

Waste Remediation Services Ltd
Symes Manawapou Landfarm
Monitoring Programme
Annual Report
2019-2020

Technical Report 2020-88

ISSN: 1178-1467 (Online)
Document: 2488312 (Word)
Document: 2638880 (Pdf)

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STRATFORD
February 2021

Executive summary

Waste Remediation Services Ltd (the Company) operates WRS Symes Manawapou Landfarm located at 156 Manawapou Road, Manutahi, in the Manawapou catchment, South Taranaki. The consent was granted in 2012 and was then transferred to the Company in June 2014. This report marks the sixth year that the Company has been in charge of the landfarm and it is the eighth report by the Council for this facility.

This report for the period July 2019 to June 2020 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess the Company's environmental and consent compliance performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of the Company's activities.

The Company holds one resource consent, which include a total of 27 conditions setting out the requirements that the Company must satisfy. The Company holds one consent to allow it to discharge drilling waste to land under the practice known as landfarming.

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

The Council's monitoring programme for the year under review included four inspections, 15 water samples and two composite soil samples collected for physicochemical analysis.

The monitoring showed a brief consent exceedance in terms of total dissolved solid concentration in one groundwater monitoring well, on one occasion. The subsequent monitoring rounds were found to be compliant with consent conditions. Soil monitoring of the most recently landfarmed area of M1810 indicated that this area is now within criteria to be surrendered.

To date all previously landfarmed areas at the Symes Manawapou Landfarm are within criteria for surrender from consent to occur. For this to occur the consent holder must submit for a variation of consent.

By comparison with previous years, the monitoring indicated an improvement in groundwater conditions. There was one brief and temporary unauthorised incident recording non-compliance in respect of this consent holder during the period under review.

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

For reference, in the 2019-2020 year, consent holders were found to achieve a high level of environmental performance and compliance for 81% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 17% of the consents, a good level of environmental performance and compliance was achieved.

In terms of overall environmental and compliance performance by the consent holder over the last several years, this report shows that the consent holder's performance has improved from the category of good to a high in the year under review.

This report includes recommendations for the 2020-2021 year.

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1 Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2019 to June 2020 by the Taranaki Regional Council (the Council) on the monitoring programme associated with a resource consent held by Waste Remediation Services Ltd (WRS) (the Company). The Company operates a landfarm, WRS Symes Manawapou Landfarm situated at 156 Manawapou Road, Manutahi, in the Manawapou catchment.

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 relates to the discharges of drilling waste within the Manawapou catchment, from the site.

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

1.1.2 Structure of this report

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

- consent compliance monitoring under the RMA and the Council's obligations;
- the Council's approach to monitoring sites through annual programmes;
- the resource consents held by the Company in the Manawapou 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 2020-2021 monitoring year.

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

1.1.3 The Resource Management Act 1991 and monitoring

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

- a. the neighbourhood or the wider community around an activity, and may include cultural and social-economic effects;
- b. physical effects on the locality, including landscape, amenity and visual effects;
- c. ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;

- d. natural and physical resources having special significance (for example recreational, cultural, or aesthetic); and
- e. risks to the neighbourhood or environment.

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

1.1.4 Evaluation of environmental and administrative performance

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

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

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

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

Environmental Performance

High: No or inconsequential (short-term duration, less than minor in severity) breaches of consent or regional plan parameters resulting from the activity; no adverse effects of significance noted or likely in the receiving environment. The Council did not record any verified unauthorised incidents involving 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 during investigations of incidents reported to the Council by a third party 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 during investigations of incidents reported to the Council by a third party. 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 during investigations of incidents reported to the Council by a third party. 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 2019-2020 year, consent holders were found to achieve a high level of environmental performance and compliance for 81% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 17% of the consents, a good level of environmental performance and compliance was achieved.¹

1.2 Process description

1.2.1 Drilling waste

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

Drilling fluids

Oil and gas wells may be drilled with either synthetic-based mud (SBM) or water-based mud (WBM). As the names suggest, these are fluids with either water (fresh or saline) or synthetic oil as a base material, to which

¹ The Council has used these compliance grading criteria for almost two decades. They align closely with the 4 compliance grades in the MfE Best Practice Guidelines for Compliance, Monitoring and Enforcement, 2018

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, paraffin or esters as a base material. While this is technically still a form of oil based fluid, these fluids have been engineered to remove polycyclic aromatic hydrocarbons, reduce the potential for bioaccumulation, and accelerate biodegradation compared with OBM.

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

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

Cuttings

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

1.2.2 Landfarming

The landfarming process has typically been used in the Taranaki region to assist the conversion of sandy coastal sites prone to erosion into productive pasture. Results of an independent research project conducted by AgKnowledge Ltd (2013) have indicated that the re-contoured sand dunes, after the inclusion of the drilling wastes (as per the consents), and with the addition of appropriate fertilisers and water (irrigation) are capable of producing high quality clover-based pastures and thus increasing the value of the land from about \$3-4,000/ha to \$30-40,000/ha (2013).

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

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

Photos 1 and 2 depict different stages in the landfarming process at the Manawapou Landfarm. The landfarming process utilised at the site is on a single application basis. This means dedicated spreading

areas each receive only a single application of waste. When disposal is complete, the area will be reinstated and monitored until consent surrender criteria have been met.



Photo 1 WRS Symes Manawapou Landfarm post discharge and reinstatement pre-seeding 2014



Photo 2 WRS Symes Manawapou Landfarm post completion 2018

1.3 Site location and description

The site is located on Manawapou Road, Manutahi, South Taranaki. This site is positioned on marginal coastal farm land situated on reworked dune fields. An extensive (100-250 m) foredune is located seaward of the consented site, and will remain undisturbed by site activities. The foredune provides a considerable natural buffer from prevailing onshore winds. A natural gas pipeline runs adjacent to the length of the site on the seaward side, marking the seaward extent of the disposal site. In addition, a QE II covenant is located in the north western end of the site, and Lake Taumaha (which is a QE II covenant and a Key Native Ecosystem) is located east of the site. The proximity of the site to these recognised ecosystems has been taken into account in the setting of buffer distances and location of the stockpiling facilities.

The predominant soil type has been identified as black loamy sand and vegetation growth is primarily a mixture of pasture and dune grasses. Test pitting and the logging of boreholes on site indicated a relatively shallow water table. Test bores were augured to 10 m in the pit area, revealing extensive compacted, low permeable clays underlying coastal dune sands. Pit construction revealed mostly tightly packed sand at the pit bases (approximately 4-5 m below surface). Average annual rainfall for the site is 1,023 mm (taken from the nearby 'Duffy' monitoring station). As with the other South Taranaki coastal sites, this site is subject to strong winds.



Figure 1 WRS Symes Manawapou Landfarm extent and regional location

Site data

Location	
Word descriptor:	Manawapou Road, Manutahi, Taranaki
Map reference:	E 1717244
(NZTM)	N 5608736
Mean annual rainfall:	1,023 mm
Mean annual soil temperature:	~15.1°C
Mean annual soil moisture:	~32.9%
Elevation:	~40 m
Geomorphic position:	Dune backslope
Erosion / deposition:	Erosion
Vegetation:	Pasture, dune grasses
Parent material:	Aeolian deposit
Drainage class:	Free / well draining

1.4 Resource consents

The Company holds one resource consent, the detail of which is summarised in the table below. Summaries of the conditions attached to the permit are set out in Section 3 of this report.

A summary of the various consent types issued by the Council is included in Appendix I, as are copies of all permits held by the Company during the period under review.

Table 1 Consent held by the Company

Consent number	Purpose	Granted	Review	Expires
Discharge of wastes to land				
7795-1	To discharge drilling wastes (consisting of drilling cuttings and drilling fluids from water based muds and synthetic based muds), from hydrocarbon exploration and production activities, onto and into land via landfarming.	May 2012	June 2022	June 2028

1.5 Monitoring programme

1.5.1 Introduction

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

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

The monitoring programme for the site consisted of four primary components.

1.5.2 Programme liaison and management

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

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

1.5.3 Site inspections

The Symes Manawapou Landfarm was inspected on four occasions this monitoring period. Additional visits were undertaken during monitoring rounds for soil, groundwater and surface water. Air inspections focused on plant processes with associated actual and potential emission sources and characteristics, including potential odour, dust, noxious or offensive emissions. Sources of data being collected by the Company were identified and accessed, so that performance in respect of operation, internal monitoring, and supervision could be reviewed by the Council. The neighbourhood was surveyed for environmental effects.

1.5.4 Chemical sampling

Soil, groundwater and surface water monitoring form part of the annual compliance monitoring programme for the Manawapou Landfarm.

Groundwater monitoring

The facility, as part of its consented obligations contains an active groundwater monitoring network which is comprised of four active groundwater monitoring wells. These wells were sampled four times per annum to ascertain for seasonal fluctuation. Their aim was to assess for any potential adverse effects which may have occurred through the exercise of the consent. The sampling was conducted through a peristaltic pump. Field parameters were captured via a Yellow Springs Instrument (YSi) multi parameter probe. The samples were collected once field parameters had been stable for three consecutive readings.

Groundwater analysis parameters

- Barium (dissolved and acid soluble), chloride, conductivity (@ 25°C), sodium, total dissolved salts (TDS), pH;
- Benzene, ethylbenzene, total petroleum hydrocarbons (speciated), toluene, meta-xylene, ortho-xylene, and
- In-situ readings: pH, conductivity, dissolved oxygen (DO), oxidation and reduction potential (ORP) and temperature.

Soil monitoring

The rationale for soil sampling is primarily to assess the concentration of target contaminants within the soil, within a landfarmed area. The methodology utilised by the Council for the collection of soil samples was adapted from the Guidelines for the Safe Application of Biosolids to land in New Zealand (2003). Whereby a soil corer was inserted to a depth of 400 mm +/- to encompass the zone of application. Ten soil cores are collected, these are generally spaced 10 meters apart. These ten soil cores are then composited to gain one representative soil sample of a landfarm application area. In this monitoring period six soil samples were collected. The soil samples were subjected to the following analysis.

Soil analysis parameters

- Total heavy metals (arsenic, cadmium, chromium, copper, mercury, nickel, lead and zinc);
- Chloride, conductivity, sodium, sodium adsorption ratio (SAR) and soluble salts;
- Total petroleum hydrocarbons; poly-cyclic aromatic hydrocarbons and mono-cyclic aromatic hydrocarbons; and
- Moisture factor.

Surface water monitoring

A surface water spot sample is collected from Lake Taumaha annually. The aim of this spot sample is to provide a brief chemical assessment of the surface water body.

- Total petroleum hydrocarbons, benzene, toluene, ethylbenzene, and xylenes (BTEX).
- Temperature, electrical conductivity, chloride, sodium, pH and acid soluble barium.

1.5.5 A review of Company-provided information

The Company provided the Council with an annual report of landfarming operations this monitoring period. This requirement is bestowed by the associated resource consent (7795-1, condition 9). The annual report is appended in appendix II of this report. The annual report provides information on the consent holder's operations in the 2019-2020 monitoring period. This report was provided to the Council on 12 July 2020.

2 Results

2.1 Water

2.1.1 Inspections

1 July 2019

During an inspection the following was observed. No recent deliveries of material had occurred and all the storage pits contained storm water only. The historical spreading areas had good pasture which appeared healthy and no muds were identified at the surface.

The most recent spreading areas also held good pasture cover, though bare in some places and mud was present at the surface. The muds were well weathered and broke apart easily.

8 November 2019

During an inspection the following was observed. No recent mud deliveries had occurred. All lined pits contained storm water only. No surface hydrocarbons were present. The colour of the water was likely caused by algal growth.

No recent landfarming activities had occurred. The historical spreading areas had good pasture cover which appeared healthy. The most recent spreading had a few bare patches, but the majority of the area was establishing good pasture. The shoreline was inspected, no effects were observed on the foreshore.

6 January 2020

During an inspection the following was noted. No recent mud deliveries had occurred, the lined pits contained storm water only, and no surface hydrocarbons were present. The recent spreading area was inspected. Good pasture cover was observed across the area, though there were some bare patches where the muds had formed a hard pan at the surface.

No recent grazing or cropping had occurred. All historical spreading areas had good pasture cover which appeared healthy. No muds were identified at the surface. Foreshore not inspected due to the tidal conditions at the time of inspection.

10 February 2020

During an inspection the following was observed. No recent storage or landfarming activities had occurred. The lined storage pits contained stormwater which was essentially free of surface hydrocarbons. The historical spreading areas had good pasture cover which appeared healthy.

Discussions were held with site manager who outlined the next spreading campaign would likely occur in the area south-east of the current storage/spreading areas. Preparatory earthworks were likely to occur across the whole area (approximately 7 ha) after which it will be re-sown and opened up as required. No incidents were reported.

2.1.2 Provision of consent holder provided data

No new landfarmable material was received by the Company during this monitoring period. All material which was stored has since been spread onto land under the practice of landfarming in the most recent landfarmed area; M1810. This was communicated by the consent holder through the Company provided annual report which is appended at the end of this report, Appendix II.

2.1.3 Results of receiving environment monitoring

2.1.3.1 Groundwater monitoring

The Symes Manawapou Landfarm contains four groundwater monitoring wells. The wells were installed as part of the consent and have been monitored since October 2012. They were installed to assess the quality of the groundwater; in close proximity to the storage cells in the case of GND2300 and 2301, and the landfarming exercise, in the case of GND2302 and 2303.

Four monitoring rounds were undertaken across the four wells. These were undertaken as close to quarterly as practicable to assess for seasonal variation. The analysis of the four monitoring rounds is provided in the following Tables 2-5.

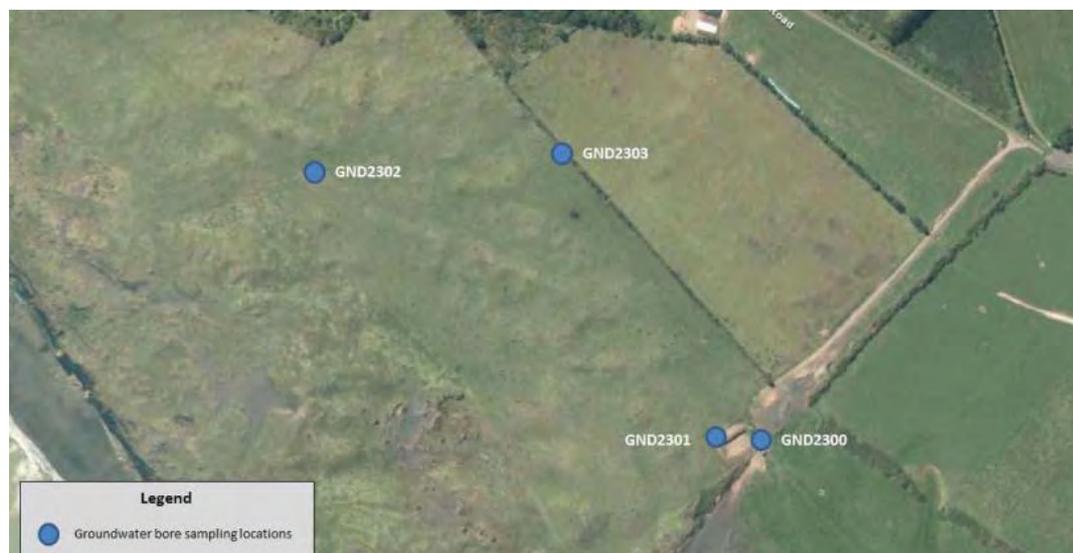


Figure 2 WRS Symes Manawapou Landfarm monitoring well locations

It is noted that no total petroleum hydrocarbons (TPH, C₇-C₉, C₁₀-C₁₄, C₁₅-C₃₆ and C₇-C₃₆) or benzene, toluene, ethylbenzene or xylenes (m, p or o) collectively known as BTEX, were recorded above the laboratory defined limit of detection (LOD) in any of the groundwater monitoring wells this monitoring year. The analytical results of these compounds have not been tabulated.

Table 2 GND2300 2019-2020 monitoring period

GND2300	Collected	21 Aug 2019	05 Dec 2019	21 May 2020	15 Jun 2020
	Time	13:25	10:55	10:35	11:20
Sample Temperature	°C	14.7	15.6	15.1	14.9
Electrical Conductivity (EC)	µS/cm	848	2960	2410	2330
	mS/m	84.8	296	241	233
pH	pH Units	6.2	5.9	6.1	6.1
Acid Soluble Barium	g/m ³	< 0.11	< 0.11	< 0.11	< 0.11

GND2300	Collected	21 Aug 2019	05 Dec 2019	21 May 2020	15 Jun 2020
	Time	13:25	10:55	10:35	11:20
Dissolved Barium	g/m ³	0.03	0.084	0.058	0.053
Total Sodium	g/m ³	77	200	161	161
Chloride	g/m ³	167	880	690	750
Total Dissolved Solids (TDS)	g/m ³	550	2,800	1,590	1,620

The monitoring of GND2300 indicated the following:

- Groundwater temperature ranged 14.7-15.6°C.
- Electrical conductivity ranged 848-2,940 µS/cm. A significant increase was observed in the December 2109 monitoring round.
- pH results remained quite stable and weakly acidic, 5.9-6.2 pH.
- Acid soluble barium remained below the laboratory defined limit of detection across all four rounds.
- Dissolved barium ranged 0.03- 0.084 g/m³.
- Total sodium results ranged 77- 200 g/m³, with an increase in the December 2019 monitoring round.
- Chloride analysis ranged 167-880 g/m³, with the December 2019 monitoring round showing a significant increase prior to a slight reduction in concentration.
- A brief consent exceedance was observed in the December 2019 monitoring round for total dissolved solids of 2,800 g/m³. Consent 7795-1, condition 18 requires the exercise of consent to not exceed a concentration of 2,500 g/m³ in any fresh water body. The subsequent monitoring rounds indicated a reduction in concentration to below the consent defined limit, identifying this as a temporary effect.
- No TPH or BTEX were recorded above the LOD.

Table 3 GND2301 2019-2020 monitoring period

GND2301	Collected	21 Aug 2019	05 Dec 2019	21 May 2020	15 Jun 2020
	Time	11:05	11:35	11:00	11:30
Sample Temperature	°C	14.9	16.1		
Electrical Conductivity (EC)	µS/cm	655	945		
	mS/m	65.5	94.5		
pH	pH Units	6.4	6.7		
Acid Soluble Barium	g/m ³	0.26	0.25		
Dissolved Barium	g/m ³	0.26	0.26		
Total Sodium	g/m ³	73	93		
Chloride	g/m ³	59	87		
Total Dissolved Solids (TDS)	g/m ³	420	580		
The final two monitoring rounds recorded insufficient water within the well to collect a sample					

The monitoring of GND2301 indicated the following:

- Only two monitoring rounds were achievable on this monitoring well, the final two rounds noted insufficient water within the well to collect a sample.

- Groundwater temperature ranged 14.9-16.1 °C.
- Electrical conductivity ranged 655-945 $\mu\text{S}/\text{cm}$, denoting a slight increase between the two monitoring rounds.
- pH remained stable and weakly acidic, 6.4-6.7 pH.
- Acid soluble barium and dissolved barium remained stable and recordable for both parameters.
- Total sodium, chloride and TDS recorded slight increases between monitoring rounds.
- No TPH or BTEX were recorded above the LOD.
- All results were within consent conditions.

Table 4 GND2302 2019-2020 monitoring period

GND2302	Collected	21 Aug 2019	05 Dec 2019	21 May 2020	15 Jun 2020
	Time	10:20	09:40	12:25	12:55
Sample Temperature	°C	14.4	16.1	15.6	15.3
Electrical Conductivity (EC)	$\mu\text{S}/\text{cm}$	1,213	1,038	1,848	1,788
	mS/m	121.3	103.8	184.8	178.8
pH	pH Units	6.3	6.3	6.3	6.2
Acid Soluble Barium	g/m^3	< 0.11	< 0.11	< 0.11	< 0.11
Dissolved Barium	g/m^3	0.052	0.043	0.087	0.082
Total Sodium	g/m^3	79	76	103	100
Chloride	g/m^3	270	230	450	440
Total Dissolved Solids (TDS)	g/m^3	980	750	1,290	1250

Monitoring of GND2302 identified the following:

- Groundwater temperature ranged 14.4-16.1°C.
- Electrical conductivity ranged 1,038-1,848 $\mu\text{S}/\text{cm}$ this monitoring period with the May 2020 monitoring round recording the high result. This also constitutes the most elevated conductivity reading in this data for this monitoring well.
- pH remained stable though weakly acidic, 6.2-6.3 pH.
- Acid soluble barium results were all below the LOD.
- Dissolved barium ranged 0.043- 0.087 g/m^3 .
- Total sodium observed a slight increasing trend throughout the monitoring period, ranging 76-103 g/m^3 .
- Chloride results also recorded an increasing trend across the monitoring period, ranging 230-450 g/m^3 .
- Total dissolved solids, in line with chloride, observed an increasing trend, ranging 750-1,290 g/m^3 .
- All results were within consent limits.

Table 5 GND2303 2019-2020 monitoring period

GND2303	Collected	21 Aug 2019	05 Dec 2019	21 May 2020	15 Jun 2020
	Time	11:10	10:15	11:50	12:15
Sample Temperature	°C	14.1	15.6	14.4	14.6
Electrical Conductivity (EC)	$\mu\text{S}/\text{cm}$	2,310	2,360	2,190	2,550

GND2303	Collected	21 Aug 2019	05 Dec 2019	21 May 2020	15 Jun 2020
	Time	11:10	10:15	11:50	12:15
	mS/m	231	236	219	255
pH	pH Units	6.2	6.1	6.4	6.1
Acid Soluble Barium	g/m ³	0.11	0.14	0.13	0.16
Dissolved Barium	g/m ³	0.122	0.143	0.148	0.172
Total Sodium	g/m ³	128	162	151	161
Chloride	g/m ³	700	740	640	830
Total Dissolved Solids (TDS)	g/m ³	1750	2300	1480	1750

The monitoring of GND2303 indicated the following:

- Groundwater temperature ranged 14-1- 15.6°C.
- Electrical conductivity ranged 2,190-2,550 µS/cm.
- pH results remained weakly acidic, ranging 6.1-6.4 pH.
- Acid soluble barium results remained stable and measurable, ranging 0.11 0.16 g/m³.
- Dissolved barium also remained stable and measurable, ranging 0.122-0.178 g/m³.
- Total sodium ranged 128-161 g/m³.
- Chloride analysis indicated a decrease in chloride concentrations from the previous monitoring period, where a data set high result of 1,740 g/m³ was recorded. The monitoring in this period ranged 700-830 g/m³.
- Total dissolved solids indicated an increase in concentration in the December 2019 monitoring round, rising from 1,750 through 2,300 g/m³, prior to reducing in the final two monitoring rounds.
- No TPH or BTEX were recorded above the LOD.
- All results were within consent conditions.

2.1.3.2 Soil monitoring

To date the consent holder (WRS) has undertaken three farming exercises on this landfarm². These landfarmed areas are defined in the Company provided map of the site (Figure 3). In this monitoring period two compliance soil samples were collected from the most recently landfarmed area of M1810. This follows on from the previous monitoring period (2018-2019) when six compliance soil samples were collected from this area.

The analysis from 2018-2019 monitoring period indicated that one of six soil samples held a value above the consent defined limit for surrender for mid-range (C10-C14) petroleum hydrocarbons. For additional information pertaining to the previous six soil samples please reference Technical Report 2019-68. The analysis of the two compliance soil samples collected in the 2019-2020 monitoring period is provided in the following Table 6, and a map of the transect locations is provided in Figure 4.

It is noted that polycyclic aromatic hydrocarbons (PAHs) were not recorded above the LOD and were not required in surrender assessment, and have not been tabulated in Table 6.

² Please note additional landfarming was undertaken by a previous consent holder and for information on the pre WRS consent holder please reference Taranaki Regional Council (2013): Remediation NZ Limited Drilling Waste Disposal Monitoring Programme Annual Report 2012-2013. Technical report 2013-67



Figure 3 Consent holder provided landfarm application map area



Figure 4 Soil transect locations M1810 WRS Symes Manawapou Landfarm 2019-2020 monitoring

Table 6 WRS Symes Manawapou Landfarm soil samples 2019-2020 monitoring period

WRS Symes Manawapou	Area M1810	Transect number	Transect A	Transect B
Soil samples 19-20	Date and Units	7795-1 surrender	02 Jul 2020	02 Jul 2020
Parameters	Time	Criteria	12:20	12:50
Dry Matter (Env)	g/100g as rcvd		89	91
pH	pH Units		7.5	8.3
Benzo[a]pyrene (BAP)	mg/kg dry wt	<0.027	< 0.011	< 0.011
Naphthalene	mg/kg dry wt	7.2	< 0.06	< 0.06
Pyrene	mg/kg dry wt	160	< 0.011	< 0.011
Total of Reported PAHs in Soil	mg/kg dry wt		< 0.3	< 0.3
Conductivity from soluble salts	mS/cm	2.9	0.3	< 0.2

WRS Symes Manawapou	Area M1810	Transect number	Transect A	Transect B
Soil samples 19-20	Date and Units	7795-1 surrender	02 Jul 2020	02 Jul 2020
Chloride	mg/kg dry wt	700	115	22
Total Recoverable Calcium	mg/kg dry wt		8900	4500
Total Recoverable Magnesium	mg/kg dry wt		3200	2000
Total Recoverable Potassium	mg/kg dry wt		1220	550
Total Recoverable Sodium	mg/kg dry wt	460	310	220
Soluble Salts	g/100g dry wt	0.25	0.11	0.06
Sodium Absorption Ratio (SAR)		<18	1	0.8
Benzene	mg/kg dry wt	1.1	< 0.05	< 0.05
Toluene	mg/kg dry wt	68	< 0.05	< 0.05
Ethylbenzene	mg/kg dry wt	53	< 0.05	< 0.05
m&p-Xylene	mg/kg dry wt	48	< 0.10	< 0.10
o-Xylene	mg/kg dry wt	48	< 0.05	< 0.05
C ₇ - C ₉	mg/kg dry wt	<120	< 8	< 8
C ₁₀ - C ₁₄	mg/kg dry wt	<58	< 20	< 20
C ₁₅ - C ₃₆	mg/kg dry wt	<4,000	270	86
Total hydrocarbons (C ₇ - C ₃₆)	mg/kg dry wt		290	88
Total Recoverable Barium	mg/kg dry wt		1210	490
Total Recoverable Arsenic	mg/kg dry wt	20	< 2	< 2
Total Recoverable Cadmium	mg/kg dry wt	1	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	600	17	15
Total Recoverable Copper	mg/kg dry wt	100	24	11
Total Recoverable Lead	mg/kg dry wt	300	5.7	2.3
Total Recoverable Mercury	mg/kg dry wt	1	< 0.10	< 0.10
Total Recoverable Nickel	mg/kg dry wt	60	11	7
Total Recoverable Zinc	mg/kg dry wt	300	65	52

The analysis provided in the above Table 6 indicated that all parameters assessed were within criteria for surrender with no consent exceedance recorded when compared to consent condition. Consent surrender concentrations are provided in the above table, left-hand column of figures.

2.1.3.3 Lake Taumaha surface water sample

A single surface water sample was collected from the nearby Lake Taumaha (Figure 5). The results of the sample are provided in Table 7.



Figure 5 Lake Taumaha surface water sample location

Table 7 Lake Taumaha surface water sample analysis

Lake Taumaha SW sample	Collected	10 Jul 2020
Parameter	Time	10:40
TEMP	°C	9.1
pH	pH Units	8
Electrical Conductivity (EC)	µS/cm	412
Acid Soluble Barium	g/m ³	< 0.11
Total Dissolved Solids (TDS)	g/m ³	220
Chloride	g/m ³	74
Total Sodium	g/m ³	41
Benzene	g/m ³	< 0.0010
Toluene	g/m ³	< 0.0010
Ethylbenzene	g/m ³	< 0.0010
m&p-Xylene	g/m ³	< 0.002
o-Xylene	g/m ³	< 0.0010
C ₇ - C ₉	g/m ³	< 0.10
C ₁₀ - C ₁₄	g/m ³	< 0.2
C ₁₅ - C ₃₆	g/m ³	< 0.4
Total hydrocarbons (C ₇ - C ₃₆)	g/m ³	< 0.7

The analysis indicated the following:

- No petroleum hydrocarbon or BTEX were recorded above the LOD this monitoring period.
- pH was recorded at pH 8 which is weakly alkaline.
- Water temperature was 9.1°C.
- Electrical conductivity was recorded at 412 $\mu\text{S}/\text{cm}$, which was a slight increase when compared to the previous monitoring period when EC recorded a concentration of 387 $\mu\text{S}/\text{cm}$.
- Acid soluble barium did not record a concentration greater than the LOD, a results similar to the previous monitoring period.
- Chloride was marginally higher this monitoring period with a concentration of 74 g/m^3 , opposed to 69 g/m^3 in the 2018-2019 monitoring period.
- Total sodium was recorded at 41 g/m^3 , which was similar to the previous monitoring period, with a concentration of 40 g/m^3 .

Overall, the results of the spot sample do not indicate any influence from the landfarming operation on the water body of Lake Taumaha.

2.2 Incidents, investigations, and interventions

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

For all significant compliance issues, as well as complaints from the public, the Council maintains a database record. The record includes events where the individual/organisation concerned has itself notified the Council. Details of any investigation and corrective action taken are recorded for non-compliant events.

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 individual/organisation is indeed the source of the incident (or that the allegation cannot be proven).

In the 2019-2020 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

In terms of site performance for the WRS Symes Manawapou Landfarm in the 2019-2020 monitoring period, minimal activity occurred as the most recently landfarmed area was farmed in October 2018. Since this date the facility has been focused on re-grassing this landfarmed paddock.

In this monitoring period the inspector did observe some areas of this landfarmed area which require re-grassing as slight barren patches have emerged. It is further noted that the Company did undertake a considerable re-grassing operation in the previous monitoring period, when yellow bristle grass was found across the newly landfarmed area which prompted the consent holder to remove it by spray.

The degree of re-grassing will be monitored in to the upcoming monitoring period. Overall, not much was required from the consent holder this monitoring period. The consent holder was prompt with supplying their annual report and associated management plan, as with last year, and have been keeping abreast of Council monitoring and inspections as they occurred.

3.2 Environmental effects of exercise of consents

The main environmental effects recorded this monitoring period were centred on the groundwater and is best described as a short term exceedance in total dissolved solid (TDS) concentration, with no environmental consequences This was recorded in monitoring well GND2300, during the December 2019 monitoring round, when a brief exceedance in consent 7795-1, condition 18, was recorded. This condition stipulates TDS to not exceed 2,500 g/m³ in any freshwater body.

This was a onetime occurrence with the subsequent monitoring rounds recording a reduction in concentration to below the consented maximum allowable value.

Soil analysis of the most recently landfarmed area, M1810, indicted that all parameters were within criteria to be allowed to be surrendered from further monitoring. It is noted that one soil transect from the 2018-2019 monitoring period was marginally above surrender due to mid-range petroleum hydrocarbons (C₁₀-C₁₄). The analysis recorded in this period indicated that this concentration had remediated to below the consent limit (58 mg/kg. C₁₀-C₁₄, TPH).

Currently all previously landfarmed areas at the Symes Manawapou Landfarm have been assessed for surrender potential and have been found to be within criteria. If the consent holder wishes to have these areas returned to their previous land use, agriculture, then the consent holder must have these areas surrendered from the resource consent 7795-1. This surrender will then need to be submitted to the District Council for sign off and re-zoning. Only after this has occurred may animals be allowed to graze these former landfarmed areas.

3.3 Evaluation of performance

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

Table 8 Summary of performance for consent 7795-1

Purpose: To discharge drilling waste cuttings (consisting of drilling cuttings and drilling fluids from water based muds and synthetic based muds), from hydrocarbon exploration and production activities, onto and into land via landfarming		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Definitions which apply to the consent	N/A	N/A
2. Best practicable option to be adopted	Inspection and liaison with consent holder	Yes
3. The consent holder shall provide a stockpiling and landfarming management plan prior to the exercise of the consent	Management plan received and approved, updated annually, plan received 12/07/2020	Yes
4. Install groundwater monitoring wells prior to exercise of consent	Inspections indicated groundwater monitoring wells installed in 2012	Yes
5. Notify TRC 48 hrs prior to stockpiling	Notifications received when stockpiling. No stockpiling in this monitoring period	Yes
6. Notify TRC 48 hrs prior to landfarming	Notifications received when landfarming. No landfarming undertaken in this monitoring period	Yes
7. The consent holder shall sample for the following: a. Total petroleum hydrocarbons b. Benzene, toluene, ethylbenzene, xylenes c. Polycyclic aromatic hydrocarbons d. Chloride, nitrogen, pH, potassium, sodium	Predisposal samples analysis supplied by consent holder as requested, though no material landfarmed in this period, thus no analysis provided	Yes
8. Keep records relating to wastes, areas, compositions, volumes, dates, treatments and monitoring	Company records provided in annual report	Yes
9. Report on records in condition 6 to Council by 31 August each year	Report received 12/07/2020	Yes
10. Discharges made only within area as specified by submitted application	Inspection indicated the discharges occur within the consented area	Yes

Purpose: To discharge drilling waste cuttings (consisting of drilling cuttings and drilling fluids from water based muds and synthetic based muds), from hydrocarbon exploration and production activities, onto and into land via landfarming		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
11. No discharge within 25 m of a water body, 10 m from any property boundary and 50 m from the QEII covenant Key Native Ecosystems	Inspection indicated the discharges are of sufficient distance from water courses	Yes
12. Maximum application thickness for wastes: a. 100 mm TPH <5% b. 50 mm TPH >5% c. No ponded liquids 1 hr after application	Company records and inspection	Yes
13. Incorporation into soil as soon as practicable to a depth of at least 250 mm	Inspection and sampling	Yes
14. Hydrocarbon concentrations in soil shall not exceed 50,000 mg/kg dry weight	Sampling	Yes
15. Landfarming areas to be used in accordance with conditions 10 and 11 and shall not be used for any subsequent discharges of drilling wastes	Inspection	Yes
16. All material to be landfarmed as soon as practicable and no later than 12 months	Company records and inspections	Yes
17. Re-vegetate landfarmed areas as soon as practicable	Company records and inspections Inspections indicated the odd barren patch	Yes
18. Total dissolved salts in any fresh water body shall not exceed 2,500 g/m ³	Sampling indicated one well on one occasion exceeded this concentration, though subsequent monitoring recorded a reduction to below consented maximum	For the most part
19. Disposal of waste shall not lead to contaminants entering surface water or ground water exceeding background concentrations	Sampling, see above note	For the most part
20. Conductivity must be less than 400 mS/m. If background conductivity exceeds 400 mS/m, then increase shall not exceed 100 mS/m	Sampling of soil indicated compliance with this condition	Yes

Purpose: To discharge drilling waste cuttings (consisting of drilling cuttings and drilling fluids from water based muds and synthetic based muds), from hydrocarbon exploration and production activities, onto and into land via landfarming		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
21. Sodium absorption ratio [SAR] must be less than 18.0, if background SAR exceeds 18.0 then increase shall not exceed 1.0	Sampling of soil indicated compliance with this condition	Yes
22. Concentrations of heavy metals in the soil shall at all times comply with MfE guidelines	Sampling of soil indicated compliance with this condition	Yes
23. Prior to expiry/cancellation of consent these levels must not be exceeded: a. conductivity, 290 mSm ⁻¹ b. chloride, 700 g/m ³ c. dissolved salts, 2500 g/m ³ d. sodium, 460 g/m ³	Areas RNZ 1, 2, 3 and X, M1408, M1610 and M1810 have been assessed against this condition and found to be compliant	N/A
24. If condition 23 is not met, consent cannot be surrendered	Previously landfarmed areas may be surrendered if the Company would like to return the areas to former status of agriculture, though areas require to be recognised by consent as not active	N/A
25. Notification of discovery of archaeological remains	Not applicable – none discovered in this monitoring period	N/A
26. Consent shall lapse on 30 June 2017	Not applicable – consent exercised	N/A
27. Optional review provision re environmental effects	Next optional review June 2022	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

N/A = not applicable

Table 9 Evaluation of environmental performance over time

Year	Consent no	High	Good	Improvement req	Poor
2012-2013	7795-1	-	-	-	1
2013-2014	7795-1	-	1	-	-
Waste Remediation Services consent holder 2014-2015 onwards					
2014-2015	7795-1	-	1	-	-
2015-2016	7795-1	-	1	-	-
2016-2017	7795-1	-	1	-	-
2017-2018	7795-1	-	1	-	-
2018-2019	7795-1	-	1	-	-
Totals	-	0	6	0	1

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

3.4 Recommendations from the 2018-2019 Annual Report

In the 2018-2019 Annual Report, it was recommended:

1. THAT in the first instance, monitoring of consented activities at WRS Symes Manawapou landfarm in the 2019-2020 year be amended from that undertaken in 2018-2019, by the following:
 - a. Groundwater monitoring will continue at quarterly intervals unchanged.
 - b. Spot Lake Taumaha sample collection will continue unchanged.
 - c. Soil sampling will be reduced from six soil samples to two soil samples to account for the reduced activity at the landfarm.
2. THAT should there be issues with environmental or administrative performance in 2019-2020, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.

Recommendation 1 was implemented.

Recommendation 2 was not required.

3.5 Alterations to monitoring programmes for 2020-2021

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

- the extent of information already made available through monitoring or other means to date;
- its relevance under the RMA;
- the Council's obligations to monitor consented activities and their effects under the RMA;
- the record of administrative and environmental performances of the consent holder; and
- reporting to the regional community.

The Council also takes into account the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki exercising resource consents.

It is proposed that for 2020-2021 monitoring period that the monitoring of consented activities at the WRS Symes Manawapou Landfarm be adjusted with the collection of two soil samples being made provisional. This is on the premise that all previous landfarmed areas have met their limit for surrender.

The two soil samples will be included if the consent holder undertakes any new landfarming in the 2020-2021 monitoring period. Groundwater monitoring and spot surface water collection from Lake Taumaha will continue unchanged.

It should be noted that the proposed programme represents a reasonable and risk-based level of monitoring for the site in question. The Council reserves the right to subsequently adjust the programme from that initially prepared, should the need arise if potential or actual non-compliance is determined at any time during 2020-2021.

4 Recommendations

1. THAT in the first instance, monitoring of consented activities at WRS Symes Manawapou Landfarm in the 2020-2021 year be amended from that undertaken in 2019-2020, by making the two soil samples provisional, unless new areas are landfarmed by the consent holder. If so, these samples will be collected.
2. Groundwater monitoring will remain at quarterly.
3. Spot sample collection from Lake Taumaha will continue.
4. THAT should there be issues with environmental or administrative performance in 2020-2021, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.

Glossary of common terms and abbreviations

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

Al*	Aluminium.
As*	Arsenic.
Biomonitoring	Assessing the health of the environment using aquatic organisms.
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 25°C and expressed in $\mu\text{S}/\text{cm}$.
Cu*	Copper.
Cumec	A volumetric measure of flow- 1 cubic metre per second ($1 \text{ m}^3\text{s}^{-1}$).
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.
$\text{g}/\text{m}^2/\text{day}$	grams/metre ² /day.
g/m^3	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.

Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
Incident register	The incident register contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
LOD	Limit of detection: the lowest measurement that analysis can differentiate from a non-detectable result.
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.
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.
MPN	Most Probable Number. A method used to estimate the concentration of viable microorganisms in a sample.
µS/cm	Microsiemens per centimetre.
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 , PM _{2.5} , PM _{1.0}	Relatively fine airborne particles (less than 10 or 2.5 or 1.0 micrometre diameter, respectively).
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	<i>Resource Management Act 1991</i> and including all subsequent amendments.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
Zn*	Zinc.

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

For further information on analytical methods, contact a Science Services Manager.

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- Waste Remediation Services Ltd (WRS), Waikaikai (Wards) & Manawapou (Symes) Landfarm Management Plan 2018-2019.
- Waste Remediation Services Ltd (WRS), Waikaikai (Wards) & Manawapou (Symes) Landfarm Management Plan 2019-2020.

Appendix I

Resource consent held by WRS Symes Manawapou Landfarm

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

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. Permits authorising the discharge of wastes to land are issued by the Council under Section 87(e) of the RMA.

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

Name of
Consent Holder: Waste Remediation Services Limited
PO Box 7150
New Plymouth 4341

Decision Date: 01 May 2012

Commencement Date: 01 May 2012

Conditions of Consent

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

Expiry Date: 01 June 2028

Review Date(s): June 2016, June 2022

Site Location: 156 Manawapou Road, Manutahi

Legal Description: Lot 1 DP 7324 (Discharge site)

Grid Reference (NZTM) 1717244E-5608736N

Catchment: Manawapou

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

General condition

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

Special conditions

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

Requirements prior to exercise of consent

3. Prior to the exercise of this consent, the consent holder shall provide a stockpiling and landfarming management plan that, to the reasonable satisfaction of the Chief Executive, Taranaki Regional Council, demonstrates the activity can and will be conducted to comply with all of the conditions of this consent. The management plan shall be reviewed annually (on or about the anniversary of the date of issue of this consent) and shall include as a minimum:
 - a) procedures for notification to Council of disposal activities;
 - b) procedures for the receipt and stockpiling of drilling wastes onto the site;
 - c) methods used for the mixing and testing of different waste types;
 - d) procedures for site preparation;
 - e) procedures for landfarming drilling wastes (including means of transfer from stockpiling area, means of spreading, and incorporation into the soil);
 - f) procedures for sowing landfarmed areas, post-landfarming management, monitoring and site reinstatement;
 - g) contingency procedures;
 - h) sampling regime and methodology;
 - i) control of site access; and
 - j) documentation for all the procedures and methods listed above.
4. Prior to the exercise of this consent, the consent holder shall after consultation with the Chief Executive, Taranaki Regional Council, install a minimum of three groundwater monitoring bores. The bores shall be at locations and to depths, that enable monitoring to determine any change in groundwater quality resulting from the exercise of this consent. The bores shall be installed in accordance with NZS 4411:2001 and all associated costs shall be met by the consent holder.

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 drilling wastes onto the site for stockpiling, from each well drilled. Notification shall include the following information:
 - a) the consent number;
 - b) the name of the well(s) from which the waste was generated;
 - c) the type of waste to be stockpiled; and
 - d) the volume of waste to be stockpiled.

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 stockpiled material, or material brought onto the site for landfarming within 48 hours. Notification shall include the following information:
 - a) the consent number;
 - b) the name of the well(s) from which the waste was generated;
 - c) the type of waste to be landfarmed;
 - d) the volume and weight (or density) of the waste to be landfarmed;
 - e) the concentration of chlorides, nitrogen and hydrocarbons in the waste; and
 - f) the specific location and area over which the waste will be landfarmed.

7. The consent holder shall take a representative sample of each type of waste, from each individual source, and have it analysed for the following:
 - a) total petroleum hydrocarbons (C₆-C₉, C₁₀-C₁₄, C₁₅-C₃₆);
 - b) benzene, toluene, ethylbenzene, and xylenes;
 - c) polycyclic aromatic hydrocarbons screening; and
 - d) chloride, nitrogen, pH, potassium, and sodium.

8. The consent holder shall keep records of the following:
 - a) wastes from each individual well;
 - b) composition of wastes (in accordance with condition 5);
 - c) stockpiling area(s);
 - d) volumes of material stockpiled;
 - e) landfarming area(s), including a map showing individual disposal areas with GPS co-ordinates;
 - f) volumes and weights of wastes landfarmed;
 - g) dates of commencement and completion of stockpiling and landfarming events;
 - h) dates of sowing landfarmed areas;
 - i) treatments applied; and
 - j) details of monitoring, including sampling locations, sampling methods and the results of analysis;and shall make the records available to the Chief Executive, Taranaki Regional Council.

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

Discharge limits

10. The discharge shall only occur on the disposal sites shown in the Drawing entitled 'Remediation NZ Ltd Proposed Disposal Site' submitted with the application and attached to this consent.
11. There shall be no discharge within buffer zone, being:
 - 25 metres of the Manawapou River;
 - 25 metres of the unnamed tributary;
 - 10 metres from any property boundary; and
 - 50 metres from the QE II covenant Key Native Ecosystem areas.
12. For the purposes of landfarming, drilling wastes shall be applied to land in a layer not exceeding:
 - a) 100 mm thick for wastes with a hydrocarbon concentration less than 50,000 mg/kg dry weight;
 - b) 50 mm thick for wastes with a hydrocarbon concentration equal to or greater than 50,000 mg/kg dry weight; and
 - c) in a rate and manner such that no ponded liquids remain after one hour, for all wastes;prior to incorporation into the soil.
13. As soon as practicable following the application of solid drilling wastes to land, the consent holder shall incorporate the wastes into the soil to a depth of at least 250 mm.
14. 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.
15. An area of land used for the landfarming of drilling wastes in accordance with conditions 10 and 11 of this consent, shall not be used for any subsequent discharges of drilling waste.

Operational requirements

16. All material must be landfarmed as soon as practicable, but no later than twelve months after being brought onto the site.
17. 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

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

19. Other than as provided for in condition 18, 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

20. 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 S/m, the landfarming of waste shall not increase the soil conductivity by more than 100 mS/m.
21. The sodium adsorption 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.
22. The concentration of heavy metals in the soil over the disposal area shall at all times comply with the Ministry for the Environment and New Zealand Water & Wastes Association’s Guidelines for the safe application of biosolids to land in New Zealand (2003), as shown in the following table:

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

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

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 (C₇-C₉, C₁₀-C₁₄, C₁₅-C₃₆)

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

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

Archaeological remains

25. 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

26. This consent shall lapse on 30 June 2017, 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.
27. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2016 and/or June 2022, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 3 June 2014

For and on behalf of
Taranaki Regional Council

A D McLay
Director - Resource Management

Appendix II

Consent holder provided annual report



07 July 2020

Chief Executive
Taranaki Regional Council
Private Bag 713
47 Cloten Road
Stratford
Attention Nathan Crook

Dear Nathan

RE: Resource Consent 7795-1 - Manawapou (Symes) - 156 Manawapou Road, RD 2, Patea

As required under special condition 9 of resource consent 7795-1, please find all relevant information recorded from the operational period 1 July 2019 to 30 June 2020 relating to stockpiling and landspreading activities undertaken at Waste Remediation Services (WRS) Manawapou disposal site. It is the sixth report completed by WRS following the previous periods;

2014-15
2015-16
2016-17
2017-18
2018-19

This report is designed to follow on from the previously submitted 2018-19 consent monitoring report and is as such focussed on activities, records and results from the 2019-20 period. This report is structured into 6 sections, as per the following:

1. Overview and Background
2. Wastes Received for Disposal
3. Disposal and Rehabilitation Operations (preparatory earthworks, landspreading/ incorporation and rehabilitation - comprising topsoil application, sowing, additional works)

4. Monitoring
5. Additional Consent Requirements
6. Summary

1. OVERVIEW AND BACKGROUND

WRS began operating the Manawapou disposal site in 2014, replacing the original site operators Remediation NZ Ltd, who were issued resource consent 7795-1 in 2012. Between 2014 and the currently reported on year (2019-20), there have been intermittent periods of activity at the site, reflecting fluctuating levels of activity within the local drilling industry.

During 2019-20 there has been minimal activity at the Manawapou site. The site has received no further drilling or production wastes, and all disposal areas other than the most recent M1810 have been surrendered, with receiving soil samples having met consent surrender criteria. Operations were therefore mostly limited to rehabilitation and maintenance, which is described in detail in Section 3.

Monitoring of the site undertaken in the 2019-20 year by both the Taranaki Regional Council (TRC) and WRS management has shown the operations undertaken at Manawapou to be compliant with consent conditions, and no incidents have been recorded against the site in 2019-20.

2. WASTES RECEIVED FOR DISPOSAL

Waste Types and Volumes

No new material has been received onsite in the 2019-20 operational period; as such, no mud register has been appended to this report.

Waste Characterisation

Consent 7795-1 requires the site operator to sample and keep records of waste chemical composition. Composite samples are taken (generally by wellsite staff prior to transport) across each waste stream before materials leave the well/source site for delivery. WRS also takes pre-spreading samples from the pits prior to landspreading for further waste characterisation. All samples are sent to RJ Hill Laboratories for analyses. Results are forwarded directly to TRC for their records and for cross referencing purposes. Results are kept and logged by WRS, and are used to calculate required spreading areas as per condition 12 of consent 7795-1 to ensure the hydrocarbon limit in condition 14 is adhered to. Elevated salinity is expected from KCL based mud wastes arriving onsite for disposal. Wastes are analysed for several salinity related parameters, and monitoring of receiving soil and groundwater is conducted by the TRC to check for any effects on soil quality and/or groundwater quality from application of highly saline muds.

As stated in Section 2, no further wastes were received onsite in 2019-20, and no land spreading was undertaken; as such, no predisposal samples have been taken during this period.

3. DISPOSAL AND REHABILITATION OPERATIONS

There have been no significant operations undertaken at the Manawapou site during 2019-20; the site has remained under care and maintenance for the entire period.

Recent photographs of the finished spreading area M1810 at the Manawapou site are attached as Appendix A.

4. MONITORING

Site Inspections - WRS

WRS closely supervise site operations to ensure all contractors are following best practice as per the site operation management plan and conditions specified in consent 7795-1. Regular site inspections are also undertaken during periods of inactivity at the site.

Site Inspections – TRC

WRS has received four inspection notices from the TRC for the 2019-20 year. All notices indicated the TRC inspector was satisfied with the physical state of the site, and with operations being undertaken around the time of inspection. Copies of the TRC inspection notices are attached as Appendix D.

Receiving Environment Sampling

Composite soil sampling and groundwater sampling is now undertaken exclusively by TRC staff, with all samples being sent to RJ Hill Laboratories for the full suite of analyses required under consent 7795-1. WRS have no receiving environment sample results to submit as part of this Annual Report; however, WRS would like to address the TRC soil sampling results for area M1810 and the groundwater monitoring results from the current monitoring period.

1. Soil sample results M1810

Six composite soil samples were collected by TRC on 18 June 2019 and sent to RJ Hill Laboratories for analysis. The results have been supplied to WRS and are summarised in the tables below alongside the relevant standards set out in consent conditions 20-23:

Table 1 Conditions 21 and 23 - M1810 composite soil sample results salinity parameters and hydrocarbons (MAH, PAH, TPH)

Sample	TRC192358	TRC192359	TRC192360	TRC192361	TRC192362	TRC192363	Standard
Constituent							
Conductivity mS/m	<20	<20	40	<20	<20	<20	290
Chloride mg/kg	63	32	380	6	8	5	700
Total Recoverable Sodium mg/kg	250	240	310	260	210	220	460
Soluble Salts mg/kg	700	500	1400	<500	<500	<500	2500
Sodium Absorption Ratio (SAR)	1	1	1.7	0.7	0.5	0.8	18
Benzene mg/kg	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	1.1
Toluene mg/kg	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	68

Sample	TRC192358	TRC192359	TRC192360	TRC192361	TRC192362	TRC192363	Standard
Ethylbenzene mg/kg	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	53
m&p-Xylene mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	48
o-Xylene mg/kg	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	
C7 - C9 mg/kg	< 8	< 8	< 8	< 8	< 8	< 8	120
C10 - C14 mg/kg	30	21	113	< 20	< 20	30	58
C15 - C36 mg/kg	540	300	540	161	128	190	4000
Naphthalene mg/kg	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	7.2
Pyrene mg/kg	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011	160
Benzo[a]pyrene (BAP)	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011	0.027

The results in Table 1 show compliance with the limits stipulated in Conditions 20, 21 and 23, with the exception of one exceedance of the surrender limit for the C10-C14 hydrocarbon fraction (highlighted). MAH and PAH concentrations are at detection levels, and the salinity parameters measured show compliance with application and surrender limits.

Table 2 Condition 22 - M1810 composite soil sample results heavy metal concentrations

Sample	TRC192358	TRC192359	TRC192360	TRC192361	TRC192362	TRC192363	Standard
Constituent (mg/kg dry weight)							
Total Recoverable Arsenic	< 2	< 2	< 2	< 2	< 2	< 2	20
Total Recoverable Cadmium	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	1
Total Recoverable Chromium	17	17	16	14	15	13	600
Total Recoverable Copper	12	14	16	14	11	9	100
Total Recoverable Lead	2.5	2.8	3.4	2.7	2.1	1.5	300
Total Recoverable Mercury	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	1
Total Recoverable Nickel	9	9	8	8	7	7	60
Total Recoverable Zinc	60	65	57	54	54	45	300

Consent condition 22 requires the concentration of heavy metals in the soil to comply at all times with the Ministry for the Environment and New Zealand Water and Wastes Association's *Guidelines for the safe application of biosolids to land in New Zealand* (2003). The results presented in Table 2 are well below the standards given in the guidelines, and heavy metal concentrations in spreading area M1810 (as well as all previous spreading areas at this site) are generally low.

Additionally, as was noted in the previous report, surrender criteria has been reached in all previous spreading areas at this site (RNZ1-3, M1408 and M1610) as identified in the Manawapou site map, attached in Appendix B.

2. Groundwater monitoring results

TRC have completed quarterly groundwater monitoring at the Manawapou site and have supplied all results to WRS, as per the agreed monitoring programme. Consent 7795-1 has two conditions relating to groundwater, conditions 18 and 19. Condition 18 relates specifically to the concentration of total dissolved salts (TDS), which is limited to a maximum concentration of 2500 g/m³. Condition 19 has a relatively broad requirement around the exercising of the consent not resulting in any other contaminant concentrations above background levels.

WRS have reviewed these supplied results and have not identified any non-compliances with condition 19. The full range of groundwater results will likely be included in the TRC Annual Report (as has been done in previous years), so these will not be presented in this report in full. The TDS results, however, will be presented and discussed below, in relation to condition 18. The TDS results for 2019-20 are presented below in Table 3.

Table 3 TRC Groundwater TDS results, all monitoring bores 2019-20

Bore	Date	TDS g/m ³	Bore	Date	TDS g/m ³
GND2300	21 Aug 2019	550	GND2302	21 Aug 2019	980
	05 Dec 2019	2800		05 Dec 2019	750
	21 May 2020	1590		21 May 2020	1290
	15 Jun 2020	1620		15 Jun 2020	1250
GND2301	21 Aug 2019	420	GND2303	21 Aug 2019	1750
	05 Dec 2019	580		05 Dec 2019	2300
	21 May 2020	<i>Dry bore</i>		21 May 2020	1480
	15 Jun 2020	<i>Dry bore</i>		15 Jun 2020	1750

In previous monitoring periods (as has been recorded in TRC Annual Reports for the site) there has been significant fluctuation of TDS concentrations in GND2300 and GND2303 (identified on site map, Appendix B). This has meant there have been times when results have exceeded the TDS limit for these two bores, but the concentrations have been erratic and not correlated temporally or spatially with recent (low levels of) activity undertaken on site. Because of this, WRS have engaged TRC in several discussions about the variability in the groundwater results, to try to reach a definitive understanding of what could be contributing to the TDS results at the site. WRS acknowledges that on one occasion, viz 05 Dec 2019, the TDS result for GND2300 was 300g/m³ above the consent limit of 2,500 g/m³; however no plausible reason for this observation can be identified. As an empirical value the consent limit has been exceeded, however there is no identifiable consequence or any effect upon the environment of any account within the context of the RMA.

For the current monitoring period, other than the December 2019 result for GND2300, the results have all been compliant with the TDS consent limit. The results for GND2300 and GND2303 in the previous two monitoring rounds are well within the limit, and WRS considers this an encouraging result, hopefully indicating a further downward and more stable trend for these two bores.

5. ADDITIONAL CONSENT REQUIREMENTS

As per condition 3 of consent 7795-1, the site management plan has been reviewed and updated for the period July 2019 to June 2020. Operations at the Manawapou disposal site are all undertaken generally in accordance with the WRS' Landfarm Management Plan that covers both the Manawapou and Waikaikai sites. It is a live document and is constantly reviewed and updated as necessary to reflect operational requirements and practices at both sites operated by WRS. This updated plan is attached as Appendix C.

6. SUMMARY

During 2019-20 there was a relatively low level of activity at the Manawapou site. No new material was received for disposal, and operations as of the end of June 2020 have been limited to site maintenance, with any further activity subject to industry requirements. Monitoring results from TRC sampling have indicated that no significant adverse effects have occurred from the exercise of consent 7795-1 during the monitoring period under review. There was one groundwater result above the TDS limit earlier in the monitoring period, but subsequent groundwater results have been compliant. Historic spreading areas have met surrender criteria, and no incidents/significant issues have been identified at the site.

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Appendix A Field Photographs

Photographs of Area 1810 that has been re-grassed after yellow bristle grass was found, and was sprayed out, sown in chicory and then finally sown in perennial ryegrass and clover. Photographs taken 30 June 2020.





Appendix B Manawapou Site Map

