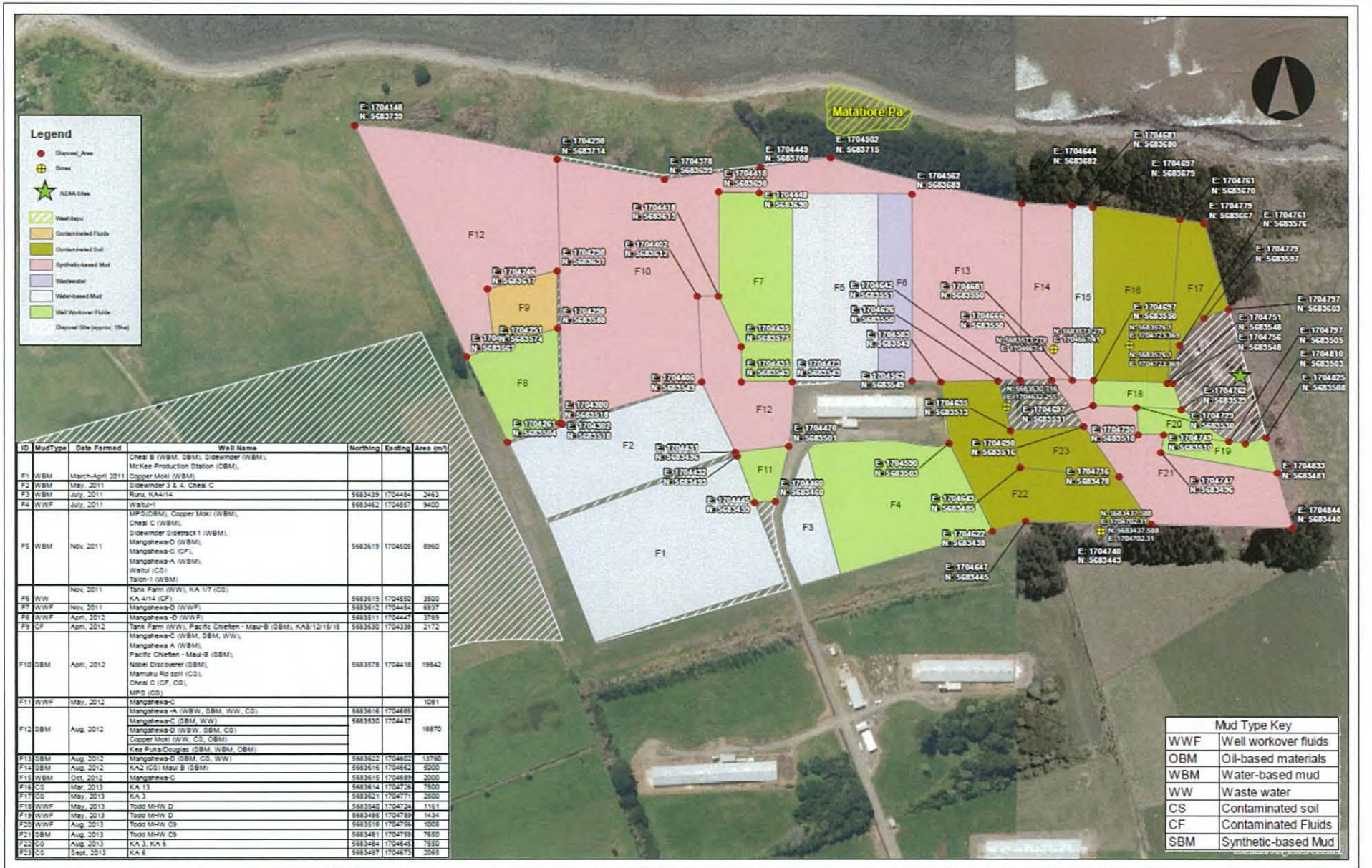
The two remaining landfarm areas that are identified as F12 and F18 have been monitored by both the consent holder and the TRC during the monitoring period. All results from the consent holder and the TRC have shown the F18 now meets surrender criteria and no further soil sampling is required for this area. The F12 area has shown a significant variance in the sampling results. This may be due to a change in sampling methodology by the TRC (sampling deeper than previously) or the area having isolated hot spots.

The F12 area is a very large area of 18,870m^2, therefore we are of the opinion there is highly likely to still be some isolated hot spot areas, and this has been confirmed by some of the TRC sampling results.

All the soil sampling results demonstrated 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. All the landfarmed areas are also measured against the Ministry for the Environment guidelines for assessing and managing petroleum hydrocarbons on contaminated sites in New Zealand. This is a conservative guideline document to protect human health and based on the agricultural landuse values which are the most stringent in this guideline.

Only the F12 area is in question regarding meeting surrender criteria. The variance in the results does provide some evidence there is still likely to be hot spot areas within the F12 area. We also consider these hot spot areas to be slightly deeper which will slow the bio-remediation process and increase the time before surrender criteria can be met. Overall the site has shown a significant reduction in hydrocarbon levels in the soil, and this process will continue into the future until background soil levels have been met.

APPENDIX A SITE MAPS



ID	MudType	Date Farmed	Well Name	Northing	Easting	Area (m²)
F1	WBM	March-April 2011	Cheal B (WBM, OBM), Sidewinder (WBM), McKee Production Station (OBM), Copper Moki (WBM)			
F2	WBM	May, 2011	Sidewinder 3 & 4, Cheal C			
F3	WBM	July, 2011	Ruru, KAA/14	5683439	1704484	2463
F4	WWF	July, 2011	Waitui-1	5683462	1704557	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	1704508	8960
F6	WW	Nov, 2011	Tank Farm (WW), KA 1/7 (CS) KA 4/14 (CF)	5683619	1704650	3600
F7	WWF	Nov, 2011	Mangahewa-D (WWF)	5683612	1704484	6937
F8	WWF	April, 2012	Mangahewa -D (WWF)	5683611	1704447	3789
F9	OF	April, 2012	Tank Farm (WW), Pacific Chieften - Maui-B (OBM), KA8/12/15/18	5683630	1704338	2172
F10	OBM	April, 2012	Mangahewa-C (WBM, OBM, WW), Mangahewa A (WBM), Pacific Chieften - Maui-B (OBM), Nobel Discoverer (OBM), Mamuku Rd spill (CS), Cheal C (CF, CS), MPS (CS)	5683578	1704418	19942
F11	WWF	May, 2012	Mangahewa-C			1081
F12	OBM	Aug, 2012	Mangahewa -A (WBW, SBM, WW, CS) Mangahewa-C (OBM, WW) Mangahewa-D (WBW, SBM, CS) Copper Moki (WW, CS, OBM) Kea Puka/Douglas (OBM, WBM, OBM)	5683616 5683530	1704485 1704437	16870
F13	OBM	Aug, 2012	Mangahewa-D (OBM, CS, WW)	5683622	1704602	13760
F14	OBM	Aug, 2012	KA2 (CS) Maui B (OBM)	5683616	1704662	5000
F15	WBM	Oct, 2012	Mangahewa-C	5683615	1704689	2000
F16	CS	Mar, 2013	KA 13	5683614	1704726	7900
F17	CS	May, 2013	KA 3	5683621	1704771	2800
F18	WWF	May, 2013	Todd MHW D	5683640	1704734	1161
F19	WWF	May, 2013	Todd MHW D	5683495	1704789	1434
F20	WWF	Aug, 2013	Todd MHW C9	5683518	1704795	1008
F21	OBM	Aug, 2013	Todd MHW C9	5683481	1704768	7660
F22	CS	Aug, 2013	KA 3, KA 6	5683484	1704645	7950
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

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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

WELLINGTON LANDFARM

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

APPENDIX B PHOTOGRAPHIC RECORD OF LANDFARMING