BTW Company Limited
Wellington landfarm
Monitoring Programme
Annual Report
2014-2015

Technical Report 2015-67

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Executive summary

BTW Company Limited (the Company) operates a landfarm (Wellington Landfarm) located on Brown Road, Waitara, in the Waitara catchment. This report for the period July 2014–June 2015 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 eight inspections, 19 water samples and six composite soil samples collected for physicochemical analysis, one (four site) marine ecological survey of the inter-tidal area and a review of the Company supplied annual report.

The monitoring indicated that the landfarm has been effective at sequestering and remediating material to ground; this is evident from the analysis undertaken over time. While two locations temporarily remain outside of the conditional value for surrender, the remaining 21 locations which had been utilised for the practice of landfarming have been surrendered. The proponent provided the Council will analytical evidence to support the surrender of the 21 locations in this monitoring period; this led to a change of consent conditions in March 2015.

The site activities in comparison to previous years have ceased due to the fact the site was decommissioned in the previous period. There still remains a legacy issue in terms of elevated salinity and trace benzene in the groundwater in the immediate vicinity of the former storage cells, while two soil locations remain above the conditional value for surrender. However, in the up coming period the two outstanding soil locations as well as the elevated salinity and trace benzene should suitably remediate with time and the Council will continue to monitor the progress of these facets. It is noteworthy to mention that the elevated groundwater salinity is localised and evident in two of the four existing groundwater monitoring wells. Surface water sampling as well as the drain sampling has not indicated potential effects emanating offsite. The final marine Ecological Survey also confirmed that over time there had been nothing to suggest the activities undertaken at the site had caused an adverse effect in the specific analysed areas.

While the legacy issue still remains, given the absence of measurable adverse effects and less than minor offsite effects the Environmental performance has been rated as '**Good**' rather than 'Improvement required'.

Administrative performance was rated as **high**.

FOR 2014-2015 REPORTS For reference, in the 2014-2015 year, 75% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level o f environmental performance and compliance with their consents, while another 22% demonstrated a good level of environmental performance and compliance with their consents.

This report includes recommendations for the 2015-2016 year.

Table of contents

List of tables

List of figures

List of photos

1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2014-June 2015 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by BTW Company Limited (BTW) (The Company). The Company operates a drilling and production waste landfarm situated on Brown Road, Waitara, in the Waitara catchment. This is the third 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 previous monitoring period, 2013-2014, 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 BTW 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 2013-2014 period the Company applied for a change of conditions to the consent, whereby they provided sufficient information to allow for the Council to make an informed decision to limit the area of the site which the consent applies 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 is required. These requirements for surrender are attached in the form of the Resource Consent (7884-1.1) in Appendix I of this report.

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, land and air, and is the third 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 compliance monitoring under the RMA and the Council's obligations and general approach to monitoring sites though annual programmes, the resource consents held by the Company 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 2015-2016 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);
(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 consent holder/s during the period under review, this report also assigns a rating as to each Company's environmental and administrative performance.

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

Events that were beyond the control of the consent holder and unforeseeable (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 2014-2015 year, 75% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level o f environmental performance and compliance with their consents, while another 22% 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 1383 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: (NZTM)	E 1704599 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 showing the layout of the 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 Resource Management Act. It is due to expire on 1 June 2027.

There are 30 special conditions attached to the consent.

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

Conditions 4 to 9 deal with notifications, monitoring and reporting.

Conditions 10 to 11 relate to storage of wastes.

Conditions 12 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.

A copy of the permit is attached in Appendix I.

1.4 Monitoring programme

1.4.1 Introduction

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

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

The monitoring programme for the 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 eight 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, including the final marine ecological survey of the inter-tidal area.

1.4.4 Chemical sampling

Six composite soil samples from the Wellington site were collected for analysis during the monitoring period. The methodology utilised was compositing 10-15 soil cores (300 mm+/- depth) taken at 10 m intervals along transects through spreading areas. These were analysed for chloride, conductivity, hydrocarbons, pH, sodium absorption ratio (SAR), sodium and total soluble salts.

On 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 18 groundwater samples were taken from four monitoring bores during the monitoring period. All samples were analysed for pH, conductivity, TPH and BTEX, chloride, barium, and total dissolved solids.

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

1.4.5 Review of analytical data

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

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

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

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

1.4.6 Biomonitoring surveys

A marine ecological survey was carried out at four sites as part of the 2014-2015 monitoring programme for the Wellington Land Farm. The survey was carried out at three potential impact sites in the vicinity of the land farm, and one control site between 10 September and 8 December 2014. The objective of the survey was to determine any change in species abundance and community structure attributable to the presence of the site.

Figure 2 Biomonitoring locations

2. Results

2.1 Inspections

1 July 2014
The Wellington site was inspected in conjunction with groundwater sampling. Four bores were sampled using the new peristaltic pump. BTW staff met on site to discuss site operations and sampling procedures. The water in two of the bores had a distinct hydrocarbon odour, otherwise everything at the site appeared in order. The site had been closed for several months at the time of sample collection. Pasture cover had established well in most areas, the site was generally tidy and no odours were observed on or off site.

15 September 2014
No objectionable odours or visible emissions were found during this inspection. No recent disposal activities had occurred and the storage cells had been removed. Previously application areas were observed to have developed into complete pasture/clover/dune grass cover, although a small patch north of the site entrance was found to have no pasture or dune plants. The muds observed within this area were found to be almost at the surface and it was very difficult to put a spade into the soil profile. A mud/hydrocarbon type odour was present, the material broke apart easily upon handling. Additional test pits were dug in areas of pasture cover, whereby in comparison to the initial test pit, muds were encountered deeper in the soil profile, opposed to the surface as was encountered on the initial test pit. The groundwater discharge located at the north east of the spreading area remained localised, iron oxide/mineral sheens were present. Shoreline was inspected, no adverse effects were observed.

24 October 2014
BTW advised that they had undertaken additional remedial works in spreading area F12, whereby the area had been re-worked, blended with clean soil and straw then power harrowed.

22 January 2015
The inspection was conducted in conjunction with surface water sampling .The novaflow perforated pipe site GND2364 was sampled, but the other 3 sites (GND2363; UND000183; UND000186) were not flowing as such no samples were able to be collected. Good pasture establishment was observed on all landfarmed areas. There had been no recent spreading activity..

3 February 2015
Inspection conducted in conjunction with groundwater sampling. Site is still inactive, all four bores were sampled. Pasture was well established with plenty of gorse coming through. Weather was overcast with intermittent showers and westerly gusts.

4 February 2015
The site inspection was conducted in conjunction with soil sampling, this followed groundwater sampling which was undertaken the previous day. The site was inactive and unoccupied during the soil sampling visit. Two composite soil samples were collected. Transects were undertaken through spreading areas F2 and F3. Drilling mud was encountered at approx. 250 mm depth bgl through the F2 transect. Intermittent drilling mud was encountered in the occasional core through the F3 transect. Pasture

had established, although little growth had occurred due to the current drought conditions at the time of the visit.

16 March 2015
The site inspection was conducted in conjunction with groundwater sampling. Four bores were sampled (GND 2282, 2283, 2284, 2285) using a peristatic pump. A slight foaming and slight hydrocarbon odour was encountered in monitoring well GND2285. The static water level dropped steadily in GND2283 during sampling. No recent activity was observed at the site. A change of resource consent was under process. Pasture establishment across the site good, with gorse and lupin widespread.

20 May 2015
The site inspection was conducted in conjunction with groundwater and soil sampling. All four groundwater bores were sampled through the use of a peristaltic pump. A slight foaming and odour was encountered in some of the groundwater monitoring wells, all samples had flecks of orange oxide visible. Spreading areas F18 and F12 (large area) were soil sampled. Some drilling muds were encountered in area F12 with an associated slight odour of hydrocarbon. The two soil transects were the composite of 10 core samples each. Soils were described as dark brown colour, moist, dominant grainsize med-fine sand.

2.1.1 Results of the discharge monitoring

The Wellington Landfarm was completely decommissioned during the previous monitoring period (2013-2014). The storage cells were removed and the land reinstated, as such no new deliveries were received during this monitoring period (2014-2015). The site was processed for a partial surrender of consent in March of 2015 and the proponent 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.

The proponent undertook additional remedial work in this monitoring period 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 due to the level of contaminate benzo (a) pyrene analyzed 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 analyzed 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 28/09/2013 to 0.04 mg/kg 27/01/2015), further monitoring will dictate that 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

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

were also burned. Benzo (a) pyrene (BaP) is produced from wood burning; as such the Council is aware that this analyzed 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 consist low level has been achieved.

2.2 Results of receiving environment monitoring

2.2.1 Council soil results

Throughout the monitoring year (2014-2015) the Council collected six composite soil samples. These soil samples were collected via a soil corer which was inserted to a nominal depth of 300mm+/- 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.

Table 1 Council soil samples Wellington Landfarm 2014-15

		F12 A (large area)	F12 B (small area)	F2	F3	F18	F12
		27 Nov 2014	27 Nov 2014	04 Feb 2015	04 Feb 2015	20 May 2015	20 May 2015
Parameter	Unit	09:40	10:20	13:00	13:30	13:10	14:15
Calcium	mg/kg	169.1	13.4	25.1	2.8	16.6	132.5
Chloride	mg/kg	818.4	20.2	17.6	15.6	17.1	47.7
Conductivity	mS/m @20° C	36.7	13.6	26.1	3.2	19.6	16.5
Total Petroleum Hydrocarbon	mg/kg	8849	9	45	10	248	4862
Potassium	mg/kg	119.8	19.8	33.2	30.0	14.1	70.3
Moisture factor	nil	1.0840	1.074	1.005	1.083	1.004	1.166
Magnesium	mg/kg	17.3	2.4	5.0	1.2	3.5	10.0
Sodium	mg/kg	168.6	19.0	16.1	13.1	18.1	38.2
Ammonia	mgN/kg	0.07	0.19	1.08	0.81	1.81	4.76
Nitrite- Nitrate- Nitrogen	mgN/kg	0.05	0.61	2.31	1.61	0.30	0.45
pH	pH	7.3	7.0	6.7	6.0	6.7	7.6
Sodium Absorption Ratio	None	3.30283	1.25591	0.76782	1.65029	1.05386	0.86186
Total Soluble Salts	mg/kg	1556.6	106.4	204.3	126.0	153.4	648.0

Table 1, details the soil samples which were collected by the Council during the 2014-2015 monitoring year. The analysis focused on the area/s which contained the highest readings in the previous monitoring round, which in this case was the area F12.

During the previous monitoring period F12 was the area which contained the highest concentration of Total Petroleum Hydrocarbon (TPH) 20,000 mg/kg, this was within the standard consented value[2]. The high value for F12 was recorded in October 2013.

[2] Consented value (Condition 17) allows for a maximum application concentration of 50,000 mg/kg Total Petroleum Hydrocarbons (TPH)

The analysis undertaken by the Council during this monitoring period detailed that this high concentration has naturally bio-remediated over the course of 18 months, from 20,000 mg/kg in October 2013 to 8,846 mg/kg in November 2014 through to 4,852 mg/kg in May of 2015. The Council will continue to monitor the progress of the bio-remediation of area F12 until it has reached its conditional surrender value. As previously discussed in Section 2.1.1, area F18 will continue to be monitored for BaP, until a consistent low level has been achieved.

Figure 3 Soil sample transects undertaken by the Council at the Wellington landfarm during the 2014-2015 monitoring year

2.2.2 Council groundwater results

The Council undertook annual groundwater monitoring of the Wellington site, whereby the four groundwater monitoring wells were each sampled four times during the monitoring period to encapsulate seasonal variation. The groundwater monitoring network was installed primarily to ascertain if any adverse effects were permeating from the storage cells on the site, locations of the monitoring wells are provided in Figure 3.

Figure 4 Surface and Groundwater sampling locations

Table 2 Groundwater monitoring results from GND 2282

		GND2282	GND2282	GND2282	GND2282
		MW 1	MW1	MW1	MW1
Parameter	Unit	01 Aug 2014	03 Feb 2015	16 Mar 2015	20 May 2015
Acid soluble barium	g/m³	0.29	0.12	0.16	0.13
Dissolved barium	g/m³	0.25	0.12	0.13	0.12
Benzene	g/m³	0.0037	0.0018	0.0019	0.0016
Chloride	g/m³	718	369	384	399
Conductivity	mS/m@20°C	301	185	188	193
Ethylbenzene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
Total hydrocarbon	g/m³	<0.4	<0.10	<0.10	<0.10
C7-C9	g/m³	<0.010	<0.010	<0.010	<0.010
C10-C14	g/m³	<0.2	<0.2	<0.2	<0.2
C15-C36	g/m³	<0.4	<0.4	<0.4	<0.4
Water level	m	2.21	2.495	2.462	2.139
Sodium	g/m³	324	196	197	197
pH	pH	6.6	6.7	6.6	6.8
Total Dissolved Salts	g/m³	2328.9	1431.4	1454.6	1493.3
Temperature	°C	17.3	17.7	18.0	16.7
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 3 Groundwater monitoring results for GND2283

		GND2283	GND2283	GND2283	GND2283
		MW2	MW2	MW2	MW2
Parameter	Unit	01 Aug 2014	03 Feb 2015	16 Mar 2015	20 May 2015
Acid soluble barium	g/m³	0.08	0.086	0.10	0.07
Dissolved barium	g/m³	0.07	0.080	0.07	0.06
Benzene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
Chloride	g/m³	84.6	75.3	73.5	67.9
Conductivity	mS/m@20°C	44.7	57.4	51.9	55.6
Ethylbenzene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
Total hydrocarbon	g/m³	<0.2	<0.2	<0.10	<0.2
C7-C9	g/m³	<0.010	<0.010	<0.010	<0.010
C10-C14	g/m³	<0.2	<0.2	<0.2	<0.2
C15-C36	g/m³	<0.4	<0.4	<0.4	<0.4
Water level	m	3.075	4.660	2.306	1.524
Sodium	g/m³	41.0	42.0	41.9	42.8
pH	pH	6.4	6.4	6.4	6.5
Total Dissolved Salts	g/m³	345.8	444.1	401.6	430.2
Temperature	°C	16.1	19.4	19.1	16.2
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 4 Groundwater monitoring results for GND 2284

		GND2284	GND2284	GND2284	GND2284
		MW3	MW3	MW3	MW3
Parameter	Unit	01 Aug 2014	03 Feb 2015	16 Mar 2015	20 May 2015
Acid soluble barium	g/m³	0.27	0.56	0.79	0.72
Dissolved barium	g/m³	0.25	0.55	0.72	0.72
Benzene	g/m³	0.0148	0.027	0.033	0.039
Chloride	g/m³	118	1340	1870	1640
Conductivity	mS/m@20°C	179	392	486	470
Ethylbenzene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
Total hydrocarbon	g/m³	<0.4	<0.2	<0.2	<0.10
C7-C9	g/m³	<0.010	<0.010	<0.010	<0.010
C10-C14	g/m³	<0.2	<0.2	<0.2	<0.2
C15-C36	g/m³	<0.4	<0.4	<0.4	<0.4
Water level	m	1.53	2.283	1.925	1.298
Sodium	g/m³	122	212	288	319

		GND2284	GND2284	GND2284	GND2284
		MW3	MW3	MW3	MW3
Parameter	Unit	01 Aug 2014	03 Feb 2015	16 Mar 2015	20 May 2015
pH	pH	6.3	6.3	6.3	6.3
Total Dissolved Salts	g/m³	1384.9	3032.9	3760.2	3636.4
Temperature	°C	17.3	20.3	19.6	17.3
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 results for GND2285

		GND2285	GND2285	GND2285	GND2285
		MW4	MW4	MW4	MW4
		01 Aug 2014	03 Feb 2015	16 Mar 2015	20 May 2015
Acid soluble barium	g/m³	2.0	2.9	3.4	3.4
Dissolved barium	g/m³	1.8	2.9	3.3	3.4
Benzene	g/m³	0.35	0.29	0.30	0.29
Chloride	g/m³	1930	2380	2940	2630
Conductivity	mS/m@20°C	577	702	742	748
Ethylbenzene	g/m³	<0.0010	0.0011	<0.0010	0.0015
Total hydrocarbon	g/m³	<0.2	<0.10	<0.7	<0.2
C7-C9	g/m³	<0.010	<0.010	<0.010	<0.010
C10-C14	g/m³	<0.2	<0.2	<0.2	<0.2
C15-C36	g/m³	<0.4	<0.4	<0.4	<0.4
Water level	m	1.238	1.907	1.877	1.204
Sodium	g/m³	639	762	854	850
pH	pH	6.2	6.2	6.1	6.2
Total Dissolved Salts	g/m³	4464.3	5431.4	5740.9	5787.4
Temperature	°C	16.6	19.7	19.7	18.0
Toluene	g/m³	<0.0010	<0.0010	<0.0010	<0.0010
XYLENE-M	g/m³	<0.002	0.002	0.003	0.003
XYLENE-O	g/m³	<0.0010	0.0018	0.0019	0.0025

Tables 2-5 detail the groundwater monitoring undertaken by the Council during the 2014-2015 monitoring period for the Wellington site. In comparison to the previous years monitoring analysis, salinity remains an issue, with high salinity readings recorded in bores GND 2284 and 2285. This was identified in the previous monitoring

period, with the Company infringed as they had elevated the level of dissolved salts above the consented limit[3]; this is detailed in Figure 5.

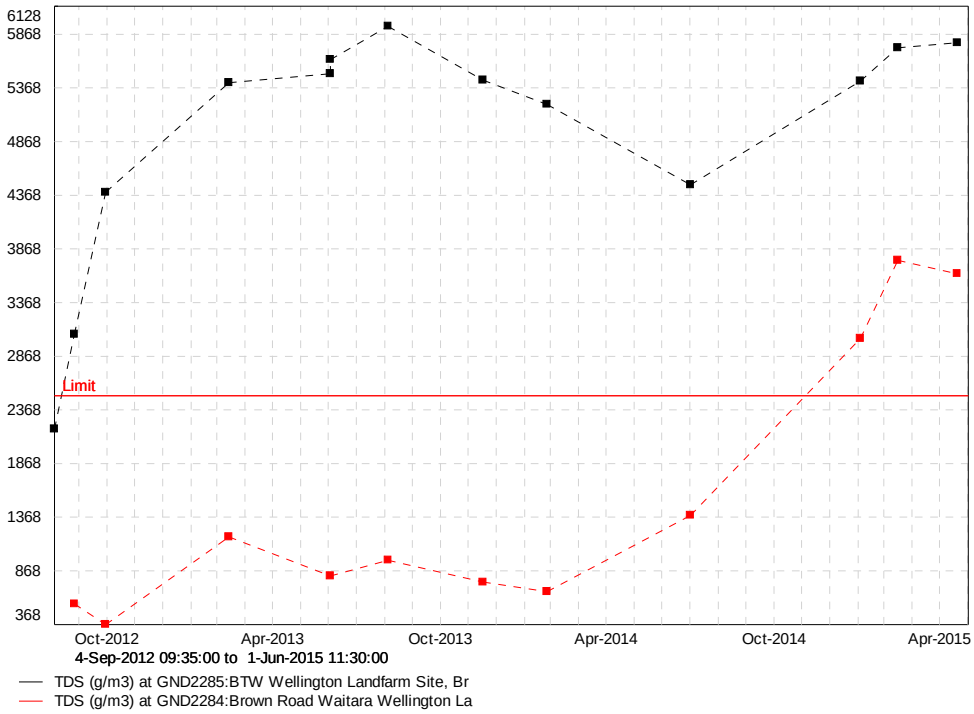

Figure 5 Total dissolved salt (TDS) concentration in g/m^3 for monitoring bores GND 2284 and GND2285

The concentrations of TDS has continued to increase during this monitoring period in well GND 2284, and rose to above the conditional requirement of 2500 g/m^3. GND 2285, which had been adversely impacted in the previous monitoring period, remained stable, with a slight seasonal fluctuation visible during the winter months (Figure 5). Conversely, the two remaining monitoring wells, GND2282 and 2283 have detailed a stable or decreasing trend in terms of TDS. The Council will continue to monitor the high salinity bores until the concentrations of TDS have returned to below the consented concentration of 2500 g/m^3.

Though the salinity has been an issue in the two monitoring wells, GND 2285 and 2284, the concentration of other parameters has not been quite so evident. For instance, the level of benzene within GND2285, which was above the ANZEEC guidelines for aquatic ecosystem protection (>0.3 mg/l) has now decreased to below the guideline value, Figure 6. Benzene concentrations within the three remaining wells have now suitably decreased to close to the limit of detection. With further monitoring this parameter should fall below the limit of detection.

From the Councils prospective, high salinity is the main issue in the groundwater at this site. The high concentration of dissolved salts underlined the rationale in future developments associated with landfarming that stockpiling storage cells be lined with fit for purpose high grade synthetic liners. The concentrations which are observed in

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[3] Consent 7884-1.1, Condition 22: The exercise shall not result in the concentration of total dissolved salts in any fresh water body exceeding 2500 g/m^3

the monitoring wells at the site are associated with a legacy issue for the historical non lined storage pits. Of note oil waste/well workover fluid cell was lined at this facility, while the other cells were not[4].

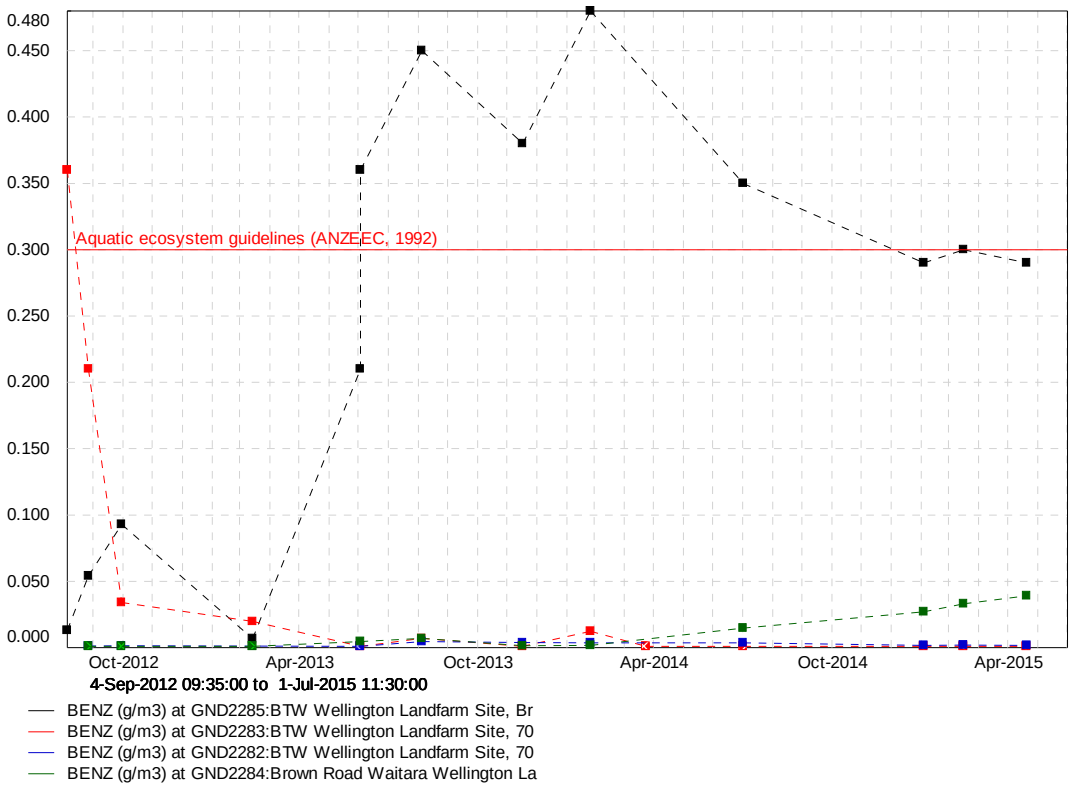


Figure 6 Benzene concentrations across the Wellington Landfarm Groundwater Monitoring network

2.2.3 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 3, this was a 50% decrease from the previous monitoring period. The rationale for the decrease in monitoring of this location was due to the long term analysis not returning any significant readings throughout the life of the monitoring site. The upstream and downstream analysis is provided in Table 6.

Table 6 Council surface water samples

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

[4] 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
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 negligible, this is similarly echoed in the level of TDS.

The Wellington site also contains four nova coils (Figure 3), one of which was sampled during this monitoring period. The rationale for the singular sample collection was centred on the lack of water to sample from the three 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 that no impacts to water within these sample locations were associated with site activities. The analysis returned during this monitoring period indicated the same. Analysis was also undertaken by the proponent, this is provided in Appendix III.

Table 7 Water Sample result for Nova Coil GND2364

		GND2364
		Novaflow 4
		22 Jan 2015
Acid soluble barium	g/m³	0.079
Dissolved barium	g/m³	0.079
Benzene	g/m³	<0.0010
Chloride	g/m³	79.8
Conductivity	mS/m@20°C	56.0
Ethylbenzene	g/m³	<0.0010
Total hydrocarbon	g/m³	<0.7
HC C7-C9	g/m³	<0.10
HC C10-C14	g/m³	<0.2
HC C15-C36	g/m³	<0.4
Sodium	g/m³	40.60

		GND2364
		Novaflow 4
		22 Jan 2015
PH-1	pH	6.4
Total Dissolved Salts	g/m^3	433.3
Temperature	°C	18.4
Toluene	g/m^3	<0.0010
XYLENE-M	g/m^3	<0.002
XYLENE-O	g/m^3	<0.0010

2.2.4 Review of analytical results

In the 2014-2015 monitoring period the proponent of the site applied for a change of consent conditions which resulted in a decrease in the monitoring which the proponent was required to supply. They undertook this by supplying the Council with analytical evidence to support the idea that certain areas of the site which had historically received a one off application of related drilling waste were suitably bio-remediated to be classified for surrendered[5]. The analysis provided by the proponent to satisfy the surrender criteria is contained within Appendix III.

The site did not receive any additional deliveries or apply any additional material to land in this monitoring period. All locations were applied and reinstated with vegetation either prior or during the 2013-2014 period. The last application to land was for area F23; this was undertaken in September 2013.

As discussed the proponent applied for and received a change of consent conditions for the site. The result of this change of conditions, as previously discussed, was to limit the monitoring to the areas of the site which were still above the conditional surrender criteria. Of the areas which did not meet the surrender criteria, there were two; area F12 and F18 which will continue to be monitored.

Area F12, this area is still above the TPH speciation value, dictated by the MfE guidelines[6] (Table 8). The final analysis collected during the monitoring of area F12 detailed a TPH of 4682 mg/kg. Note while the Council undertakes Total Petroleum Hydrocarbon analysis, the guideline value is dictated by a speciation approach to quantification. In this case it was possible to discern that the limit had not been reached due to the total count of 4682 mg/kg TPH. Moving forward the Council will continue to monitor this area until the surrender criteria has been reached and utilize speciation analysis to finally quantify the soil prior to consideration for surrender.

[5] Consent 7884-1.1 Condition 27, Appendix I
[6] Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Revised 2011) MfE Module 4 Tier 1 Soil Acceptance Criteria Table 4.15

Table 8 MfE Soil acceptance criteria for TPH (see footnote [6])

Soil type/ Contaminant	Surface (<1m)
Sand	
C_7-C_9	120
C_{10}-C_{14}	58
C_{15}-C_{36}	4000
TPH	*4178*[7]
(all values in mg/kg)	

The remaining area, F18, had been sampled by the proponent of the site, and the analysis is provided in the proponent's annual monitoring report (Appendix III). The parameter of concern in this area, which is near to the detection limit, is benzo (a) pyrene (BaP). While the analysis for this specific parameter has been low (0.1-0.03 mg/kg (2013-2015)), the regulated guideline[8] indicates that a low level of 0.027 mg/kg BaP must be met. This area will continue to be assessed until a consistently low level or non detect has been reached.

Analysis provided by the proponent outside of the monitoring period of this report has detailed that this parameter (BaP) has reached it conditional surrender value, it is expected that follow up analysis will confirm this in the upcoming monitoring year.

2.2.5 Marine Ecological Survey

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. 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.

[7] Note the Total Hydrocarbon Value is extrapolated to allow the reader to understand the speciation. Final analysis of said soils will be undertaken through speciation of individual carbon chain fractions as dictated by the MfE guidelines.
[8] Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Revised 2011) MfE Module 4 Tier 1 Soil Acceptance Criteria, Table 4.12

Figure 7 Marine Ecological Sample Sites

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.
The main body of this marine ecological survey is provided in Appendix II,

Photo 2 Control site Turangi Reef (2014)

Biomonitoring reports.

2.3 Investigations, interventions, and incidents

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

The Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The 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 2014-2015 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

As previously discussed, the site was completely decommissioned during the previous monitoring period, 2013-2014. The site did not receive any additional material, and no new applications to land were undertaken. The last application to land was in September 2013.

In March of this year the proponent applied for a change of consent conditions, to limit the extent to which they were required to monitor, they did so by providing the Council with analytical evidence to support the idea that areas of land which had originally been utilised for the practice of landfarming had met there conditional requirement for surrender with specific concentrations of certain parameters[9]. The analysis provided by the proponent is provided in Table 4.1 of the attached Company supplied annual report, Appendix III.

While the majority of the site has been remediated, confirmed by Council and proponent soil sampling, two locations were still outside the conditional requirement for surrender. These two areas, (F12 and F18) as already discussed in Section 2.2.1, will continue to be monitored until they have satisfied the Council's requirement.

The proponent remained pro-active with the site management even though the site was inactive through the monitoring period. Pro-active by means of undertaking remediation works in area F12 to stimulate microbiological breakdown, this has been effective in breaking down the hydrocarbon concentration in this area (Table 1).

The site did not require any additional inspections, nor did it receive any infringement or abatement notices during this monitoring period. The Company was also very prompt with providing the annual report to the Council.

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 legacy 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 and trace benzene concentrations in two of the four groundwater monitoring wells. The legacy remained apparent in the groundwater monitoring undertaken by the Council during this reporting period and is high lighted in Section 2.2.2 and graphically in Figure 5.

The proponent was infringed for this adverse effect during the 2012-2013 year. While the effect had been adverse, it is also minor. The degree of salt concentration ranges from 3636- 5784 mg/L TDS, this is classified as acceptable for stock water[10] in the case of dissolved salts. 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

[9] Consent 7884-1.1, Condition 27, Appendix I

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

within these two wells until they have reached the conditional requirement of total dissolved salts below 2500 mg/L.

As well as a high salinity concentration, the groundwater analysis had also detected low concentrations of benzene; this is graphically presented in Figure 6. While the benzene had been detectable, it is also in very low concentrations, which is acceptable for irrigation or stock water in line with the MfE guidelines[11]. The highest recorded reading in this monitoring period was 0.3 mg/L, this is the trigger value for Aquatic ecosystem protection defined by the ANZEEC (1992); however follow up analysis has indicated that this value is now below the guideline value.

While these two parameters have been highlighted as adverse 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 both be monitored until they have reached there consent conditioned concentration.

Surface water analysis which encapsulated the farm drain on the southern end of the site and the nova coil which bisects the site both indicated negligible effects from the site activities.

The Council also undertook a marine ecological survey as discussed in Section 2.2.5. 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. Two locations remain outside of the conditional requirement for surrender, the proponent had undertaken remediation in one of the locations to further stimulate the microbial activity which is responsible for the decreasing the degree of hydrocarbon in the soil. This indicates a pro-active response. Initial analysis from the up coming monitoring period has detailed that the degree of hydrocarbon has decreased.

Overall, the exercise of the resource consent 7884-1.1 during the 2014-2015 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.

[11] 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 Tables 8.

Table 9 Summary of performance for Consent 7884-1.1 2014-15 monitoring year.

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 condition 9 to Council by 31 August	Report received 28 August 2015	Yes
10. Well work-over fluids to be stored in tank or pit	Inspections and information provided by consent holder	Yes
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

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 2500 g/m^3	Samples collected	No
23. Contaminants in surface or groundwater not to exceed background concentrations	Sampling	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 Section 1.1.4.

3.4 Recommendations from the 2013-2014 Annual Report

In the 2013-2014 Annual Report, it was recommended:

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

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

   b) Inspection frequency is reduced from 6 times per year to twice yearly, reflecting the change in activity at the site (both parts are now both closed). *Undertaken, site inspections were limited to twice per annum, with the remainder conducted by site staff while collecting samples.*

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

   d) In place of the second surface water sampling run, annual sampling is conducted of the remaining perforated pipes at the site to monitor whether any further contaminants are leaving the site through groundwater at the down-gradient site boundary. *Undertaken, although only one sample pipe was sampled due to the lack of fluid flowing from the remainder.*

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

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

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

3.5 Alterations to monitoring programmes for 2015-2016

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

It is proposed that in the 2015-2016 monitoring year that the following be removed from the program.

- Marine Ecological Survey
- Surface Water Sampling

The rationale for the removal of these two facets is due to the fact that both modes of observation and analysis have historically not registered any contaminants of concern. While they were vital to detect any potential adverse effects permeating from the site while it was operational, now the site has been decommissioned and partially surrendered it is no longer required.

3.6 Exercise of optional review of consent

Resource consent 7884-1.1 provides for an optional review of the consent in June 2016. Condition 31 allows the Council to review the consent, if there are grounds that a review may be required. The review dates are for the purpose of ensuring that the conditions are adequate to deal with any adverse effects 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.

Based on the results of monitoring in the year under review, and in previous years as set out in earlier annual compliance monitoring reports, it is considered that there are no grounds that require a review to be pursued or grounds to exercise the review option.

4. Recommendations

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 outstanding 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.

Glossary of common terms and abbreviations

The following abbreviations and terms may be used within this report:
Please remove those items that are not relevant to the consent/s

Al*	Aluminium.
As*	Arsenic.
Biomonitoring	Assessing the health of the environment using aquatic organisms.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODF	Biochemical oxygen demand of a filtered sample.
Bund	A wall around a tank to contain its contents in the case of a leak.
CBOD	Carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate.
cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
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.
DRP	Dissolved reactive phosphorus.
E.coli	Escherichia coli, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Ent	Enterococci, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre of sample.
F	Fluoride.
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
$g/m^2/day$	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.
IR	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.
MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
mS/m	Millisiemens per metre.
Mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
NH_4	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH_3	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO_3	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
Pb*	Lead.
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
PM_{10}	Relatively fine airborne particles (less than 10 micrometre diameter).
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	*Resource Management Act* 1991 and including all subsequent amendments.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.

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

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 Limited Brown Road -Wellington Landfarm Monitoring Programme Biennial Report 2011-2013. Technical Report 13-62.

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

Appendix I

Resource consents held by The Company

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.

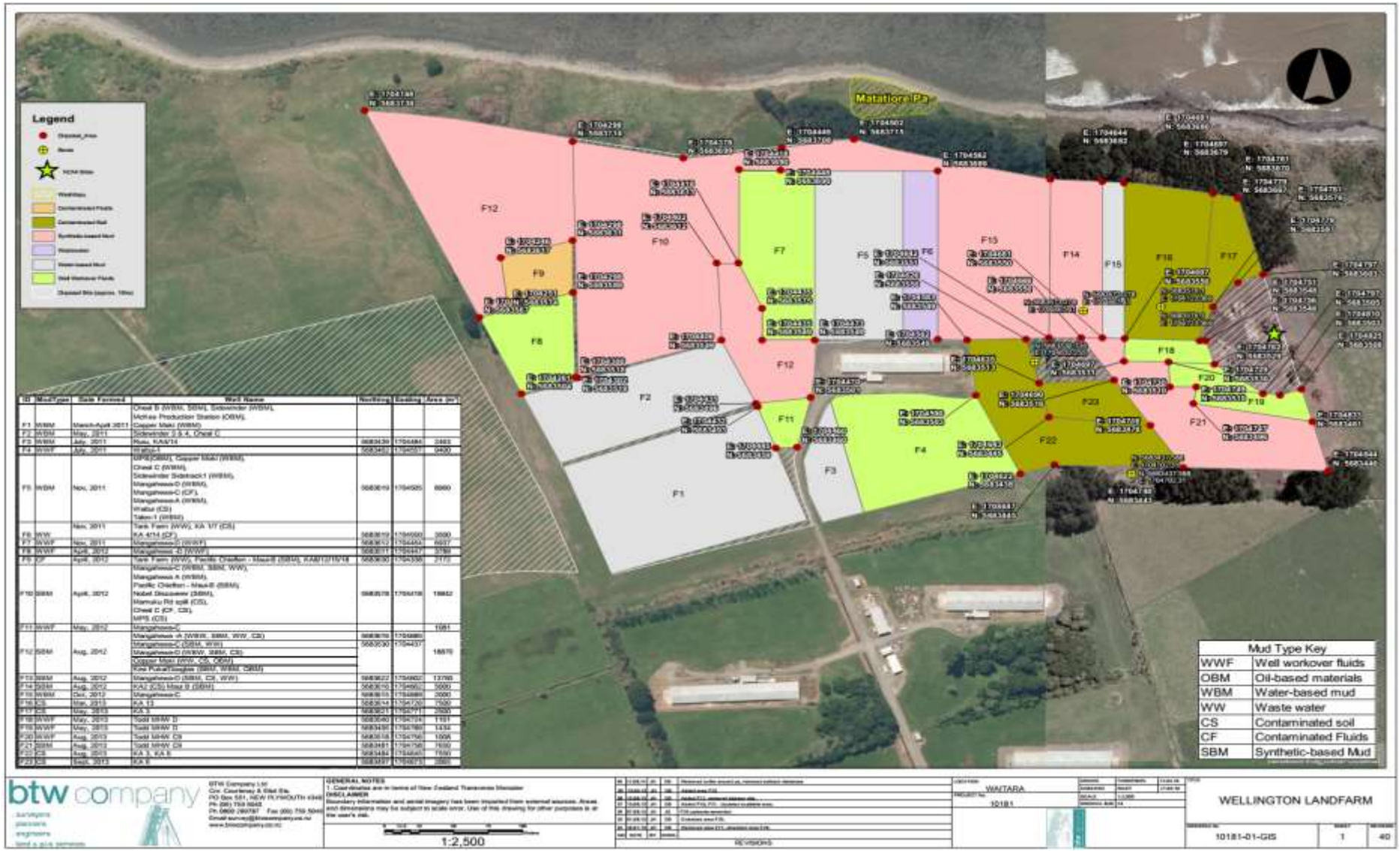
31. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2015 and/or June 2016 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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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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WELLINGTON LANDFARM
10181-01-GIS

Appendix II

Biomonitoring reports

Memorandum

To: Science Manager – Hydrology/Biology, Regan Phipps
From: Scientific Officer, Emily Roberts and Technical Officer, Thomas McElroy
File: #1514470
Date: 26 May 2015

BTW Wellington Land Farm – Marine Ecological Survey September/December 2014

Introduction

A marine ecological survey was carried out at four sites as part of the 2014-2015 monitoring programme for the BTW Wellington Land Farm. The survey was carried out at three potential impact sites in the vicinity of the land farm, and one control site between 10 September and 8 December 2014. The objective of the survey was to determine any change in species abundance and community structure attributable to the presence of the BTW Wellington Land Farm.

Methods

Field Work

The survey was conducted at four sites. The potential impact sites were: Orapa B (SEA 901043), Turanga Reef (SEA 901052), and 500m E of the Brixton Outfall (SEA 901055). The control site was at Turangi Reef (SEA 900095) see (Photographs 1-4). Note: Photos selected for memorandum are those documented closest to the time of the September/December 2014 survey.

Photograph 1 Potential impact site 500 m east of the Brixton Outfall (2013)

Photograph 2 Potential impact site at the Turanga Reef (2013)

Photograph 3 Potential impact site at Orapa B (2014)

Photograph 4 Control site at Turangi Reef (2014)

Figure 1 Position of four survey sites relative to land farm

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

Results

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

Table 1 Summary statistics – September/December 2014

Site	No. of Quadrats	Mean number of species per quadrat			Mean Shannon Weiner Index per quadrat		
		Algae	Animals	Total Species	Algae	Animals	Total Species
Turangi Reef	25	3.28	10.76	14.04	0.410	0.765	0.873
Orapa B	25	6.20	9.44	15.64	0.680	0.746	0.970
Turanga Reef	25	5.72	10.20	15.92	0.630	0.744	0.940
500m E	25	5.72	11.92	17.64	0.734	0.783	0.953

Number of Species per Quadrat

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

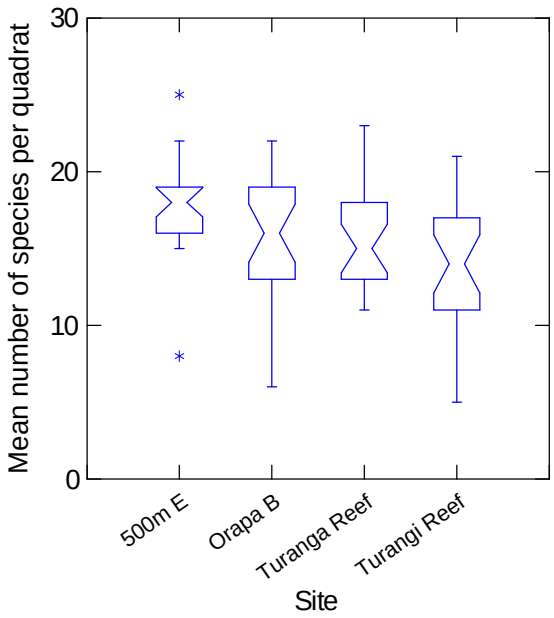


Figure 2 Box and whisker plot of total number of species per quadrat

The data obtained from the reef site 500 m east of the Brixton outfall significantly deviated from the normal distribution at the 95% confidence level (Lilliefors test, n = 25, $P < 0.05$). A

natural logarithmic transformation of the data was subsequently conducted. Three sites (500 m east of the Brixton outfall, Turangi Reef and Orapa B) still deviated from the normal distribution following this transformation (Lilliefors test, n = 25, P < 0.05). As this ANOVA assumption could not be met the remaining analyses were conducted using the raw data with non-parametric tests.

There was a significant difference in the mean number of species per quadrat between sites (Kruskal-Wallis, H = 11.2, degrees of freedom (df) = 3, P = 0.011). Significant differences between sites were determined using the Wilcoxon signed-ranks test (Table 2). There was a significant difference in the mean number of species per quadrat between the reef site 500 m east of the Brixton outfall and Turangi Reef. There were no other significant differences between sites.

Table 2 Wilcoxon signed ranks test of number of species per quadrat

Site	Turangi Reef	500 m E	Orapa B
500 m E	SIG		
Orapa B	NS	NS	
Turanga Reef	NS	NS	NS

Key: SIG = significant difference at 95% confidence level
NS = no significant difference

Shannon-Weiner Diversity Index

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

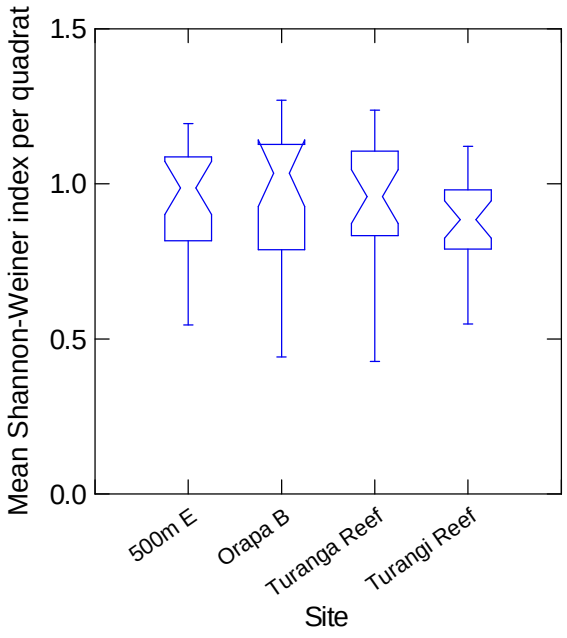


Figure 3 Box and whisker plots of mean Shannon-Weiner index per quadrat

No sites showed a significant deviation from normal distribution at the 95% confidence level (Lilliefors test, n = 25, P > 0.05). Additionally, data variance appeared to be homogeneous across sites (Figure 3). An ANOVA was subsequently conducted, as the data conformed to the assumptions.

There was no significant difference in the mean Shannon-Weiner index per quadrat between sites (ANOVA, F = 1.293, df = 3, 96, P = 0.281).

Sand Cover

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

Table 4 Mean percent cover of sand per quadrat

Site	% sand and silt per quadrat*
Turangi Reef	11.52
Orapa B	32.00
Turanga Reef	28.08
500m E	3.44

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

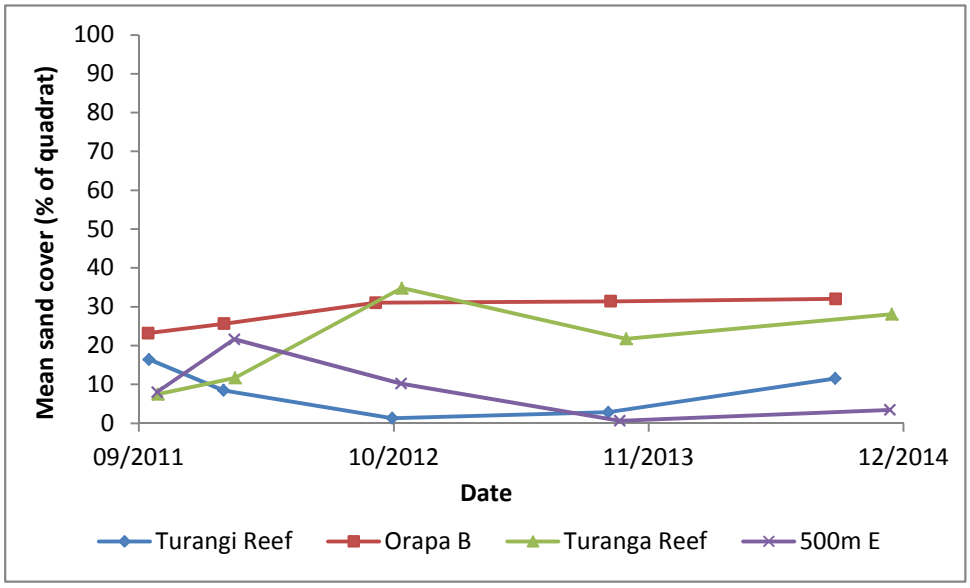


Figure 4 Mean percentage sand cover from spring 2011 to spring 2014

Sand cover at Turangi Reef and 500 m E had increased from the previous survey. Although these levels remained relatively low, the increase in sand cover at Turangi Reef coincided with a notable decrease in mean number of species at the site, suggesting a possible adverse response to increased sand cover. At Orapa B and Turanga, the mean sand cover per quadrat was 32% and 28% respectively. This level of sand cover was similar to that in previous surveys for both sites, and as such, an adverse effect on the intertidal community was not detected.

Trends over time

Species number and Shannon-Weiner index

Comparisons of the mean number of species per quadrat (Figure 5) and mean Shannon-Weiner index per quadrat (Figure 6) for all surveys are shown below.

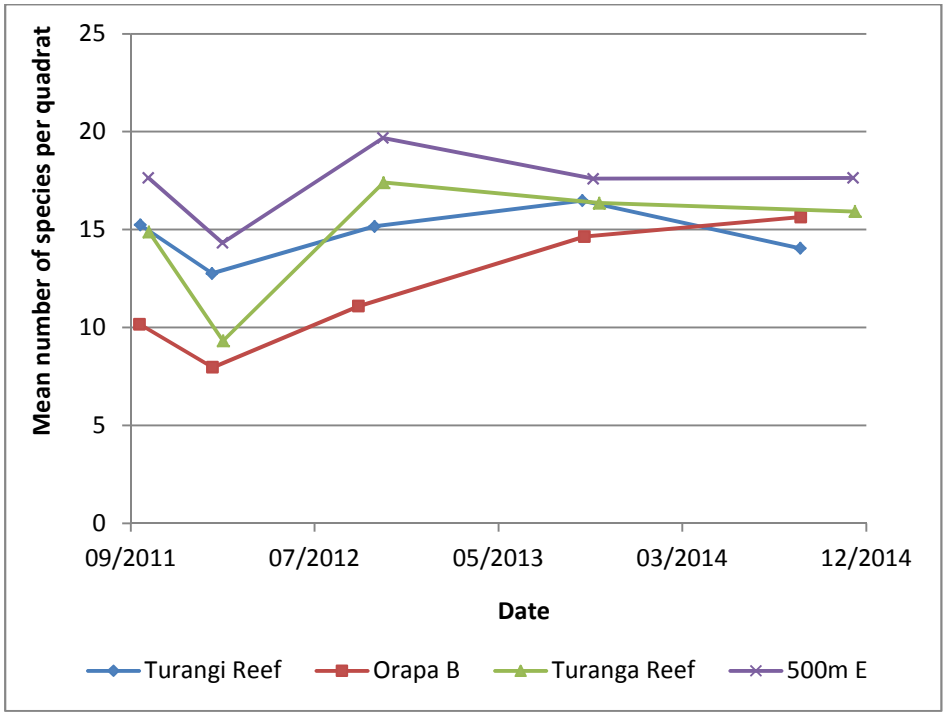


Figure 5 Mean number of species per quadrat for surveys 2011-2014

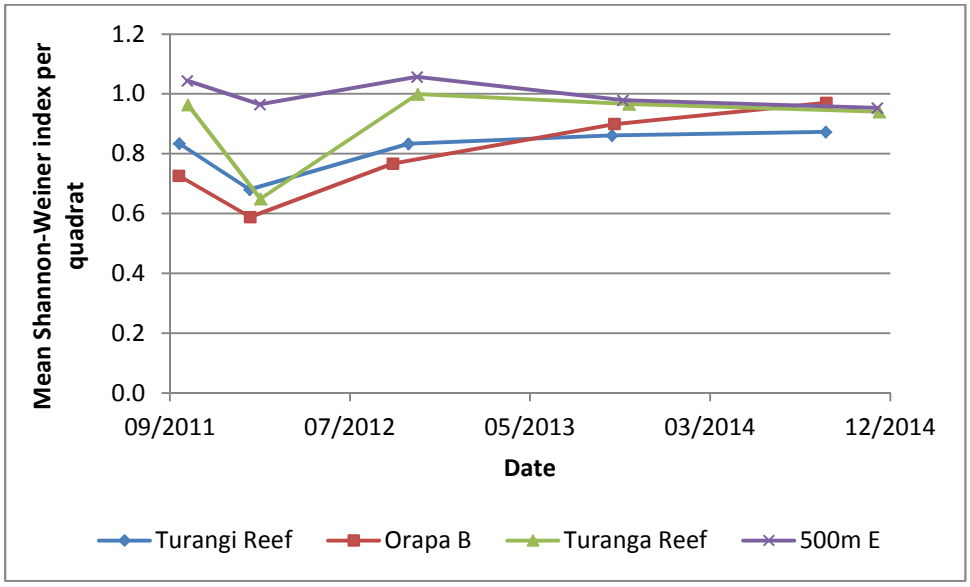


Figure 6 Mean Shannon-Weiner indices per quadrat for surveys 2011-2014

Since these surveys began (spring 2011), sites have shown interannual variability in both number of species and Shannon-Weiner Index, but there has been no noticeable difference in trends between the impact site and the control sites over this period.

The results of the spring 2014 survey show a slight decrease in the mean number of species per quadrat at Turangi Reef since spring 2013, this was not reflected in the Shannon-Weiner index which showed neglible change. Orapa B experienced an increase in the mean number of Shannon-Weiner index. Sites at Turanga Reef and 500 m east of the Brixton outfall showed little or no change in the number of species and Shannon-Weiner index from the previous year (Figures 5 and 6).

Discussion

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

Impacts of the BTW Wellington Land Farm on the local intertidal community were not evident from the spring 2014 survey results. There was no significant difference in diversity index between sites and the mean number of species was significantly higher at one of the potential impact sites (500 m east of the Brixton outfall) compared with the control site.

Sand coverage at Orapa B has remained greater than 30% since 2012; a level at which sand cover is known to have a significant impact on marine communities. Sand inundation can effect under-rock colonisation on intertidal hard-shore environments in Taranaki (Walsby, 1982). Sand cover can also result in reduced diversity due to sand scour of the biota, reduced water movement between rocks and temporary sand burial. However, although high levels of sand can have such impacts, the diversity index from Orapa B was among the highest of the four sites. This suggests there may be other important factors driving intertidal diversity at this site.

Contrary to past surveys, the colonial polychaete worm, *Neosabellaria kaiparaensis* (previously *Sabellaria kaiparaensis*) was not present in high densities at Orapa B (Figure 7, Photograph 5). Although generally uncommon in New Zealand, large colonies of this endemic polychaete occur around the Taranaki coastline. *N. kaiparaensis* thrives in sand rich environments, and domination of this species can prevent other rock dwelling organisms from colonising the area. Whether the relatively low cover of *N. kaiparaensis* was due to unsuccessful recruitment or other factors, the result was a decrease in competition for space on the rocky substrate at this site. This allowed more space for other organisms to persist; evening out the relative abundance of species and ultimately increasing the diversity at the site.

In this survey the control site, Turangi Reef, had the least number of species and the lowest diversity index. As the mean number of animal species and diversity index was comparable with other sites, algal richness and diversity index appear to be an influential factor in the overall diversity of the site (Table 1). The proximity of the Waitara River to the three potential impact sites relative to the control site may explain this discrepancy (Figure 1).

Compared with the Turangi Reef site, it is possible that these potential impact sites receive a consistently high level of nutrients from the Waitara River. This nutrient input may support the growth of ephemeral algal species at these sites and lead to the persistence of a greater number of algal species relative to Turangi Reef.

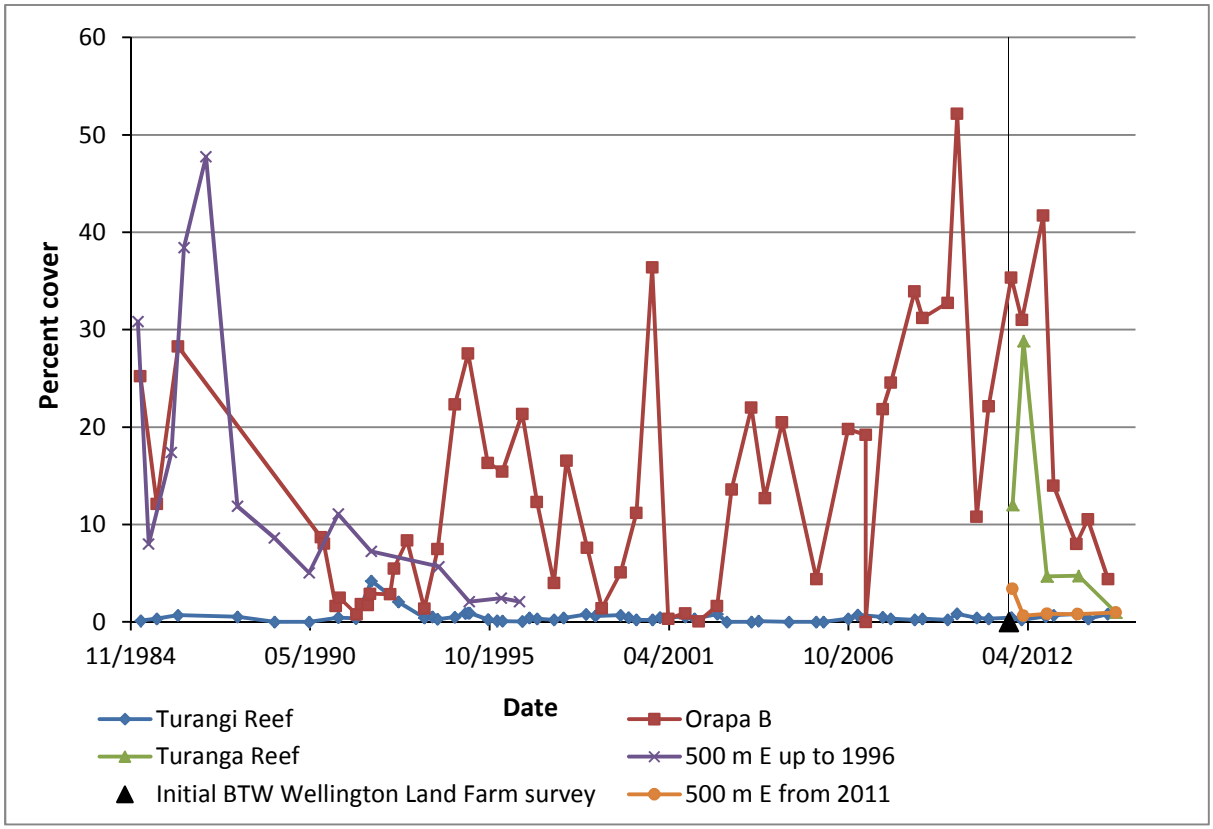


Figure 7 Record of mean percent cover of *Neosabellaria kaiparaensis* at four survey sites from 1985. **Note:** Surveys were not conducted at the site 500 m east of the Brixton outfall between 1996 and 2011.

Photograph 5 Polychaete worm *Neosabellaria kaiparaensis*

Other important factors that can influence the structure of intertidal communities include the composition and mobility of substrate, and exposure to wave disturbance.

Conclusions

In order to assess the effects of the BTW Wellington Land Farm on the nearby intertidal communities, ecological surveys were conducted between 10 September and 8 December 2014 at four sites. These surveys included three potential impact sites and one control site. Potential adverse effects of the BTW Wellington Land Farm on the intertidal communities were assessed by comparing species richness and diversity at the potential impact sites relative to the control site.

As both species richness and diversity were similar at the control site and potential impact sites, the results indicate that the BTW Wellington Land Farm 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.

Emily Roberts
Marine Ecologist

Thomas McElroy
Technical Officer

References

Walsby, J.R. (1982) Marine ecological baseline programme NZSFC Synthetic Petrol Plant Motunui.

Appendix III

Company Supplied 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	26/8/15 Date
Reviewed by	Cameron Twigley	26/8/15 Date

10181
26/08/2015

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 2014 to 30 June 2015 as well as monitoring required under SC 21-27.

1.2 July 2014 to June 2015 - Summary

The site was completely decommissioned during the previous 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 F12 area was known to be a hot spot area with elevated hydrocarbons in the soil, however still well within consent application limits. However during the monitoring period the consent holder decided to undertake further remediation of this area to essentially speed up the breakdown process of the identified hydrocarbons in the soil. The further works involved aerating the soil in known hot spot areas and adding straw and clean top soil. After the remediation was completed the F12 area was re-sampled, and the sampling results have shown a significant reduction in the hydrocarbon concentrations. Now the F12 area meets the consent surrender criteria for soils which is a stringent standard to meet. Once soils meet this consent surrender limit the soil is deemed safe for agricultural purposes and no further sampling is required.

Now only F18 area does not met soil surrender criteria from the consent holder's results. However, we note the soil data for the F18 area is likely bias, due to the large pile of trees that were burnt adjacent to this area and incomplete combustion of material (charcoal) was found within the soil matrix, which is likely to have caused a constituent to be recorded at a trace level with the soil analysis.

Overall 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 previous year. So no new records on the composition of waste are supplied, as this 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 previous monitoring period.

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

The F12 area was re-worked during the monitoring year to stimulate microbial breakdown of hydrocarbons in the soil matrix. The treatment was the turning and aeration of the waste layer and the addition of clean top soil and straw. Once the area was reworked this isolated hot spot area was re-sown in permanent pasture.

No other sowing or treatment has taken place during the monitoring year.

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; however as shown in Appendix D the individual tests undertaken by BTW are far greater than the consent requirements.

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

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

Apart from the soil sampling, one surface water sample was taken by the consent holder. The sample was taken from one of the perforated nova coils that run through the landfarming site. The results of the sampling are contained in Appendix B.

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 (10 sub samples) retrieved in a transect line from the central point. The line direction is dependent on the underlying orientation of the landfarmed material. The transect line is approximately 60 meters in length, essentially 30meters either side of the central coordinate point.

3.3 Methods

Sampling involves collecting a composite of 10 sub-samples which are located with GPS along a transect line running from the central point of a landfarmed area. Typically, samples are retrieved

from approximately 250mm but this can vary depending on the location of the drilling mud layer. This procedure has been adopted by the TRC for land farming sites where the composition of the waste is known (pre-disposal samples) and the location of each specific waste source is known.

3.4 Inspection Notices

The site has been inactive since about November 2013, therefore no landfarming has taken place during the monitoring year. However there was some minor remediation works in the F12 area to stimulate microbiological breakdown of some elevated hydrocarbon levels in the soil.

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. As can be noted in table 4.1, only the F18 area does not meet consent surrender requirements for the receiving environment soil. For completeness the consent holder has provided the complete table of soil sampling results for each individual area, this provides significant data and 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

		TRC Compliant				TRC Non-Compliant																				
	Date	Soil conductivity <290mS m-1 (see Consent if PD is greater than 400)	Sodium 460 mg/kg	SAR <18	Dissolved salts <2500gm-3	Benozene <1.1(v)	Toulene <68(4m)	Ethylbenzene (53)(4.v)	Xylenes (48) (4,m)	Naphthalene (7.2) (p)	Non-carc. (Pyrene) (160) (4p)	Benzo(a)pyrene eq.(5) (0.027)(p)	Arsenic (20mg/kg)	Cadmium (1mg/kg)	Chromium (600mg/kg)	Copper (100mg/kg)	Lead (300mg/kg)	Mercury (1mg/kg)	Nickel (60mg/kg)	Zinc (300mg/kg)	C7-C9 120 (m)	C10-C14 58 (x)	C15-C36 (4000) (7,x)	nitrogen g/100g dry wt	Chloride 700 mg/kg	Material
F1	4/11/2012																								23	WBM
	19/04/2013	90	41	1.1	594	0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	11	23	3.9	<0.10	6	57	8	20	40	26	23	WBM
																										WBM
F2	21/01/2012					0.05	<0.05	<0.05	<0.10	<0.03	<0.03	<0.03	<2	<0.10	10	18	3.3	<0.10	6	57	8	20	40	0.05	310	WBM
	19/04/2013	250	76	2.2	1643	0.05	<0.05	<0.05	<0.10	<0.12	<0.03	<0.03	<2	<0.10	9	16	2.3	<0.10	4	53	8	20	40	2	116	WBM
																										WBM
F3	14/02/2012																								19	WBM
	12/06/2012																				9	20	40			WBM
	11/04/2013	1	49	1.4	260	0.05	<0.05	<0.05	<0.10	<0.05	<0.05	<0.05	<2	<0.10	12	15	2.6	<0.10	5	63	8	20	40	0.13	36	WBM
																										WBM
F4	21/01/2012		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	390	1350	0.09	610	WBM
	18/02/2012	180	57	1.6	1155																			6	610	WBM
	12/06/2012																				9	20	129			WBM
	12/12/2012		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	4140	0.05	<0.05	<0.05	<0.10	<0.13	<0.03	<0.03	<2	<0.10	10	16	2.7	<0.10	4	56	8	20	380	1	210	WBM
	28/09/2013	40	0.5	1.6	251	<0.05	<0.05	<0.05	<0.10	<0.13	<0.03	<0.03	<2	<0.10	9	15	2.5	<0.10	5	50	<8	<20	<40	2	7	WBM
																										WBM
F6	21/01/2012		450			0.05	< 0.05	< 0.05	< 0.10	<0.13	<0.03	<0.03	7	<0.1	10	17	41	0.26	5	71	<8	<20	191	<0.05	<30	CS / WW
	18/02/2012	70	43	1.3	436																					CS / WW
	12/06/2012																				9	20	117			CS / WW
	12/12/2012		460			0.05	< 0.05	< 0.05	< 0.10	<0.14	<0.03	<0.03	<2	<0.10	7	15	5.9	<0.1	4	52	10	124	620	0.15	12	CS / WW
	11/04/2013	50	43	1.7	356	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	<0.10	<2	<0.10	10	16	3.4	< 0.10	4	68	8	20	40	2	17	CS / WW
																										CS / WW
F7	29/05/2012	170	218	8.7	1135	0.05	<0.05	<0.05	<0.10	<0.015	<0.03	<0.03	<2	<0.10	11	17	1.4	0.1	6	75	9	20	40	0.07	91	WWF
	12/12/2012		590			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	4,590	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														
F19	18/07/2013	0.2	12	0.9	99	0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	9	11	1.2	<0.10	4	41	8	20	40	1	3	WWF
	28/09/2013	10	12	1.1	79.2	<0.05	<0.05	<0.05	<0.05	<0.12	0.12	0.06	<2	<0.10	9	12	1.4	<0.10	4	46	8	20	40		4	WWF
	5/06/2014					<0.05	<0.05	<0.05	<0.05	<0,12	<0.03	<0.03									8	20	40			WWF
F20	27/09/2013	1	11	0.8	79.2	<0.05	<0.05	<0.05	<0.05	<0.12	<0.03	<0.03	<2	<0.10	11	12	1.1	<0.10	4	49	8	20	40		3	WWF
	4/03/2014					<0.05	<0.05	<0.05	<0.05	<0.11	<0.03	0.02									8	20	40			

		Consent Surrender limit meet			Consent Surrender limit not meet															TPH						
	Date	Soil conductivity <290mSm-1 (see Consent if PD is greater than 400)	SAR <18	Total Soluble salts 2500 mg/kg	Benzene <1.1(v)	Toulene <68(4m)	Ethylbenzene (53)(4.v)	Xylenes (48) (4,m)	Naphthalene (7.2) (p)	Non-carc. (Pyrene) (160) (4p)	Benzo(a)pyrene eq.(5) (0.027)(p)	Arsenic (20mg/kg)	Cadmium (1mg/kg)	Chromium (600mg/kg)	Copper (100mg/kg)	Lead (300mg/kg)	Mercury (1mg/kg)	Nickel (60mg/kg)	Zinc (300mg/kg)	C7-C9 (120) (m)	C10-C14 (58) (x)	C15-C36 (4000) (7,x)	nitrogen mg/kg	Chloride 700 mg/kg	Sodium 460 mg/kg	Material
F21	9/10/2013	160	1.8	1082	<0.05	<0.05	<0.05	<0.05	<0.13	0.17	0.13	<2	<0.10	8	12	1.6	<0.10	5	45	8	490	1960	2	107	77	SBM
	4/03/2014				<0.05	<0.05	<0.05	<0.05	<0.12	0.04	0.11									8	39	340				
	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.

A surface water sample was collected from the nova coil outlet drain. Compliance with SC21 is displayed within Appendix B.

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 has now been met for all landfarmed areas 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 complaint with Table 7.1, Section 7 of the Ministry of the Environment and New Zealand Water and Wastes Association's Guidelines for the safe application of biosolids to land in New Zealand (2003).

4.2.4 Condition 26 and 27 – Constituent Closure Criteria

Condition 26 requires:

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

Table 4.2: Consent Closure Criteria – Condition 26

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

MAHs – benzene, toluene, ethylbenzene, xylenes
PAHs – naphthalene, non 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. As already discussed this reduction has been aided by additional remediation/treatment of hot spot areas within the F12 area. All areas now meet the surrender criteria for the C10-C14 carbon band as demonstrated in table 4.1 above.

Area/s not within surrender limits: None.

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. Again the F12 area was the last area to meet the surrender criteria for these carbon bands and was the only area monitored by the consent holder during the monitoring year.

Area/s not within surrender limits: None.

4.2.12 PAHs

Three PAHs are required to be monitored in the soil (Naphthalene, Non-carc. (Pyrene) & Benzo(a) pyrene eq). Naphthalene and non-carc (Pyrene) have never been detected in any of the landfarmed areas. Very slight traces of Benzo (a) pyrene have been detected, however only the F18 area does not meet the consent surrender criteria. The trace detection of Benzo (a) pyrene is considered to be attributed to the burning of large amounts of trees on the property, as charcoal was found within the soil matrix at this location during sampling. This assumption that the Benzo (a) pyrene is not related to the disposal of hydrocarbon material in this area is confirmed by the pre-disposal samples taken for this area that show no detection of Benzo (a) pyrene. The consent holder will continue to monitor this area until consent surrender has been met.

Area/s not within surrender limits: F18

4.2.13 Summary

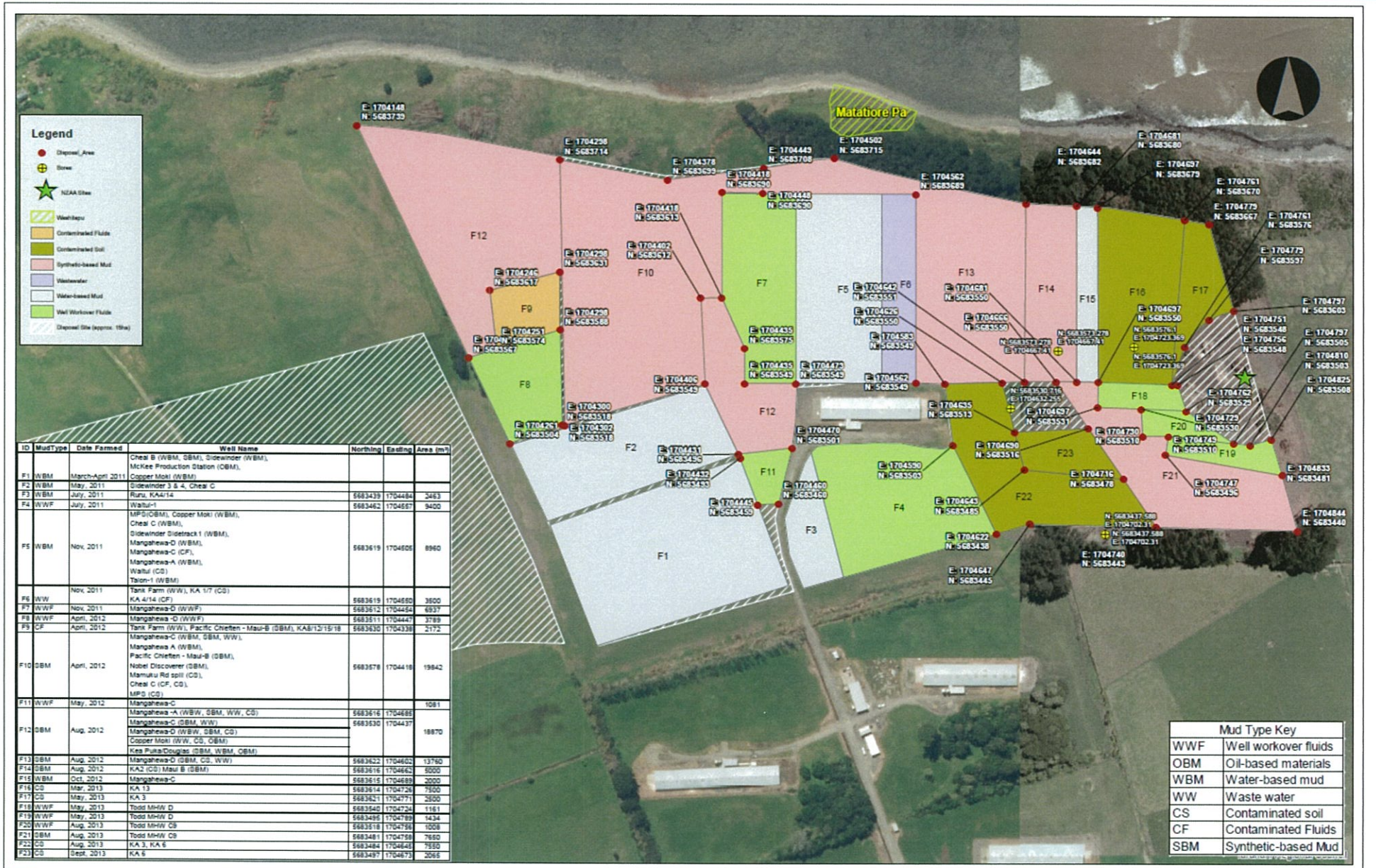
The site has been inactive during the monitoring year as the site was decommissioned and completed during the previous monitoring year. The consent holder monitored two land farmed areas (F12 & F18) during the monitoring year as well as one surface sample from a nova flow that runs through the site. The consent holder also did some additional treatment/remediation of a known hot spot area within the F12 area. The consent holder undertook this additional work on their own behalf to stimulate breakdown of hydrocarbons to consent surrender limits. This additional treatment has been very successful in the F12 area, as now this area meets consent surrendering criteria for the soil as shown in table 4.1.

The results for the F18 area have shown a trace of benzo pyrene which is likely to be associated with the burning of some trees on-site due to incomplete combustion and the by-product of charcoal forming. Charcoal was observed at the surface during sampling this area. Therefore it would be fair to conclude this area has been affected by external influences in regards to recent soil sampling and the soil results are likely bias and don't reflect the material landfarmed in this area. However the applicant will continue to monitor this area until all constituents meet consent surrender criteria.

All the results demonstrate no elevated levels of heavy metals in the soil. All levels fall well below the biosolids guideline values set by the Ministry for the Environment to protect human health and the environment, plus to safeguard the life-supporting capacity of soils. All the landfarmed areas are also measured against the Ministry for the Environment guidelines for assessing and managing petroleum hydrocarbons on contaminated site in New Zealand. This is a strict guideline document to protect human health and based on the agricultural landuse values which are the most stringent on this guideline.

Overall the soil sampling results have demonstrated a significant reduction in any elevated constituents from initial application of the waste sources. All landfarmed areas except F18 meet the soil surrender criteria, and we would continue to expect levels within the soil to bio-remediate over time to background levels.

APPENDIX A SITE MAPS



ID	MudType	Date Farmed	Well Name	Northing	Easting	Area (m²)
F1	WBM	March-April 2011	Cheal B (WBM, SBM), Sidewinder (WBM), McKee Production Station (OBM), Copper Moki (WBM)			
F2	WBM	May, 2011	Sidewinder 3 & 4, Cheal C			
F3	WBM	July, 2011	Ruru, KA4/14	5683439	1704484	3463
F4	WWF	July, 2011	Waitui-1	5683462	1704667	9400
F5	WBM	Nov, 2011	MPD(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	1704605	8960
F6	WW	Nov, 2011	Tank Farm (WW), KA 1/7 (CS) KA 4/14 (CF)	5683619	1704550	3600
F7	WWF	Nov, 2011	Mangahewa-D (WWF)	5683612	1704464	6937
F8	WWF	April, 2012	Mangahewa -D (WWF)	5683511	1704447	3789
F9	CF	April, 2012	Tank Farm (WW), Pacific Chieften - Maui-B (SBM), KA8/13/15/18	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), MPD (CS)	5683578	1704418	19842
F11	WWF	May, 2012	Mangahewa-C			1081
F12	SBM	Aug, 2012	Mangahewa -A (WBW, SBM, WW, CS) Mangahewa-C (SBM, WW) Mangahewa-D (WBW, SBM, CS) Copper Moki (WW, CS, OBM) Kea Puka/Douglas (SBM, WBM, OBM)	5683616 5683530	1704686 1704437	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	2600
F18	WWF	May, 2013	Todd MHW D	5683640	1704724	1161
F19	WWF	May, 2013	Todd MHW D	5683495	1704789	1434
F20	WWF	Aug, 2013	Todd MHW C9	5683518	1704788	1008
F21	SBM	Aug, 2013	Todd MHW C9	5683481	1704759	7650
F22	CS	Aug, 2013	KA 3, KA 6	5683484	1704645	7550
F23	CS	Sept, 2013	KA 6	5683497	1704673	2068

btw company
surveyors
planners
engineers
land & gis services

BTW Company Ltd
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Ph 0800 289787 Fax (06) 759 5049
Email survey@btwcompany.co.nz
www.btwcompany.co.nz

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

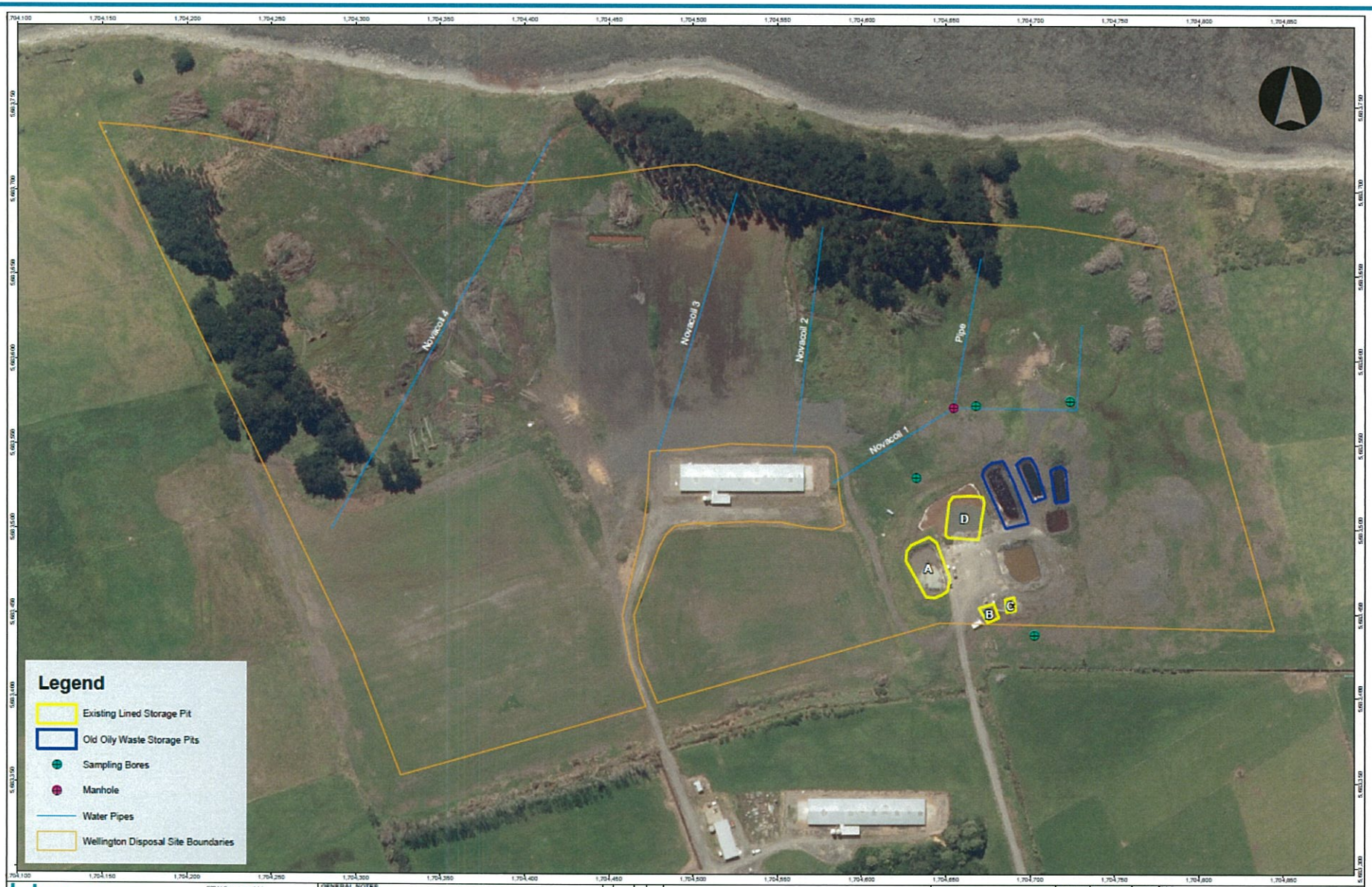
1:2,500

NO	DATE	BY	CHKD	REVISIONS
06	21.08.13	JH	DB	Removed buffer around pa, removed setback distances
05	12.08.13	JH	DB	Added area F23
04	15.05.13	JH	DB	Added F22, removed storage pits
03	13.05.13	JH	DB	Added F20, F21 - Updated available area
02	07.05.13	JH	JS	F20 contents amended
01	01.05.13	JH	DB	Extended area F20
04	26.07.12	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	A0

TITLE: WELLINGTON LANDFARM

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


Novacoil 4
Novacoil 3
Novacoil 2
Pipe
Novacoil 1
A
B
C
D
Legend
Existing Lined Storage Pit
Old Oily Waste Storage Pits
Sampling Bores
Manhole
Water Pipes
Wellington Disposal Site Boundaries
btw company
surveyors
planners
engineers
land & gis services
BTW Company Ltd
Cnr Courtenay & Elliot Sts
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Email survey@btwcompany.co.nz
www.btwcompany.co.nz
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1:2,000
REVISIONS
LOCATION
WAITARA
10181
WELLINGTON DISPOSAL SITE
NOVACOIL LOCATIONS
10181-104-GIS

APPENDIX B NOVA COIL & SURFACE DRAIN MONITORING RESULTS

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

ANALYSIS REPORT

Client:	BTW Company Limted	**Lab No:**	1361754	SPv1
Contact:	Dave Bolger	**Date Registered:**	09-Dec-2014	
	C/- BTW Company Limted	**Date Reported:**	15-Dec-2014	
	PO Box 551	**Quote No:**	55462	
	NEW PLYMOUTH 4340	**Order No:**	10181	
		Client Reference:	Stormwater testing	
		Submitted By:	Adam Wood	

Sample Type: Aqueous						
Sample Name:		Brown-Nova 4 08-Dec-2014 3:00 pm				
Lab Number:		1361754.1				
Individual Tests						
pH	pH Units	6.5	-	-	-	-
Total Suspended Solids	g/m³	< 4*	-	-	-	-
Chloride	g/m³	78	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m³	< 0.10	-	-	-	-
C10 - C14	g/m³	< 0.2	-	-	-	-
C15 - C36	g/m³	< 0.4	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m³	< 0.7	-	-	-	-

Analyst's Comments

* There was insufficient sample left to filter the usual amount for the Total Suspended Solids test on sample 1361754/1 so the detection limit is higher than normal.

SUMMARY OF METHODS

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

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

APPENDIX C PHOTOGRAPHIC RECORD OF LANDFARMING

June 2015

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

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

ANALYSIS REPORT

Client:	BTW Company Ltd	**Lab No:**	1148060
Contact:	Dave Bolger	**Date Registered:**	21-Jun-2013
	C/- BTW Company Ltd	**Date Reported:**	01-Jul-2013
	PO Box 551	**Quote No:**	36604
	NEW PLYMOUTH 4340	**Order No:**	
		Client Reference:	Receiving Environment -Soil
		Submitted By:	Dave Bolger

Sample Type: Soil

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

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

Sample Type: Soil

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

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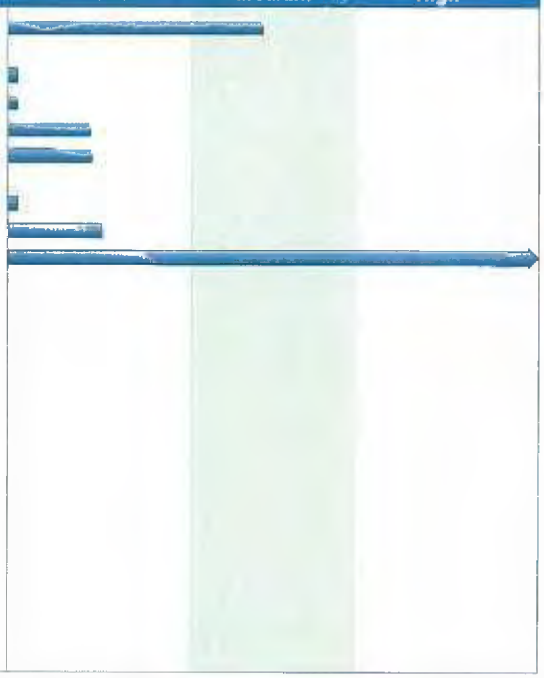
ANALYSIS REPORT

Client:	BTW Company Ltd	**Lab No:**	1147909 shpv1
Address:	PO Box 551 NEW PLYMOUTH 4340	**Date Registered:**	21-Jun-2013
		Date Reported:	28-Jun-2013
		Quote No:	36604
		Order No:	
		Client Reference:	
Phone:	06 759 5040	**Submitted By:**	Dave Bolger

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

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



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