

**Todd Petroleum Ltd Kapuni-J
Hydraulic Fracturing
Monitoring Programme
2021/22
Technical Report 23-90**



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Hydraulic Fracturing

Monitoring Programme

2021/22

Technical Report 23-90

Taranaki Regional Council
Private Bag 713
Stratford

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Executive summary

Todd Energy Ltd (Todd) operates the Kapuni-J hydrocarbon exploration site located on Palmer Road, Kaponga. This report outlines and discusses the results of the monitoring programme implemented by the Council in relation to hydraulic fracturing activities conducted by Todd at the wellsite over the period 2 December 2021 to 30 March 2022. The report also details the results of the monitoring undertaken and assesses the environmental effects of the Company's activities.

During the monitoring period, Todd demonstrated an overall high level of environmental performance and an overall high level of administrative performance.

The programme undertaken by Todd at the Kapuni-J wellsite included the hydraulic fracturing of four wells. The wells targeted for stimulation were the Kapuni-21, Kapuni-22, Kapuni-24, and Kapuni-23ST1 wells.

The programme of monitoring implemented by the Council in relation to these hydraulic fracturing activities occurred during the 2021/22 monitoring year. Monitoring included pre and post discharge groundwater sampling. Samples of hydraulic fracturing fluids, and fluids returning to the wellhead post fracturing, were also obtained for physicochemical analysis in order to characterise the discharges and to determine compliance with consent conditions.

This is the first monitoring report produced by the Council in relation to the hydraulic fracturing activities at the Kapuni-J wellsite.

The monitoring carried out by the Council indicates that the hydraulic fracturing activities undertaken by Todd had no significant adverse effects on local groundwater or surface water resources. There were no unauthorised incidents recording non-compliance in respect of the resource consent held by Todd in relation to these activities or provisions in regional plans, during the period under review.

Todd demonstrated a high level of environmental and administrative performance and compliance with the resource consents over the reporting period.

For reference, in the 2021/22 year, consent holders were found to achieve a high level of environmental performance and compliance for 88% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 10% of the consents, a good level of environmental performance and compliance was achieved.

This report includes recommendations for the future monitoring of any hydraulic fracturing activities at the Kapuni-J wellsite.

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1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report outlines and discusses the results of the monitoring programme implemented by Taranaki Regional Council (the Council) in relation to the programme of hydraulic fracturing undertaken by Todd Energy Ltd (Todd) at the Kapuni-J wellsite, over the period 2 December 2021 to 30 March 2022. The report also assesses Todd's level of environmental performance and compliance with the resource consent held in relation to the activity.

The programme undertaken by Todd at the Kapuni-J wellsite included the hydraulic fracturing of four wells. The wells targeted for stimulation were the Kapuni-21, Kapuni-22, Kapuni-24 and Kapuni-23ST1 wells.

The programme of monitoring implemented by the Council in relation to these hydraulic fracturing activities occurred during the 2021/22 monitoring year. Monitoring included a mixture of groundwater, surface water and discharge monitoring components. This is the first monitoring report produced by the Council in relation to hydraulic fracturing activities at the Kapuni-J wellsite.

1.1.2 Structure of this report

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

- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted at Kapuni-J.

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 for the future monitoring of any hydraulic fracturing activities at the Kapuni-J wellsite.

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

1.1.3 The Resource Management Act 1991 and monitoring

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

- a. the neighbourhood or the wider community around an activity, and may include cultural and social-economic effects;
- b. physical effects on the locality, including landscape, amenity and visual effects;
- c. ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;
- d. natural and physical resources having special significance (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 a rating as to each Company's environmental and administrative performance during the period under review. The rating categories are high, good, improvement required and poor for both environmental and administrative performance. The interpretations for these ratings are found in Appendix II.

For reference, in the 2021/22 year, consent holders were found to achieve a high level of environmental performance and compliance for 88% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 10% of the consents, a good level of environmental performance and compliance was achieved.¹

1.2 Process description

1.2.1 Hydraulic fracturing

Hydraulic fracturing is a reservoir stimulation technique used to increase the flow of hydrocarbons to the surface. The primary objective of hydraulic fracturing is to increase the permeability of the target reservoir by creating numerous small, interconnected fractures, thus increasing the flow of hydrocarbons from the formation to a given well. The process of hydraulic fracturing has enabled companies to produce hydrocarbons at economically viable rates from extremely low permeability reservoirs and those that have become depleted using conventional production techniques.

The process of hydraulic fracturing involves the pumping of fluids and a proppant (medium-grained sand or small ceramic pellets) down a well, through a perforated section of the well casing, and into the target reservoir. The fluid mixture is pumped at a pressure that exceeds the fracture strength of the reservoir rock in order to create fractures. Once fractures have been initiated, pumping continues in order to force the fluid and proppant into the fractures created. The proppant is designed to keep the fractures open when the pumping is stopped. The placement of proppant into the fractures can be assisted by the use of cross-linked gels (gel fracturing), turbulent flow (slick-water fracturing), or the use of nitrogen gas.

1.2.1.1 Gel fracturing

Gel fracturing utilises cross-linked gel solutions, which are liquid at the surface but, when mixed, form long-chain polymer bonds and thus become viscous gels. These gels are used to transport the proppant into the

¹ The Council has used these compliance grading criteria for more than 21 years. They align closely with the 4 compliance grades in the MfE Best Practice Guidelines for Compliance, Monitoring and Enforcement, 2018

formation. Once in the formation they 'break' back with time, temperature and the aid of gel breaking chemicals into a liquid state and are flowed back to surface, without disturbing the proppant which remains in place and enhances the flow of hydrocarbons back to the surface.

1.2.1.2 Slick water fracturing

Slick water fracturing utilises water based fracturing fluids with friction-reducing additives. The addition of the friction reducers allows the fracturing fluids and proppant to be pumped to the target zone at higher rates and reduced pressures, than when using water alone. The higher rate creates turbulence within the fluid column holding the proppant and enabling its placement into the open fractures and enhancing the flow of hydrocarbons back to the surface.

1.2.1.3 Nitrogen gas fracturing

Nitrogen gas assisted fracturing involves replacing some of the fluid used in the fracturing process with nitrogen gas, which can fracture rock at high pressures much like water. While nitrogen (N₂) is a gas at room temperature, it can be maintained in a liquid state through cooling and pressurisation. Nitrogen assisted fracturing can be beneficial from a production standpoint as inevitably during the fracturing process some of the water pumped down the well remains underground in the rock formation, which can block some of the small pores inhibiting hydrocarbon recovery. The use of nitrogen gas reduces the amount of water required for each fracturing event. This also reduces the total concentration of chemical additives required and the volume of water returning to the surface that requires subsequent disposal.

1.2.2 The Kapuni-J wellsite and hydraulic fracturing activities

The Kapuni-J wellsite is located on Palmer Road, Kaponga. The area surrounding the site is rural in nature and farming and forestry activities co-exist with active petroleum exploration and production operations. The location of the wellsite is illustrated in Figure 1. A summary of the hydraulic fracturing activities carried out by Todd at the Kapuni-J wellsite during the period being reported is provided below in Table 1.

Table 1 Summary of hydraulic fracturing details

Well	Bore id.	Date range	Mid-point injection intervals (m TVDss)	Formation
Kapuni-21	GND3153	02/12/2021 – 29/12/2021	3208.7 - 3587	Kapuni
Kapuni-22	GND3154	18/12/2021 - 03/01/2022	3301.3 – 3468.6	Kapuni
Kapuni-24	GND3156	14/03/2022 – 17/03/2022	3311.3 - 3513	Kapuni
Kapuni-23ST1	GND3155	12/03/2022 – 30/03/2022	3103.2 – 3482.6	Kapuni

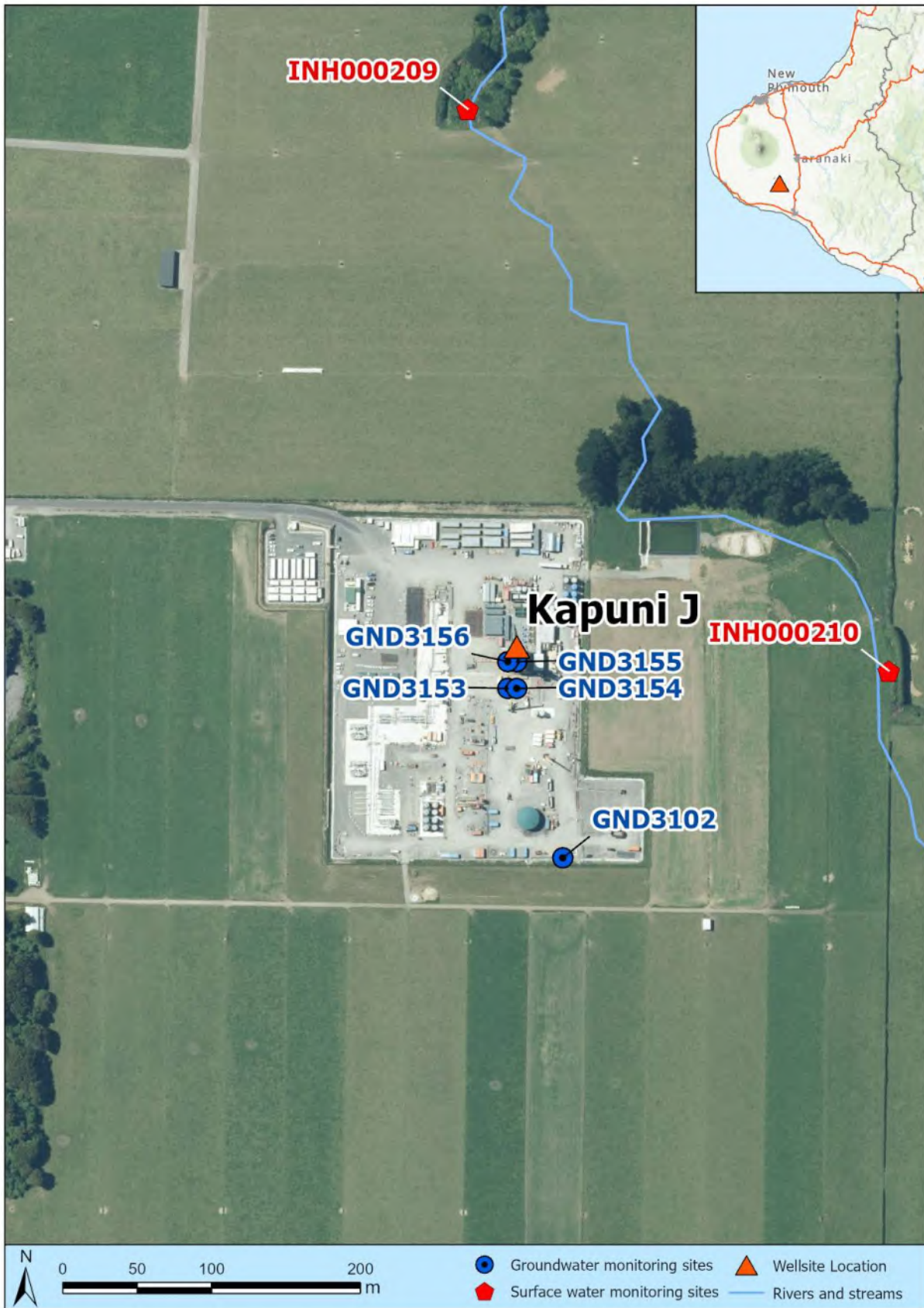


Figure 1 Location map

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.

The Company holds one resource consent the details of which are summarised in Table 2 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 Appendix I, as is a copy of the permit held by the Company during the period under review.

Table 2 Resource consent held by the Company during the period under review

Consent number	Purpose of consent	Granted	Next review	Expires
10736-1.0	To discharge water based hydraulic fracturing fluids into land at depths greater than 3,000m TVDss beneath the Kapuni-J wellsite	4 July 2019	June 2024	1 June 2035

1.4 Monitoring programme

1.4.1 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 Kapuni-J wellsite 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 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.

1.4.3 Assessment of data submitted by the consent holder

As required by the conditions of Consent 10736 Todd submitted pre and post fracturing discharge reports to the Council for the wells fractured during the period under review. Pre-fracturing discharge reports provide an outline of the proposed fracturing operations in relation to each well, while post fracturing reports confirm details of what actually occurred. The specific range of information required in each report is stipulated in the conditions of the consent.

1.4.4 Physicochemical sampling

1.4.4.1 Groundwater

As a general principle, all existing bores or wells within a 1km radius of a hydraulic fracturing activity are assessed for their suitability for sampling (or otherwise) and included in the monitoring programme for the wellsite. A summary of bore details are included in Table 3 below.

Table 3 Details of groundwater sites included in the monitoring programme

Monitoring site	Easting (NZTM)	Northing (NZTM)	Distance from wellsite (m)	Total depth (m)	Screened/open interval (m)
GND3102	1701751	5632812	On-site	20	14-20

Samples of groundwater were obtained pre-fracturing to provide a baseline reference of groundwater composition and a further two rounds of sampling were carried out following completion of the activities.

1.4.4.2 Hydraulic fracturing and return fluids

In addition to the sampling of local groundwater, representative samples of the hydraulic fracturing fluid and reservoir fluids produced back to the wellhead immediately following each fracturing event (return fluids) were obtained for analysis.

Samples of return fluids were collected at regular intervals during the flow-back period. Return fluids are comprised of a mixture of hydraulic fracturing fluids and formation fluids produced from the target reservoir, following the completion of the hydraulic fracturing process. The relative concentrations of each contributing fluid type change as the volume of fluid produced from the well increases. Immediately following the opening of the well post fracturing, a high proportion of the fluid returning to the wellhead is fluid injected during the hydraulic fracturing process. As the volume of fluid produced from the well increases, the proportion of hydraulic fracturing fluid reduces in relation to formation fluids. The individual samples of return fluid are generally combined in a composite sample for laboratory analysis. Composites are designed to provide a representative sample of fluids returning to the wellhead over the entire flow-back period.

All samples were transported to Hill Laboratories Ltd (Hills) for analysis following standard chain of custody procedures.

1.4.5 Surface water quality monitoring

The site is located in the Inaha catchment with an unnamed tributary of the Inaha Stream located approximately 140m from the northeastern boundary of the wellsite. Following a survey of the area, two suitable monitoring sites were identified, one upstream of the wellsite and the other below the discharge point.

The details of the surface water monitoring sites are summarised in Table 4 and the locations in relation to the wellsite are shown in in Figure 1.

Table 4 Surface water biomonitoring sites

Site number	Site code	Grid reference (NZTM)	Location	Altitude (masl)
1	INH000209	E1701687 N5633316	Approx. 260m upstream of Kapuni-J discharge	240
2	INH000210	E1701970 N5632938	Approx. 60m below Kapuni-J discharge	235

2. Results

2.1 Consent holder submitted data

The conclusions from the Kapuni-J post fracturing discharge reports are summarised as follows:

2.1.1 Kapuni-21 post fracturing discharge report

- A total of six intra-zonal units were fractured over the period 2 December to 28 December at mid-point depths between 3269.6 to 3587m TVDss.
- A total of 24,747bbls (3,934.4m³) of liquid was discharged across the eleven fractured units. The total proppant weight was 371.8 tonnes (819,685 lbs).
- A total of 18,246bbls of fluid was returned from the well over the flow-back period.
- A total of 371.8 tonnes (819,685 lbs) of proppant was estimated to have remained within the formation following flow-back.
- There were no screen outs occurred during hydraulic fracturing of the Kapuni-21 well.
- The Company monitored the Geonet seismic network throughout the duration of the programme and there were no events recorded in proximity to the wellsite.
- All return fluid from the Kapuni-21 fracturing operations was pumped to the Kapuni Production Station (KPS) and disposed of by deep well injection under the Company's deep well injection consents.
- Pressure testing was undertaken of all surface equipment, including flow lines and the wellhead, prior to injection.
- There was no escape of fluids during hydraulic fracturing operations.

2.1.2 Kapuni-22 post fracturing discharge report

- A total of three intra-zonal units were fractured over the period 18 December 2021 to 3 January 2022 at mid-point depths between 3301.3 to 3468.6m TVDss.
- A total of 9,043bbls (1,437.7m³) of liquid was discharged across the five fractured zones. The total proppant weight was 172.5 tonnes (380,500 lbs).
- A total of 4,564bbls of fluid was returned from the well over the flow-back period.
- A total of 172.5 tonnes (380,500 lbs) of proppant was estimated to have remained within the formation following flow-back.
- No screen outs were recorded during the hydraulic fracturing of the Kapuni-22 well. All fluids remained within the injection interval.
- The Company monitored the Geonet seismic network throughout the duration of the programme and there were no events recorded in proximity to the wellsite.
- All return fluid from the Kapuni-22 fracturing operations was pumped to the KPS and disposed of by deep well injection under the Company's deep well injection consents.
- Pressure testing was undertaken of all surface equipment, including flow lines and the wellhead, prior to injection.
- There was no escape of fluids during hydraulic fracturing operations.

2.1.3 Kapuni-24 post fracturing discharge report

- A total of two intra-zonal units were fractured over the period 14 March to 17 March 2022 at mid-point depths between 3,113.3 to 3,513.5m TVDss.

- A total of 13,026bbls (2,070.9m³) of liquid was discharged across the five fractured zones. The total proppant weight was 252.9 tonnes (557,552 lbs).
- A total of 3,184bbls of fluid injected was returned from the well over the flow-back period.
- A total of 252.8 tonnes (557,495 lbs) of proppant was estimated to have remained within the formation following flow-back.
- No screen outs were recorded during the hydraulic fracturing of the Kapuni-24 well. All fluids remained within the injection interval.
- The Company monitored the Geonet seismic network throughout the duration of the programme and there were no events recorded in proximity to the wellsite.
- All return fluid from the Kapuni-24 fracturing operations was pumped to the KPS and disposed of by deep well injection under the Company's deep well injection consents.
- Pressure testing was undertaken of all surface equipment, including flow lines and the wellhead, prior to injection.
- There was no escape of fluids during hydraulic fracturing operations.

2.1.4 Kapuni-23ST1 post fracturing discharge report

- A total of four intra-zonal units were fractured over the period 12 March to 30 March 2022 at mid-point depths between 3111.7m to 3482.6m TVDss.
- A total of 15,168bbls (2,411.5m³) of liquid was discharged across the 13 fractured zones. The total proppant weight was 342.9 tonnes (756,117 lbs).
- A total of 5,135bbls of fluid was returned from the well over the flow-back period.
- A total of 279.3 tonnes (615,791 lbs) of proppant was estimated to have remained within the formation following flow-back.
- Two screen outs occurred during hydraulic fracturing of the Kapuni-23ST1 well, one in K3B_L and one in K1C_L. All fluids remained in the injection interval. K3B_L screen out was likely due to the uneven slurry distribution among the 3 separate intervals targeted. The likely cause of the screen out in K1C_L is a near wellbore restriction, possibly related to perforation performance. The screen outs did not impact on consent special conditions 1 and 5, as the discharge point remained at the perforated intervals.
- The Company monitored the Geonet seismic network throughout the duration of the programme and there were no events recorded in proximity to the wellsite.
- All return fluid from the Kapuni-23ST1 fracturing operations was pumped to the KPS and disposed of by deep well injection under the Company's deep well injection consents.
- Pressure testing was undertaken of all surface equipment, including flow lines and the wellhead, prior to injection.
- There was no escape of fluids during hydraulic fracturing operations.

2.2 Physicochemical sampling

2.2.1 Groundwater

Hydraulic fracturing activities commenced at the Kapuni-J wellsite on 2 December 2021 and continued until 30 March 2022. A pre-fracturing baseline sample was collected on 1 December 2021. Post fracturing samples were collected at various intervals following commencement of the activities which spanned several months. Samples were collected on 7 March, 27 June, 5 December 2022 and 12 April 2023.

Methane concentrations $> 1\text{g/m}^3$ were reported in all samples both pre and post-hydraulic fracturing activities and can occur as a result of biogenic processes in sulphate depleted groundwater systems. To determine whether the source of the methane was biogenic or thermogenic, samples were sent to Geological and Nuclear Sciences (GNS) for carbon 13 isotope analysis. The presence of carbon 13 isotopes at concentrations less than -50‰ indicate a thermogenic deep gas source and concentrations greater than -50‰ a shallow biogenic gas source. Carbon 13 concentrations ranged between -65.3 to -83.1‰ in samples collected from GND3102. The results presented indicate a shallow biogenic/thermogenic source of methane at the monitoring site. The presence of methane is not uncommon in Taranaki and are not indicative of any significant change in groundwater quality at the site.

Overall, samples demonstrate relatively narrow ranges between analyte concentrations over time. The subtle variation in analyte concentrations at each site are a result of natural seasonal fluctuation and sampling variability. The results of the laboratory analysis indicate there have been no significant changes in groundwater composition over the period monitored.

A summary of the results for groundwater samples taken in relation to the hydraulic fracturing activities compared to baseline is included in Table 4. The certificates of analysis for the review period are included in Appendix III.

Table 5 Results of groundwater sampling carried out in relation to the Kapuni-J fracturing event

		Pre-fracturing	3 mth post fracturing	3 mth post fracturing	1 year post fracturing	1 year post fracturing
Sample date	Unit	01/12/2021	07/03/2022	27/06/2022	05/12/2022	12/04/2023
Sample time	-	8:50	10:45	12:25	11:40	10:25
Sample id. TRC	-	TRC214059	TRC225640	TRC226863	TRC229273	TRC2311827
pH	pH	7.5	6.9	6.9	7.0	6.9
Temperature	°C	14.7	15.7	13.5	14.7	14.5
Total alkalinity	$\text{g/m}^3 \text{CaCO}_3$	85	74	89	82	87
Bicarbonate	$\text{g/m}^3 \text{HCO}_3$	103	90	108	100	106
Total hardness	$\text{g/m}^3 \text{CaCO}_3$	40	48	39	73	47
Electrical conductivity	mS/m	23.3	27.2	23.9	32.6	25.5
Total dissolved solids	g/m^3	210	230	200	230	210
Dissolved calcium	g/m^3	8.5	9.6	7.7	15.3	9.8
Chloride	g/m^3	22	36	21	46	25
Dissolved magnesium	g/m^3	4.6	6.0	4.9	0.27	5.4
Dissolved potassium	g/m^3	10.6	10.6	10.8	9.4	10.2
Dissolved sodium	g/m^3	26	28	28	27	29
Nitrite	$\text{g/m}^3 \text{N}$	0.008	0.0016	< 0.02	0.009	0.006
Nitrate	$\text{g/m}^3 \text{N}$	< 0.002	0.003	< 0.02	0.014	0.008
Nitrate & nitrite	$\text{g/m}^3 \text{N}$	0.010	0.019	0.02	0.023	0.014
Sulphate	g/m^3	0.7	2.4	< 0.5	4.2	< 0.5
Dissolved barium	g/m^3	0.034	0.034	0.031	0.034	0.032
Bromide	g/m^3	0.09	0.11	0.08	0.14	0.10
Dissolved copper	g/m^3	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0007
Dissolved iron	g/m^3	17.1	17.9	19.1	7.6	13.7
Dissolved manganese	g/m^3	0.56	0.57	0.56	0.27	0.46
Dissolved mercury	g/m^3	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008
Dissolved Nickel	mg/kg	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved zinc	g/m^3	0.0034	0.0023	< 0.0010	0.0012	0.0020
Ethylene glycol	g/m^3	< 4	< 4	< 4	< 4	< 4
Propylene glycol	g/m^3	< 4	< 4	< 4	< 4	< 4

		Pre-fracturing	3 mth post fracturing	3 mth post fracturing	1 year post fracturing	1 year post fracturing
Sample date	Unit	01/12/2021	07/03/2022	27/06/2022	05/12/2022	12/04/2023
Sample time	-	8:50	10:45	12:25	11:40	10:25
Sample id. TRC	-	TRC214059	TRC225640	TRC226863	TRC229273	TRC2311827
Methanol	g/m ³	< 2	< 2	< 2	<2	<2
Benzene	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	<0.0010
Toluene	g/m ³	0.0028	< 0.0010	< 0.0010	<0.0010	<0.0010
Ethylbenzene	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	<0.0010
m-Xylene	g/m ³	< 0.002	< 0.002	< 0.002	< 0.002	<0.002
o-Xylene	g/m ³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	<0.0010
Formaldehyde	g/m ³	< 0.02	< 0.02	0.02	< 0.02	0.02
Ethane	g/m ³	< 0.003	< 0.003	< 0.003	< 0.003	<0.003
Ethylene	g/m ³	< 0.003	< 0.004	< 0.004	< 0.004	<0.004
Methane	g/m ³	5.3	4.2	6.5	1.02	5.4
C7-C9 hydrocarbons*	g/m ³	< 0.10	< 0.10	< 0.10	< 0.10	<0.10
C10-C14 hydrocarbons*	g/m ³	< 0.2	< 0.2	< 0.2	< 0.2	<0.2
C15-C36 hydrocarbons	g/m ³	< 0.4	< 0.4	<0.4	< 0.4	<0.4
Total hydrocarbons*	g/m ³	< 0.7	< 0.7	< 0.7	< 0.7	<0.7
δ13C value	‰ (-)	-72.9	-65.3	-78.4	-73.8	-83.1

Note* higher detection limits are a result of the matrix requiring dilution prior to analysis

2.2.2 Hydraulic fracturing and return fluids

The results of the analyses carried out on samples of the hydraulic fracturing fluid used in the treatment of the Kapuni-21, Kapuni-22, Kapuni-24 and Kapuni-23ST1 wells are shown below in Table 6 and Table 7. The results of the analyses carried out on the return fluid samples obtained following the hydraulic fracturing of the Kapuni-21, Kapuni-22, Kapuni-24 and Kapuni-23ST1 wells are summarised below in Table 8. The certificates of analysis are included in Appendix IV.

Table 6 Results of hydraulic fracturing fluid sampling GND3153 and GND3154

Parameter	Site code	GND3153			GND3154		
	Todd id.	Kapuni-21			Kapuni-22		
Sample id.	Unit	TRC2255400	TRC225401	TRC225402	TRC225405	TRC225403	TRC225404
Ethylene glycol	g/m ³	<4	<4	<4	<4	<4	<4
Propylene glycol	g/m ³	<4	<4	<4	<4	<4	<4
Methanol	g/m ³	<2	<2	<2	<2	<2	<2
Benzene	g/m ³	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Toluene	g/m ³	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Ethylbenzene	g/m ³	<0.0010	<0.010	<0.010	<0.010	<0.010	0.013
m-Xylene	g/m ³	<0.019	<0.02	<0.02	<0.019	<0.02	<0.02
o-Xylene	g/m ³	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
C7-C9 hydrocarbons	g/m ³	<0.8	<0.8	<0.8	<6	<0.8	1.2
C10-C14 hydrocarbons	g/m ³	165	165	280	2,400	48	1,130
C15-C36 hydrocarbons	g/m ³	97	43	144	370	66	230
Total hydrocarbons	g/m ³	770	210	420	2,800	114	1,360

Table 7 Results of hydraulic fracturing fluid sampling GND3155 and GND3156

Parameter	Site code	GND3155			GND3156
	Todd id.	Kapuni-23ST1			Kapuni-24
Sample id.	Unit	TRC226406	TRC226407	TRC226408	TRC226409
Ethylene glycol	g/m ³	31	<20	47	28
Propylene glycol	g/m ³	<20	<20	<20	<20
Methanol	g/m ³	230	460	163	210
Benzene	g/m ³	0.054	0.050	0.047	<0.0010
Toluene	g/m ³	0.280	0.28	0.22	0.0027
Ethylbenzene	g/m ³	0.023	0.023	0.0125	0.0031
m-Xylene	g/m ³	0.192	0.199	0.111	<0.002
o-Xylene	g/m ³	0.031	0.032	0.0177	<0.0010
C7-C9 hydrocarbons	g/m ³	0.7	0.9	0.5	0.51
C10-C14 hydrocarbons	g/m ³	104	73	96	250
C15-C36 hydrocarbons	g/m ³	46	49	46	67

Parameter	Site code	GND3155			GND3156
	Todd id.	Kapuni-23ST1			Kapuni-24
Total hydrocarbons	g/m ³	151	122	142	320

Table 8 Results of hydraulic fracturing return fluid sampling

Parameter	Site code	GND3153	GND3154	GND3155			GND3156
	Todd id.	KA-21	KA-22	KA-23ST1			KA-24
Sample id.	unit	TRC225406	TRC225407	TRC226410	TRC226411	TRC226412	TRC226413
pH	pH	8.6	8	7.9	1.9	8.0	8.0
Total alkalinity	g/m ³ CaCO ₃	-	10,600	7,000	11,300	10,600	10,700
Electrical conductivity	mS/m	14.93	2,330	2,000	2,040	2,170	1,948
Total suspended solids	g/m ³	<30	<50	16,300	16,800	20,000	15,800
Bromide	g/m ³	-	15.2	15	13	14	11
Chloride	g/m ³	11.2	2,900	3,600	2,800	2,200	2,700
Nitrite nitrogen	g/m ³ N	-	<0.010	0.016	0.123	0.031	<0.010
Nitrate nitrogen	g/m ³ N	-	0.052	0.038	<0.010	<0.010	<0.010
C7-C9 hydrocarbons	g/m ³	<0.15	6.9	540	3.4	28	1.79
C10-C14 hydrocarbons	g/m ³	<0.4	21	1,240	16.4	101	11.9
C15-C36 hydrocarbons	g/m ³	3.4	10	730	20	116	26
Total hydrocarbons	g/m ³	3.8	38	2,500	40	240	40

Note * Depending on the viscosity of the sample received at the laboratory, samples may require dilution prior to analysis which results in higher detection limit.

2.3 Surface water quality monitoring

The Council collected streambed macroinvertebrates from two sites in an unnamed tributary of the Inaha Stream to investigate the effects of discharges from the Kapuni-J wellsite on macroinvertebrate health. Macroinvertebrates were identified and the number of different types of taxa counted (taxa richness), and MCI and SQMCI scores were calculated for each site. The first survey was carried out on 24 November 2021, following drilling and prior to hydraulic fracturing. A further survey was carried out on 21 April 2022 following hydraulic fracturing. No pre-drill survey was able to be carried out due to a combination of unsuitable flow conditions and COVID lockdown.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of nutrient pollution in streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to pollution. The SQMCI takes into account taxa abundance as well as sensitivity to pollution and may reveal more subtle changes in communities. Significant differences in either the MCI or the SQMCI between sites indicate the degree of adverse effects (if any) of the discharges being monitored and enable the overall health of the macroinvertebrate communities to be determined.

The post-drill/pre-hydraulic fracturing (HF) survey recorded moderate taxa richness of 18 and 19 taxa at the two sites respectively, while the post-HF recorded moderately low richness of 14 taxa at both sites. MCI scores of 92 and 98 were recorded in the post-drill/pre-HF survey, while the post-HF survey recorded 109 and 89 at the two sites, which is a significant decline between the two sites. Between surveys, this shows a significant improvement between the two surveys at site 1, while the change was not significant at site 2. The elevated score at site 1 in this survey is largely due to the absence of several 'tolerant' taxa compared to the previous survey and the downstream site. SQMCI scores were 4.8 and 5.1 in the post-drill/pre-HF survey, and 5.2 and 4.8 in the post-HF survey. All recorded SQMCI scores were not significantly different from each other.

Overall, the three macroinvertebrate metrics did not provide any indication that stormwater discharges from the Kapuni-J wellsite during hydrocarbon exploration activities had caused any significant adverse effects on the macroinvertebrate communities of the unnamed tributary of the Inaha Stream.

2.4 Investigations, interventions, and incidents

The monitoring programme for the year was based on what was considered to be an appropriate level of monitoring, review of data, and liaison with Todd. 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.

The Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The incident register includes events where the consent holder 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).

During the period under review, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with Todd's conditions in resource consents or provisions in Regional Plans.

3. Discussion

3.1 Environmental effects of exercise of consents

Four wells, Kapuni-21, Kapuni-22, Kapuni-24 and Kapuni-23ST1, were stimulated by hydraulic fracturing at the Kapuni-J wellsite during the period 2 December 2021 to 30 March 2022.

The monitoring programme carried out by the Council in relation to the fracturing events undertaken included pre and post fracturing sampling at one groundwater monitoring site in the vicinity of Kapuni-J wellsite. The results of post fracturing groundwater sampling carried out generally showed only very minor variations in water composition in comparison to baseline results. The minor variations in analytes are a result of natural variations in water composition. Surface water monitoring surveys undertaken in relation to the wellsite during the hydraulic fracturing events showed minimal variation between pre-HF and post-HF surveys.

In summary, the monitoring carried out by the Council during the period being reported indicated that the hydraulic fracturing activities undertaken by Todd at the Kapuni-J wellsite has had no significant adverse effects on local groundwater or surface water resources.

3.2 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Table 9.

Table 9 Summary of performance for Consent 10736-1.0

Purpose: To discharge water based hydraulic fracturing fluids into land at depths greater than 3,000m true vertical depth subsea (TVDss) beneath the Kapuni-J wellsite		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Any discharge shall occur below 3,000m TVDss	Assessment of consent holder submitted data	Yes
2. No discharge shall occur after 1 June 2030	Assessment of consent holder submitted data	N/A
3. Monitoring and reporting of seismic events within 5 km of any discharge location	Notification and post fracturing report	Yes
4. Actions to be taken following the occurrence of any event described in condition 3	Notification under condition 3	N/A
5. Exercise of consent shall not result in any contaminants reaching any useable freshwater	Results of groundwater monitoring	Yes
6. Consent holder shall undertake sampling programme	Development and certification of a monitoring programme	Yes
7. If no suitable bores exist within 500m of the wellsite, a monitoring bore may need to be installed	Inspection of bores	Yes
8. Sampling programme shall follow recognised field procedures and be analysed for a specified range of chemical parameters	Development and certification of a monitoring programme and assessment of results	Yes
9. All sampling to be carried out in accordance with a certified Sampling and Analysis Plan	Development and certification of a Sampling and Analysis Plan	Yes

Purpose: To discharge water based hydraulic fracturing fluids into land at depths greater than 3,000m true vertical depth subsea (TVDss) beneath the Kapuni-J wellsite		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
10. Well and equipment pressure testing to be carried out prior to any hydraulic fracturing programme commencing	Assessment of consent holder submitted data	Yes
11. A pre-fracturing discharge report is to be provided to the Council 14 days prior to discharge	Pre-fracturing discharge report received	Yes
12. Consent holder shall notify the Council of hydraulic fracturing discharge	Notification received	Yes
13. A post fracturing discharge report is to be provided to the Council within 90 days of any commencement	Post fracturing discharge report received	Yes
14. For programs including multiple hydraulic fracturing discharges, more than one 'Post-fracturing discharge report' may be required	Reports received via email	Yes
15. The reports outlined in conditions 11 and 13 must be emailed to consents@trc.govt.nz	Report received by email	Yes
16. The consent holder shall provide access to a location where samples of hydraulic fracturing fluids and return fluids can be obtained by the Council officers	Access provided	Yes
17. Consent holder to adopt best practicable option at all times	Site inspections, sampling and assessment of consent holder submitted data	Yes
18. No hydrocarbon based hydraulic fracturing fluid shall be discharged	Assessment of consent holder submitted data and sampling of fracturing fluid	Yes
19. Lapse clause	Receive notice of exercise of consent	Yes
20. Review condition	N/A	N/A
Overall assessment of environmental performance and compliance in respect of this consent		High
Overall assessment of administrative performance and compliance in respect of this consent		High

N/A = not applicable

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

3.3 Alterations to monitoring programmes of future hydraulic fracturing events

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 the range of monitoring carried out in relation to the hydraulic fracturing activities undertaken by Todd be replicated for any future fracturing events at the Kapuni-J wellsite.

Recommendations to this effect are included in Section 4 of this report.

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 future monitoring periods.

3.4 Exercise of optional review of consent

Resource Consent 10736-1 provides for an optional review of the consent in June 2024. Condition 20 allows the Council to review the consent, for the purpose of:

- a. ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this 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; and/or
- b. further specifying the best practicable option as required by condition 20; and/or
- c. ensuring hydraulic fracturing operations appropriately take into account any best practice guidance published by a recognised industry association or environmental regulator.

Based on the results of monitoring in the year under review, 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 in the first instance, the range of monitoring carried out during the reporting period in relation to Todd's hydraulic fracturing activities be replicated for any future fracturing events at the Kapuni-J wellsite.
2. THAT should there be issues with environmental or administrative performance in future periods, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.
3. THAT the option for a review of resource consents in June 2024, as set out in condition 20 of the consent not be exercised.

Glossary of common terms and abbreviations

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

Biomonitoring	Assessing the health of the environment using aquatic organisms.
bbls	Barrel. Unit of measure used in the oil and gas industry (equivalent to approximately 159L).
Conductivity	An indication of the level of dissolved salts in a sample, usually measured at 25°C and expressed in $\mu\text{S}/\text{cm}$.
DO	Dissolved oxygen.
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.
EPT	Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) which are macroinvertebrates sensitive to pollution.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
g/m^3	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish the circumstances/events surrounding an incident including any allegations of an incident.
L/s	Litres per second.
Macroinvertebrate	An invertebrate that is large enough to be seen without the use of a microscope.
masl	Metres above sea level.
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.
m^3	Cubic metre (1,000 L).
NZTM	New Zealand Transverse Mercator coordinates.
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.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	Resource Management Act 1991 and including all subsequent amendments.

Screen Out	A condition that occurs when the solids carried in a treatment fluid, such as proppant in a fracture fluid, create a bridge across the perforations or similar restricted flow area. This creates a sudden and significant restriction to fluid flow that causes a rapid rise in pump pressure.
SQMCI	Semi quantitative macroinvertebrate community index.
TVDss	True vertical depth sub-sea.
µS/cm	Microsiemens per centimetre.
Workover	The repair or stimulation of an existing production well for the purpose of restoring, prolonging or enhancing the production of hydrocarbons.

For further information on analytical methods, contact an Environment Quality Manager.

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Todd Energy Ltd (2022) Hydraulic fracturing - Todd Kapuni-J wellsite Post fracturing Discharge Report Kapuni-21. March 2022. Frodo number #3013955.

Todd Energy Ltd (2022) Hydraulic fracturing - Todd Kapuni-J wellsite Post fracturing Discharge Report Kapuni-22. March 2022. Frodo number #3013954.

Todd Energy Ltd (2022) Hydraulic fracturing - Todd Kapuni-J wellsite Post fracturing Discharge Report Kapuni-23ST1. May 2022. Frodo number #3072459.

Todd Energy Ltd (2022) Hydraulic fracturing - Todd Kapuni-J wellsite Pre-fracturing Discharge Report Kapuni-24. May 2022. Frodo number #3072461.

Appendix I

Resource consents held by Todd Petroleum Ltd

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

Water abstraction permits

Section 14 of the RMA stipulates that no person may take, use, dam or divert any water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or it falls within some particular categories set out in Section 14. Permits authorising the abstraction of water are issued by the Council under Section 87(d) of the RMA.

Water discharge permits

Section 15(1)(a) of the RMA stipulates that no person may discharge any contaminant into water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or by national regulations. Permits authorising discharges to water are issued by the Council under Section 87(e) of the RMA.

Air discharge permits

Section 15(1)(c) of the RMA stipulates that no person may discharge any contaminant from any industrial or trade premises into air, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Permits authorising discharges to air are issued by the Council under Section 87(e) of the RMA.

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.

Land use permits

Section 13(1)(a) of the RMA stipulates that no person may in relation to the bed of any lake or river use, erect, reconstruct, place, alter, extend, remove, or demolish any structure or part of any structure in, on, under, or over the bed, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Land use permits are issued by the Council under Section 87(a) of the RMA.

Coastal permits

Section 12(1)(b) of the RMA stipulates that no person may erect, reconstruct, place, alter, extend, remove, or demolish any structure that is fixed in, on, under, or over any foreshore or seabed, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Coastal permits are issued by the Council under Section 87(c) 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: Todd Petroleum Mining Company Limited
PO Box 802
New Plymouth 4340

Decision Date 4 July 2019

Commencement Date 4 July 2019

Conditions of Consent

Consent Granted: To discharge water-based hydraulic fracturing fluids into land at depths greater than 3,000 mTVDss beneath the Kapuni-J wellsite

Expiry Date: 1 June 2035

Review Date(s): June annually and in accordance with special condition 20

Site Location: Kapuni-J wellsite, 632 Palmer Road, Kaponga

Grid Reference (NZTM) 1701720E-5632955N

Catchment: Inaha

*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. The discharge point shall be deeper than 3,000 mTVDss.

Note: mTVDss = metres true vertical depth subsea, i.e. the true vertical depth in metres below mean sea level

2. There shall be no discharge of hydraulic fracturing fluids after 1 June 2030.
3. If the GeoNet seismic monitoring network records a seismic event higher than a Modified Mercalli intensity of magnitude 3 within 5 km of the geographical position (in 3 dimensions) of any hydraulic fracturing discharge, then:
 - (a) if a hydraulic fracturing discharge is currently being undertaken it shall cease immediately and not recommence; or
 - (b) if a hydraulic fracturing discharge has occurred within the previous 72 hours no further hydraulic fracturing discharges shall occur.
4. Following the occurrence of any seismic event described in special condition 3 the consent holder shall immediately notify the Chief Executive, Taranaki Regional Council and investigate and report on the likelihood of the seismic event being induced by the exercise of this consent. Hydraulic fracturing discharges may only then continue once the Chief Executive, Taranaki Regional Council has considered the report and concluded that the environmental risk of recommencing hydraulic fracturing is acceptable and has advised the consent holder accordingly.
5. The consent holder shall ensure that the exercise of this consent does not result in contaminants reaching any useable fresh water (groundwater or surface water). Usable fresh groundwater is defined as any groundwater having a Total Dissolved Solids concentration of less than 1,000 mg/l.
6. The consent holder shall undertake a programme of sampling and testing that monitors the effects of the exercise of this consent on fresh water resources to assess compliance with condition 5 (the 'Monitoring Programme'). The Monitoring Programme shall be certified by the Chief Executive, Taranaki Regional Council ('the Chief Executive'), before this consent is exercised, and shall include:
 - (a) the location of the discharge point(s);
 - (b) the location of sampling sites; and
 - (c) sampling frequency with reference to a hydraulic fracturing programme.

7. Representative groundwater sampling is required to be undertaken at a minimum of one suitable site within 500 metres of the wellsite. If no suitable groundwater monitoring sites can be identified it will be necessary to install at least one monitoring bore of a depth, location and design determined after consultation with the Chief Executive, Taranaki Regional Council and installed in accordance with NZS 4411:2001.
8. All water samples taken for monitoring purposes shall be taken in accordance with recognised field procedures and analysed for:
 - (a) pH;
 - (b) conductivity;
 - (c) total dissolved solids;
 - (d) major ions (Ca, Mg, K, Na, total alkalinity, bromide, chloride, nitrate-nitrogen, and sulphate);
 - (e) trace metals (barium, copper, iron, manganese, nickel, and zinc);
 - (f) total petroleum hydrocarbons;
 - (g) formaldehyde;
 - (h) dissolved methane and ethane gas;
 - (i) methanol;
 - (j) glycols;
 - (k) benzene, toluene, ethylbenzene, and xylenes (BTEX); and
 - (l) carbon-13 composition of any dissolved methane gas discovered ($^{13}\text{C-CH}_4$).

Note: The samples required, under conditions of this consent could be taken and analysed by the Taranaki Regional Council or other contracted party on behalf of the consent holder.

9. All sampling and analysis shall be undertaken in accordance with a *Sampling and Analysis Plan*, which shall be submitted to the Chief Executive, Taranaki Regional Council for review and certification before the first sampling is undertaken. The plan shall specify the use of standard protocols recognised to constitute good professional practice including quality control and assurance. An International Accreditation New Zealand (IANZ) accredited laboratory shall be used for all sample analysis. Results shall be provided to the Chief Executive within 30 days of sampling and shall include supporting quality control and assurance information. These results will be used to assess compliance with condition 5.

Note: The Sampling and Analysis Plan may be combined with the Monitoring Programme required by condition 6.

10. The consent holder shall undertake well and equipment pressure testing prior to any hydraulic fracture programme on a given well to ensure any discharge will not affect the integrity of the well and hydraulic fracturing equipment.

11. Any hydraulic fracture discharge shall only occur after the consent holder has provided a comprehensive 'Pre-fracturing Discharge Report' to the Chief Executive, Taranaki Regional Council. The report shall be provided at least 14 days before the discharge is proposed to commence and shall detail the hydraulic fracturing programme proposed, including as a minimum:
- (a) the specific well in which each discharge is to occur, the intended fracture interval(s) ('fracture interval' is the discrete subsurface zone to receive a hydraulic fracture treatment), and the duration of the hydraulic fracturing programme;
 - (b) the number of discharges proposed and the geographical position (i.e. depth and lateral position) of each intended discharge point;
 - (c) the total volume of fracture fluid planned to be pumped down the well, including mini-fracture treatments, and their intended composition, including a list of all contaminants and Material Safety Data Sheets for all the chemicals to be used;
 - (d) the monitoring techniques to be used to determine the fate of discharged material;
 - (e) the results of the reviews required by condition 17;
 - (f) results of modelling showing an assessment of the likely extent and dimensions of the fractures that will be generated by the discharge;
 - (g) the preventative and mitigation measures to be in place to ensure the discharge does not cause adverse environmental effects and complies with condition 5;
 - (h) the extent and permeability characteristics of the geology above the discharge point to the surface;
 - (i) an annotated seismic profile showing the locations of any identified faults (active or inactive) within 2 km of the injection location, and a discussion regarding the potential for adverse environmental effects due to the presence of any identified faults;
 - (j) an assessment of the integrity of the well;
 - (k) the burst pressure of the well casing and the anticipated maximum well and discharge pressures and the duration of the pressures;
 - (l) details of the disposal of any returned fluids, including any consents that are relied on to authorise the disposal; and
 - (m) details why the contaminants in the discharge and the monitoring techniques used comply with condition 17.

Note; If seismic data is not available within 2 km of the subsurface discharge location the pre-fracturing report should include a seismic profile to the distance that data is available and a map showing any identified faults within the modelled fracture length plus a margin of 50%.

Note: For further information regarding the level of detail required to adequately comply with the requirements of the pre-fracturing report contact Taranaki Regional Council.

12. The consent holder shall notify the Taranaki Regional Council of the date that each discharge is intended to commence by emailing worknotification@trc.govt.nz unless the Chief Executive, Taranaki Regional Council advises that an alternative electronic method of service is required. Notification also shall identify the 'Pre-fracturing Discharge Report', required by condition 11, which details the discharge and be given no less than 3 days before the intended discharge date. If any discharge occurs more than 30 days after the notification date, additional notification as specified in this condition is required.

Note; For clarification the notification date is the date that the Chief Executive, Taranaki Regional Council received notification in accordance with this condition, not the intended discharge date.

13. Subject to condition 14, within 90 days of any commencement date as advised under condition 12, the consent holder shall submit a comprehensive 'Post-fracturing Discharge Report' to the Chief Executive, Taranaki Regional Council. The report shall, as a minimum, contain:
- (a) date and time of discharge;
 - (b) confirmation of the interval(s) where fracturing occurred for that programme, and the geographical position (i.e., depth and lateral position) of the discharge point for each fracture interval;
 - (c) the contaminant volumes and composition of fluid discharged into each fracture interval;
 - (d) the volume of return fluids from each fracture interval;
 - (e) an analysis for the constituents set out in conditions 8(a) to 8(k), in a return fluid sample taken within the first two hours of flow back, for each fracture interval if flowed back individually, or for the well if flowed back with all intervals comingled;
 - (f) an estimate of the volume of fluids (and proppant) remaining underground;
 - (g) the volume of water produced with the hydrocarbons (produced water) over the period beginning at the start of the hydraulic fracturing programme and ending 30 days after the programme is completed or after that period of production;
 - (h) an assessment of the extent and dimensions of the fractures that were generated by the discharge, based on modelling undertaken after the discharge has occurred and other diagnostic techniques, including production analysis, available to determine fracture length, height and containment;
 - (i) The results of the seismic monitoring required by condition 3;
 - (j) the results of pressure testing required by condition 10 and the top-hole pressure (psi), slurry rate (bpm), surface proppant concentration (lb/gal), bottom hole proppant concentration (lb/gal), and calculated bottom hole pressure (psi), as well as predicted values for each of these parameters; prior to, during and after each hydraulic fracture treatment;
 - (k) details of the disposal of any returned fluids, including any consents that are relied on to authorise the disposal;
 - (l) details of any incidents where hydraulic fracture fluid is unable to pass through the well perforations (screen outs) that occurred, their likely cause and implications for compliance with conditions 1 and 5;
 - (m) results of the monitoring referred to in condition 11(d); and
 - (n) an assessment of the effectiveness of the mitigation measures in place with specific reference to those described in the application for this consent.

Note: Further information regarding the level of detail required to adequately comply with the requirements of the post-fracturing report can be found on the Taranaki Regional Council website.

14. For programs including multiple hydraulic fracturing discharges, more than one 'Post-fracturing discharge report' may be required in order to meet the specified 90-day deadline from each commencement date. In these situations the consent holder shall submit a subsequent 'Post-fracturing Discharge Report' to the Chief Executive within 90 days of the previous report submitted.
15. The reports described in conditions 11 and 13 shall be emailed to consents@trc.govt.nz with a reference to the number of this consent, unless the Chief Executive, Taranaki Regional Council advises that an alternative electronic method of service is required.

Consent 10736-1.0

16. The consent holder shall provide access to a location where the Taranaki Regional Council officers can obtain a sample of the hydraulic fracturing fluids and the return fluids.
17. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimize any actual or likely adverse effect of the activity on the environment by, as a minimum, ensuring that:
 - (a) the discharge is contained within the fracture interval;
 - (b) regular reviews of monitoring techniques used to ensure the discharge does not cause adverse environmental effects are undertaken;
 - (c) regular reviews are undertaken of the preventative and mitigation measures adopted to ensure the discharge does not cause adverse environmental effects; and
 - (d) regular reviews of the chemicals used are undertaken with a view to reducing the toxicity of the chemicals used.
18. The fracture fluid shall be comprised of no less than 95% water, nitrogen and proppant by volume.
19. This consent shall lapse on 30 September 2024, 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.
20. The Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review:
 - a) during the month of June each year, and/or
 - b) within 30 days of receiving any notification and/or report in accordance with special condition 4 above;for the purposes of:
 - (a) ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this 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; and/or
 - (b) further specifying the best practicable option as required by condition 17; and/or
 - (c) ensuring hydraulic fracturing operations appropriately take into account any best practice guidance published by a recognised industry association or environmental regulator.

Signed at Stratford on 4 July 2019

For and on behalf of
Taranaki Regional Council

A D McLay
Director - Resource Management

Appendix II

Categories used to evaluate environmental and administrative performance

Categories used to evaluate 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 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.

Appendix III

Certificates of analysis (groundwater)



Certificate of Analysis

Page 1 of 4

Client:	Taranaki Regional Council	Lab No:	2909011	SPv1
Contact:	Jane Harvey	Date Received:	09-Mar-2022	
	C/- Taranaki Regional Council	Date Reported:	17-Mar-2022	
	Private Bag 713	Quote No:	47915	
	Stratford 4352	Order No:	4500002828	
		Client Reference:	#7447 - Todd Kapuni-J 3 month PF/Pre-frac GW March 2022	
		Submitted By:	Angela Collins	

Sample Type: Aqueous

Sample Name:	TRC225640 (GND3102) 07-Mar-2022 10:45 am				
Lab Number:	2909011.1				
Individual Tests					
Sum of Anions	meq/L	2.5 #1	-	-	-
Sum of Cations	meq/L	3.1 #1	-	-	-
pH	pH Units	6.9	-	-	-
Total Alkalinity	g/m ³ as CaCO ₃	74	-	-	-
Bicarbonate	g/m ³ at 25°C	90	-	-	-
Total Hardness	g/m ³ as CaCO ₃	48	-	-	-
Electrical Conductivity (EC)	mS/m	27.2	-	-	-
Total Dissolved Solids (TDS)	g/m ³	230	-	-	-
Sample Temperature*†	°C	15.7	-	-	-
Dissolved Barium	g/m ³	0.034	-	-	-
Dissolved Calcium	g/m ³	9.6	-	-	-
Dissolved Copper	g/m ³	< 0.0005	-	-	-
Dissolved Iron	g/m ³	17.9	-	-	-
Dissolved Magnesium	g/m ³	6.0	-	-	-
Dissolved Manganese	g/m ³	0.57	-	-	-
Dissolved Mercury	g/m ³	< 0.00008	-	-	-
Dissolved Nickel	g/m ³	< 0.0005	-	-	-
Dissolved Potassium	g/m ³	10.6	-	-	-
Dissolved Sodium	g/m ³	28	-	-	-
Dissolved Zinc	g/m ³	0.0023	-	-	-
Bromide	g/m ³	0.11	-	-	-
Chloride	g/m ³	36	-	-	-
Nitrite-N	g/m ³	0.016	-	-	-
Nitrate-N	g/m ³	0.003	-	-	-
Nitrate-N + Nitrite-N	g/m ³	0.019	-	-	-
Sulphate	g/m ³	2.4	-	-	-
Ethylene Glycol in Water*					
Ethylene glycol*	g/m ³	< 4	-	-	-
Propylene Glycol in Water*					
Propylene glycol*	g/m ³	< 4	-	-	-
Methanol in Water - Aqueous Solvents*					
Methanol*	g/m ³	< 2	-	-	-



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Sample Type: Aqueous						
Sample Name:		TRC225640 (GND3102) 07-Mar-2022 10:45 am				
Lab Number:		2909011.1				
BTEX in Water by Headspace GC-MS						
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	-	-	-	-
Formaldehyde in Water by DNPH & LCMSMS						
Formaldehyde	g/m ³	< 0.02	-	-	-	-
Gases in groundwater						
Ethane	g/m ³	< 0.003	-	-	-	-
Ethylene	g/m ³	< 0.004	-	-	-	-
Methane	g/m ³	4.2	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.10	-	-	-	-
C10 - C14	g/m ³	< 0.2	-	-	-	-
C15 - C36	g/m ³	< 0.4	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	-	-	-	-

Analyst's Comments

† Customer supplied data. Please note: Hill Laboratories cannot be held responsible for the validity of this customer supplied data, or any subsequent calculations that rely on this information.

#1 It was noted that some of the anion / cation balances did not agree to within expected limits. This was largely attributed to the high levels of dissolved iron. We have included dissolved iron in the cation balance equations. However, the precipitation of large amounts of iron in the unpreserved containers (soon after sampling) will result in the loss of ions from solution and consumption of alkalinity. This may well result in the lower anions relative to the cations, being reported. The loss of soluble iron in the unpreserved container does not affect the cation balance, as the dissolved iron is sampled into an acid preserved container, stabilising the iron in solution.

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 simple 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. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total anions for anion/cation balance check	Calculation: sum of anions as mEq/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N. Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E 23 rd ed. 2017.	0.07 meq/L	1
Total cations for anion/cation balance check	Sum of cations as mEq/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H ⁺) also included in calculation if available. APHA 1030 E 23 rd ed. 2017.	0.05 meq/L	1
pH	pH meter. APHA 4500-H ⁺ B 23 rd ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) 23 rd ed. 2017.	1.0 g/m ³ as CaCO ₃	1
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO ₂ D 23 rd ed. 2017.	1.0 g/m ³ at 25°C	1
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 23 rd ed. 2017.	1.0 g/m ³ as CaCO ₃	1

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 23 rd ed. 2017.	0.1 mS/m	1
Total Dissolved Solids (TDS)	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 23 rd ed. 2017.	10 g/m ³	1
Sample Temperature*	Temperature of the sample at the time of sampling, supplied by customer.	0.1 °C	1
Dissolved Barium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.005 g/m ³	1
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.05 g/m ³	1
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0005 g/m ³	1
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.02 g/m ³	1
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.02 g/m ³	1
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0005 g/m ³	1
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m ³	1
Dissolved Nickel	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0005 g/m ³	1
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.05 g/m ³	1
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.02 g/m ³	1
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0010 g/m ³	1
Bromide	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.05 g/m ³	1
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.5 g/m ³	1
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) 23 rd ed. 2017.	0.002 g/m ³	1
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO ₂ N. In-House.	0.0010 g/m ³	1
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) 23 rd ed. 2017.	0.002 g/m ³	1
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.5 g/m ³	1
Ethylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m ³	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m ³	1
Methanol in Water - Aqueous Solvents*	GC-FID analysis. In-house.	1.0 g/m ³	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis. In-house based on US EPA 8260 and 5021.	0.0010 - 0.002 g/m ³	1
Formaldehyde in Water by DNPH & LCMSMS	Derivatisation, SPE extraction, LC-MS/MS analysis. In-house based on US EPA 8315A.	0.02 g/m ³	1
Gases in groundwater	Headspace GC-FID analysis. In-house.	0.002 - 0.003 g/m ³	1
Total Petroleum Hydrocarbons in Water			
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.10 g/m ³	1
C10 - C14	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m ³	1
C15 - C36	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m ³	1
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	0.7 g/m ³	1

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

Testing was completed between 10-Mar-2022 and 17-Mar-2022. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

A handwritten signature in blue ink, appearing to be 'Ara Heron', consisting of several overlapping loops and a long horizontal stroke extending to the right.

Ara Heron BSc (Tech)
Client Services Manager - Environmental



Certificate of Analysis

Page 1 of 3

Client:	Taranaki Regional Council	Lab No:	2786248	SPv1
Contact:	Jane Harvey	Date Received:	02-Dec-2021	
	C/- Taranaki Regional Council	Date Reported:	08-Dec-2021	
	Private Bag 713	Quote No:	47915	
	Stratford 4352	Order No:	4500002828	
		Client Reference:	#7220 - Todd Kapuni-J Pre Frac GW December 21	
		Submitted By:	Sarah Larkin	

Sample Type: Aqueous

Sample Name:	TRC214059 (GND3102) 01-Dec-2021 8:50 am				
Lab Number:	2786248.1				
Individual Tests					
Sum of Anions	meq/L	2.3	-	-	-
Sum of Cations	meq/L	2.8	-	-	-
pH	pH Units	7.5	-	-	-
Total Alkalinity	g/m ³ as CaCO ₃	85	-	-	-
Bicarbonate	g/m ³ at 25°C	103	-	-	-
Total Hardness	g/m ³ as CaCO ₃	40	-	-	-
Electrical Conductivity (EC)	mS/m	23.3	-	-	-
Total Dissolved Solids (TDS)	g/m ³	210	-	-	-
Sample Temperature*†	°C	14.7	-	-	-
Dissolved Barium	g/m ³	0.034	-	-	-
Dissolved Calcium	g/m ³	8.5	-	-	-
Dissolved Copper	g/m ³	< 0.0005	-	-	-
Dissolved Iron	g/m ³	17.1	-	-	-
Dissolved Magnesium	g/m ³	4.6	-	-	-
Dissolved Manganese	g/m ³	0.56	-	-	-
Dissolved Mercury	g/m ³	< 0.00008	-	-	-
Dissolved Nickel	g/m ³	0.0005	-	-	-
Dissolved Potassium	g/m ³	10.6	-	-	-
Dissolved Sodium	g/m ³	26	-	-	-
Dissolved Zinc	g/m ³	0.0034	-	-	-
Bromide	g/m ³	0.09	-	-	-
Chloride	g/m ³	22	-	-	-
Nitrite-N	g/m ³	0.008	-	-	-
Nitrate-N	g/m ³	< 0.002	-	-	-
Nitrate-N + Nitrite-N	g/m ³	0.010	-	-	-
Sulphate	g/m ³	0.7	-	-	-
Ethylene Glycol in Water*					
Ethylene glycol*	g/m ³	< 4	-	-	-
Propylene Glycol in Water*					
Propylene glycol*	g/m ³	< 4	-	-	-
Methanol in Water - Aqueous Solvents*					
Methanol*	g/m ³	< 2	-	-	-



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Sample Type: Aqueous						
Sample Name:		TRC214059 (GND3102) 01-Dec-2021 8:50 am				
Lab Number:		2786248.1				
BTEX in Water by Headspace GC-MS						
Benzene	g/m ³	< 0.0010	-	-	-	-
Toluene	g/m ³	0.0028	-	-	-	-
Ethylbenzene	g/m ³	< 0.0010	-	-	-	-
m&p-Xylene	g/m ³	< 0.002	-	-	-	-
o-Xylene	g/m ³	< 0.0010	-	-	-	-
Formaldehyde in Water by DNPH & LCMSMS						
Formaldehyde	g/m ³	< 0.02	-	-	-	-
Gases in groundwater						
Ethane	g/m ³	< 0.003	-	-	-	-
Ethylene	g/m ³	< 0.003	-	-	-	-
Methane	g/m ³	5.3	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.10	-	-	-	-
C10 - C14	g/m ³	< 0.2	-	-	-	-
C15 - C36	g/m ³	< 0.4	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	-	-	-	-

Analyst's Comments

† Customer supplied data. Please note: Hill Laboratories cannot be held responsible for the validity of this customer supplied data, or any subsequent calculations that rely on this information.

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 simple 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. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total anions for anion/cation balance check	Calculation: sum of anions as mEq/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N. Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E 23 rd ed. 2017.	0.07 meq/L	1
Total cations for anion/cation balance check	Sum of cations as mEq/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H ⁺) also included in calculation if available. APHA 1030 E 23 rd ed. 2017.	0.05 meq/L	1
pH	pH meter. APHA 4500-H ⁺ B 23 rd ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) 23 rd ed. 2017.	1.0 g/m ³ as CaCO ₃	1
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO ₂ D 23 rd ed. 2017.	1.0 g/m ³ at 25°C	1
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 23 rd ed. 2017.	1.0 g/m ³ as CaCO ₃	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 23 rd ed. 2017.	0.1 mS/m	1
Total Dissolved Solids (TDS)	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 23 rd ed. 2017.	10 g/m ³	1
Sample Temperature*	Temperature of the sample at the time of sampling, supplied by customer.	0.1 °C	1

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Dissolved Barium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.005 g/m ³	1
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.05 g/m ³	1
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0005 g/m ³	1
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.02 g/m ³	1
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.02 g/m ³	1
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0005 g/m ³	1
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m ³	1
Dissolved Nickel	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0005 g/m ³	1
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.05 g/m ³	1
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.02 g/m ³	1
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0010 g/m ³	1
Bromide	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.05 g/m ³	1
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.5 g/m ³	1
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) 23 rd ed. 2017.	0.002 g/m ³	1
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO ₂ N. In-House.	0.0010 g/m ³	1
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) 23 rd ed. 2017.	0.002 g/m ³	1
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.5 g/m ³	1
Ethylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m ³	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m ³	1
Methanol in Water - Aqueous Solvents*	GC-FID analysis. In-house.	1.0 g/m ³	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis. In-house based on US EPA 8260 and 5021.	0.0010 - 0.002 g/m ³	1
Formaldehyde in Water by DNPH & LCMSMS	Derivatisation, SPE extraction, LC-MS/MS analysis. In-house based on US EPA 8315A.	0.02 g/m ³	1
Gases in groundwater	Headspace GC-FID analysis. In-house.	0.002 - 0.003 g/m ³	1
Total Petroleum Hydrocarbons in Water			
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.10 g/m ³	1
C10 - C14	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m ³	1
C15 - C36	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m ³	1
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	0.7 g/m ³	1

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

Testing was completed between 02-Dec-2021 and 08-Dec-2021. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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Martin Cowell - BSc
Client Services Manager - Environmental



Certificate of Analysis

Page 1 of 3

Client:	Taranaki Regional Council	Lab No:	3021726	SPv1
Contact:	Jane Harvey	Date Received:	28-Jun-2022	
	C/- Taranaki Regional Council	Date Reported:	05-Jul-2022	
	Private Bag 713	Quote No:	47915	
	Stratford 4352	Order No:	4500002828	
		Client Reference:	#7648 - Kapuni-J HF Monitoring - June 2022	
		Submitted By:	Angela Collins	

Sample Type: Aqueous

Sample Name:	TRC226863 (GND3102) 27-Jun-2022 12:25 pm				
Lab Number:	3021726.1				
Individual Tests					
Sum of Anions	meq/L	2.4	-	-	-
Sum of Cations	meq/L	3.0	-	-	-
pH	pH Units	6.9	-	-	-
Total Alkalinity	g/m ³ as CaCO ₃	89	-	-	-
Bicarbonate	g/m ³ at 25°C	108	-	-	-
Total Hardness	g/m ³ as CaCO ₃	39	-	-	-
Electrical Conductivity (EC)	mS/m	23.9	-	-	-
Total Dissolved Solids (TDS)	g/m ³	200	-	-	-
Sample Temperature*†	°C	13.5	-	-	-
Dissolved Barium	g/m ³	0.031	-	-	-
Dissolved Calcium	g/m ³	7.7	-	-	-
Dissolved Copper	g/m ³	< 0.0005	-	-	-
Dissolved Iron	g/m ³	19.1	-	-	-
Dissolved Magnesium	g/m ³	4.9	-	-	-
Dissolved Manganese	g/m ³	0.56	-	-	-
Dissolved Mercury	g/m ³	< 0.00008	-	-	-
Dissolved Nickel	g/m ³	< 0.0005	-	-	-
Dissolved Potassium	g/m ³	10.8	-	-	-
Dissolved Sodium	g/m ³	28	-	-	-
Dissolved Zinc	g/m ³	< 0.0010	-	-	-
Bromide	g/m ³	0.08	-	-	-
Chloride	g/m ³	21	-	-	-
Nitrite-N	g/m ³	< 0.02	-	-	-
Nitrate-N	g/m ³	< 0.02	-	-	-
Nitrate-N + Nitrite-N	g/m ³	0.02	-	-	-
Sulphate	g/m ³	< 0.5	-	-	-
Ethylene Glycol in Water*					
Ethylene glycol*	g/m ³	< 4	-	-	-
Propylene Glycol in Water*					
Propylene glycol*	g/m ³	< 4	-	-	-
Methanol in Water - Aqueous Solvents*					
Methanol*	g/m ³	< 2	-	-	-



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Sample Type: Aqueous						
Sample Name:		TRC226863 (GND3102) 27-Jun-2022 12:25 pm				
Lab Number:		3021726.1				
BTEX in Water by Headspace GC-MS						
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	-	-	-	-
Formaldehyde in Water by DNPH & LCMSMS						
Formaldehyde	g/m ³	0.02	-	-	-	-
Gases in groundwater						
Ethane	g/m ³	< 0.003	-	-	-	-
Ethylene	g/m ³	< 0.004	-	-	-	-
Methane	g/m ³	6.5	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m ³	< 0.10	-	-	-	-
C10 - C14	g/m ³	< 0.2	-	-	-	-
C15 - C36	g/m ³	< 0.4	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m ³	< 0.7	-	-	-	-

Analyst's Comments

† Customer supplied data. Please note: Hill Laboratories cannot be held responsible for the validity of this customer supplied data, or any subsequent calculations that rely on this information.

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 simple 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. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total anions for anion/cation balance check	Calculation: sum of anions as mEq/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N. Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E 23 rd ed. 2017.	0.07 meq/L	1
Total cations for anion/cation balance check	Sum of cations as mEq/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H ⁺) also included in calculation if available. APHA 1030 E 23 rd ed. 2017.	0.05 meq/L	1
pH	pH meter. APHA 4500-H ⁺ B 23 rd ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) 23 rd ed. 2017.	1.0 g/m ³ as CaCO ₃	1
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO ₂ D 23 rd ed. 2017.	1.0 g/m ³ at 25°C	1
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 23 rd ed. 2017.	1.0 g/m ³ as CaCO ₃	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 23 rd ed. 2017.	0.1 mS/m	1
Total Dissolved Solids (TDS)	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 23 rd ed. 2017.	10 g/m ³	1
Sample Temperature*	Temperature of the sample at the time of sampling, supplied by customer.	0.1 °C	1

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Dissolved Barium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.005 g/m ³	1
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.05 g/m ³	1
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0005 g/m ³	1
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.02 g/m ³	1
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.02 g/m ³	1
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0005 g/m ³	1
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m ³	1
Dissolved Nickel	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0005 g/m ³	1
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.05 g/m ³	1
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.02 g/m ³	1
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0010 g/m ³	1
Bromide	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.05 g/m ³	1
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.5 g/m ³	1
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) 23 rd ed. 2017.	0.002 g/m ³	1
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO ₂ N. In-House.	0.0010 g/m ³	1
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) 23 rd ed. 2017.	0.002 g/m ³	1
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.5 g/m ³	1
Ethylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m ³	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m ³	1
Methanol in Water - Aqueous Solvents*	GC-FID analysis. In-house.	1.0 g/m ³	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis. In-house based on US EPA 8260 and 5021.	0.0010 - 0.002 g/m ³	1
Formaldehyde in Water by DNPH & LCMSMS	Derivatisation, SPE extraction, LC-MS/MS analysis. In-house based on US EPA 8315A.	0.02 g/m ³	1
Gases in groundwater	Headspace GC-FID analysis. In-house.	0.002 - 0.003 g/m ³	1
Total Petroleum Hydrocarbons in Water			
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.10 g/m ³	1
C10 - C14	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m ³	1
C15 - C36	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m ³	1
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	0.7 g/m ³	1

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

Testing was completed between 29-Jun-2022 and 05-Jul-2022. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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Martin Cowell - BSc
Client Services Manager - Environmental



Certificate of Analysis

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Client:	Taranaki Regional Council	Lab No:	3130385	SPV1
Contact:	Jane Harvey	Date Received:	06-Dec-2022	
	C/- Taranaki Regional Council	Date Reported:	13-Dec-2022	
	Private Bag 713	Quote No:	47915	
	Stratford 4352	Order No:	4500002828	
		Client Reference:	#8092 - Todd Kapuni-J 1 yr PF GW Dec 22	
		Submitted By:	Angela Collins	

Sample Type: Aqueous

Sample Name:		TRC229273 (GND3102) 01-Dec-2022 11:40 am	
Lab Number:		3130385.1	
Individual Tests			
Sum of Anions	meq/L	3.0	
Sum of Cations	meq/L	3.2	
pH	pH Units	7.0	
Total Alkalinity	g/m³ as CaCO₃	82	
Bicarbonate	g/m³ at 25°C	100	
Total Hardness	g/m³ as CaCO₃	73	
Electrical Conductivity (EC)	mS/m	32.6	
Total Dissolved Solids (TDS)	g/m³	230	
Sample Temperature*†	°C	14.7	
Dissolved Barium	g/m³	0.034	
Dissolved Calcium	g/m³	15.3	
Dissolved Copper	g/m³	< 0.0005	
Dissolved Iron	g/m³	7.6	
Dissolved Magnesium	g/m³	8.3	
Dissolved Manganese	g/m³	0.27	
Dissolved Mercury	g/m³	< 0.00008	
Dissolved Nickel	g/m³	< 0.0005	
Dissolved Potassium	g/m³	9.4	
Dissolved Sodium	g/m³	27	
Dissolved Zinc	g/m³	0.0012	
Bromide	g/m³	0.14	
Chloride	g/m³	46	
Nitrite-N	g/m³	0.009	
Nitrate-N	g/m³	0.014	
Nitrate-N + Nitrite-N	g/m³	0.023	
Sulphate	g/m³	4.2	
Ethylene Glycol in Water*			
Ethylene glycol*	g/m³	< 4	
Propylene Glycol in Water*			
Propylene glycol*	g/m³	< 4	
Methanol in Water - Aqueous Solvents*			
Methanol*	g/m³	< 2	
BTEX in Water by Headspace GC-MS			
Benzene	g/m³	< 0.0010	
Toluene	g/m³	< 0.0010	
Ethylbenzene	g/m³	< 0.0010	
m&p-Xylene	g/m³	< 0.002	
o-Xylene	g/m³	< 0.0010	



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Sample Type: Aqueous		
Sample Name:	TRC229273 (GND3102) 01-Dec-2022 11:40 am	
Lab Number:	3130385.1	
Formaldehyde in Water by DNPH & LCMSMS		
Formaldehyde	g/m³	< 0.02
Gases in groundwater		
Ethane	g/m³	< 0.003
Ethylene	g/m³	< 0.004
Methane	g/m³	1.02
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

† Customer supplied data. Please note: Hill Laboratories cannot be held responsible for the validity of this customer supplied data, or any subsequent calculations that rely on this information.

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 simple 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. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total anions for anion/cation balance check	Calculation: sum of anions as mEq/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N. Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E 23 rd ed. 2017.	0.07 meq/L	1
Total cations for anion/cation balance check	Sum of cations as mEq/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H ⁺) also included in calculation if available. APHA 1030 E 23 rd ed. 2017.	0.05 meq/L	1
pH	pH meter. APHA 4500-H ⁺ B 23 rd ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) 23 rd ed. 2017.	1.0 g/m ³ as CaCO ₃	1
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO ₂ D 23 rd ed. 2017.	1.0 g/m ³ at 25°C	1
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 23 rd ed. 2017.	1.0 g/m ³ as CaCO ₃	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 23 rd ed. 2017.	0.1 mS/m	1
Total Dissolved Solids (TDS)	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 23 rd ed. 2017.	10 g/m ³	1
Sample Temperature*	Temperature of the sample at the time of sampling, supplied by customer.	0.1 °C	1
Dissolved Barium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.005 g/m ³	1
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.05 g/m ³	1
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0005 g/m ³	1
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.02 g/m ³	1
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.02 g/m ³	1

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0005 g/m ³	1
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m ³	1
Dissolved Nickel	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0005 g/m ³	1
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.05 g/m ³	1
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.02 g/m ³	1
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0010 g/m ³	1
Bromide	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.05 g/m ³	1
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.5 g/m ³	1
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) 23 rd ed. 2017.	0.002 g/m ³	1
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO ₂ N. In-House.	0.0010 g/m ³	1
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) 23 rd ed. 2017.	0.002 g/m ³	1
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.5 g/m ³	1
Ethylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m ³	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m ³	1
Methanol in Water - Aqueous Solvents*	GC-FID analysis. In-house.	1.0 g/m ³	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis. In-house based on US EPA 8260 and 5021.	0.0010 - 0.002 g/m ³	1
Formaldehyde in Water by DNPH & LCMSMS	Derivatisation, SPE extraction, LC-MS/MS analysis. In-house based on US EPA 8315A.	0.02 g/m ³	1
Gases in groundwater	Headspace GC-FID analysis. In-house.	0.002 - 0.003 g/m ³	1
Total Petroleum Hydrocarbons in Water			
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.10 g/m ³	1
C10 - C14	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m ³	1
C15 - C36	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m ³	1
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	0.7 g/m ³	1

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

Testing was completed between 06-Dec-2022 and 13-Dec-2022. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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Ara Heron BSc (Tech)
Client Services Manager - Environmental



Certificate of Analysis

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Client:	Taranaki Regional Council	Lab No:	3238903	SPV1
Contact:	Jane Harvey	Date Received:	13-Apr-2023	
	C/- Taranaki Regional Council	Date Reported:	21-Apr-2023	
	Private Bag 713	Quote No:	47915	
	Stratford 4352	Order No:	4500007241	
		Client Reference:	Groundwater	
		Submitted By:	Angela Collins	

Sample Type: Aqueous

Sample Name:		TRC2311827 (GND3102) 12-Apr-2023 10:25 am	
Lab Number:		3238903.1	
Individual Tests			
Sum of Anions	meq/L	2.5	
Sum of Cations	meq/L	3.0	
pH	pH Units	6.9	
Total Alkalinity	g/m³ as CaCO₃	87	
Bicarbonate	g/m³ at 25°C	106	
Total Hardness	g/m³ as CaCO₃	47	
Electrical Conductivity (EC)	mS/m	25.5	
Total Dissolved Solids (TDS)	g/m³	210	
Sample Temperature*†	°C	14.5	
Dissolved Barium	g/m³	0.032	
Dissolved Calcium	g/m³	9.8	
Dissolved Copper	g/m³	0.0007	
Dissolved Iron	g/m³	13.7	
Dissolved Magnesium	g/m³	5.4	
Dissolved Manganese	g/m³	0.46	
Dissolved Mercury	g/m³	< 0.00008	
Dissolved Nickel	g/m³	< 0.0005	
Dissolved Potassium	g/m³	10.2	
Dissolved Sodium	g/m³	29	
Dissolved Zinc	g/m³	0.0020	
Bromide	g/m³	0.10	
Chloride	g/m³	25	
Nitrite-N	g/m³	0.006	
Nitrate-N	g/m³	0.008	
Nitrate-N + Nitrite-N	g/m³	0.014	
Sulphate	g/m³	< 0.5	
Ethylene Glycol in Water*			
Ethylene glycol*	g/m³	< 4	
Propylene Glycol in Water*			
Propylene glycol*	g/m³	< 4	
Methanol in Water - Aqueous Solvents*			
Methanol*	g/m³	< 2	
BTEX in Water by Headspace GC-MS			
Benzene	g/m³	< 0.0010	
Toluene	g/m³	< 0.0010	
Ethylbenzene	g/m³	< 0.0010	
m&p-Xylene	g/m³	< 0.002	
o-Xylene	g/m³	< 0.0010	



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Sample Type: Aqueous		
Sample Name:	TRC2311827 (GND3102) 12-Apr-2023 10:25 am	
Lab Number:	3238903.1	
Formaldehyde in Water by DNPH & LCMSMS		
Formaldehyde	g/m³	0.02
Gases in groundwater		
Ethane	g/m³	< 0.003
Ethylene	g/m³	< 0.004
Methane	g/m³	5.4
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

† Customer supplied data. Please note: Hill Laboratories cannot be held responsible for the validity of this customer supplied data, or any subsequent calculations that rely on this information.

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 simple 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. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total anions for anion/cation balance check	Calculation: sum of anions as mEq/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N. Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E 23 rd ed. 2017.	0.07 meq/L	1
Total cations for anion/cation balance check	Sum of cations as mEq/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H ⁺) also included in calculation if available. APHA 1030 E 23 rd ed. 2017.	0.05 meq/L	1
pH	pH meter. APHA 4500-H ⁺ B 23 rd ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) 23 rd ed. 2017.	1.0 g/m ³ as CaCO ₃	1
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO ₂ D 23 rd ed. 2017.	1.0 g/m ³ at 25°C	1
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 23 rd ed. 2017.	1.0 g/m ³ as CaCO ₃	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 23 rd ed. 2017.	0.1 mS/m	1
Total Dissolved Solids (TDS)	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 23 rd ed. 2017.	10 g/m ³	1
Sample Temperature*	Temperature of the sample at the time of sampling, supplied by customer.	0.1 °C	1
Dissolved Barium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.005 g/m ³	1
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.05 g/m ³	1
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0005 g/m ³	1
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.02 g/m ³	1
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.02 g/m ³	1

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0005 g/m ³	1
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m ³	1
Dissolved Nickel	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0005 g/m ³	1
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.05 g/m ³	1
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.02 g/m ³	1
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B 23 rd ed. 2017.	0.0010 g/m ³	1
Bromide	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.05 g/m ³	1
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.5 g/m ³	1
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) 23 rd ed. 2017.	0.002 g/m ³	1
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO ₂ N. In-House.	0.0010 g/m ³	1
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) 23 rd ed. 2017.	0.002 g/m ³	1
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.5 g/m ³	1
Ethylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m ³	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m ³	1
Methanol in Water - Aqueous Solvents*	GC-FID analysis. In-house.	1.0 g/m ³	1
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis. In-house based on US EPA 8260 and 5021.	0.0010 - 0.002 g/m ³	1
Formaldehyde in Water by DNPH & LCMSMS	Derivatisation, SPE extraction, LC-MS/MS analysis. In-house based on US EPA 8315A.	0.02 g/m ³	1
Gases in groundwater	Headspace GC-FID analysis. In-house.	0.002 - 0.003 g/m ³	1
Total Petroleum Hydrocarbons in Water			
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.10 g/m ³	1
C10 - C14	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m ³	1
C15 - C36	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m ³	1
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	0.7 g/m ³	1

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

Testing was completed between 18-Apr-2023 and 21-Apr-2023. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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Ara Heron BSc (Tech)
Client Services Manager - Environmental

Appendix IV

Certificates of analysis
(hydraulic fracturing fluids)



Certificate of Analysis

Page 1 of 3

Client:	Taranaki Regional Council	Lab No:	2881249	SPV1
Contact:	Jane Harvey	Date Received:	18-Feb-2022	
	C/- Taranaki Regional Council	Date Reported:	04-Mar-2022	
	Private Bag 713	Quote No:	92175	
	Stratford 4352	Order No:	4500002828	
		Client Reference:	#7411 - Returned Fluid Kapuni-J KA21 and KA22	
		Submitted By:	Sarah Larkin	

Sample Type: Saline

Sample Name:	TRC225406 KA21	TRC225407 KA22		
	19-Dec-2021	06-Jan-2022		
Lab Number:	2881249.1	2881249.2		

Individual Tests

pH	pH Units	8.6	8.0	-	-	-
Total Alkalinity*	g/m ³ as CaCO ₃	-	10,600	-	-	-
Electrical Conductivity (EC)	mS/m	14.93	2,330	-	-	-
Total Suspended Solids	g/m ³	< 30 #1	< 50 #2	-	-	-
Bromide*	g/m ³	-	15.2	-	-	-
Chloride*	g/m ³	11.2	2,900	-	-	-
Nitrite-N	g/m ³	-	< 0.010 #3	-	-	-
Nitrate-N	g/m ³	-	0.052	-	-	-
Nitrate*	g/m ³	-	0.23	-	-	-
Nitrate-N + Nitrite-N	g/m ³	-	0.055 #3	-	-	-

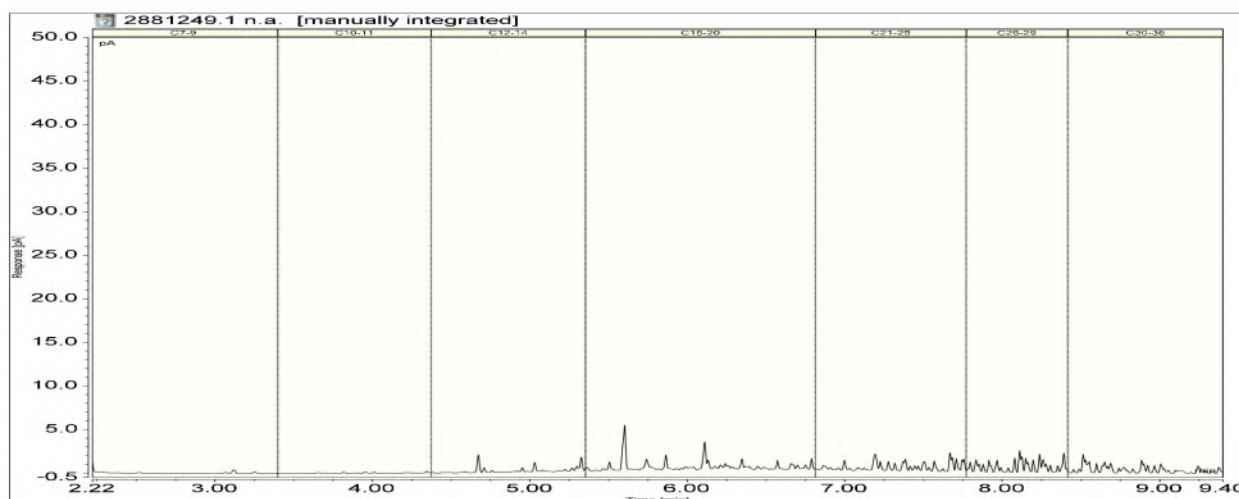
Total Petroleum Hydrocarbons in Water*

C7 - C9*	g/m ³	< 0.15	6.9	-	-	-
C10 - C14*	g/m ³	< 0.4	21	-	-	-
C15 - C36*	g/m ³	3.4	10.0	-	-	-
Total hydrocarbons (C7 - C36)*	g/m ³	3.8	38	-	-	-

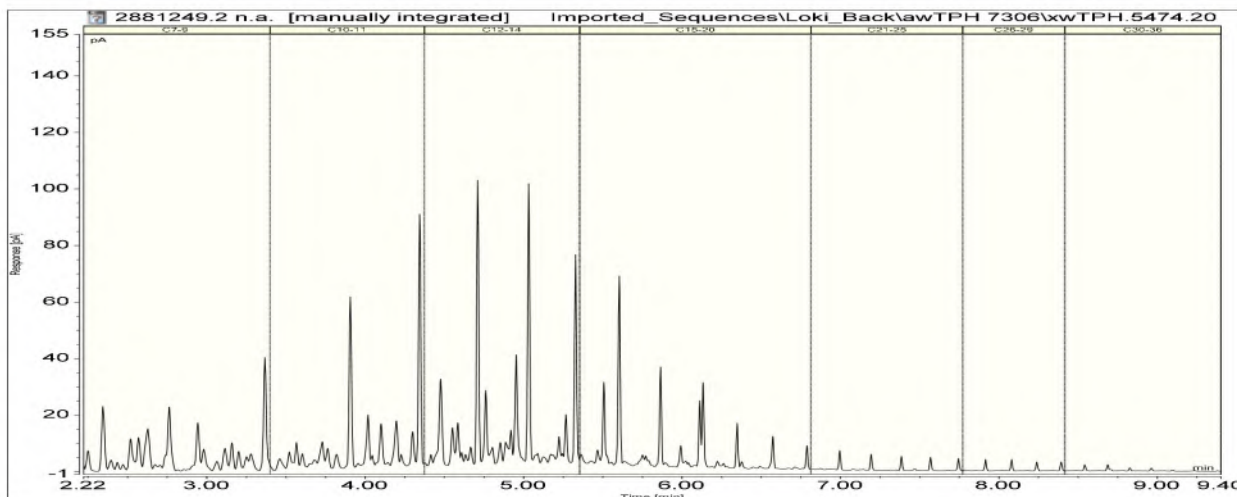
2881249.1

TRC225406 KA21 19-Dec-2021

Client Chromatogram for TPH by FID



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Analyst's Comments

- #1 Due to the nature of the sample, it was not possible to filter the usual volume for the Total Suspended Solids analysis. As the volume filtered was less than usual, the detection limit achieved for this sample is greater than normal.
- #2 There was insufficient sample left to filter the usual amount for the Total Suspended Solids test on this sample, so the detection limit is higher than normal.
- #3 Due to the nature of this sample a dilution was performed prior to analysis, resulting in a detection limit higher than that normally achieved for the NO₂N, NO₃N and NO_xN analysis.

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 simple 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. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Saline

Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Filtration, Unpreserved*	Sample filtration through 0.45µm membrane filter.	-	1-2
pH*	pH meter. APHA 4500-H ⁺ B 23 rd ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	2
pH	Saline water, pH meter. APHA 4500-H ⁺ B 23 rd ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1
Total Alkalinity*	Saline water, Titration to pH 4.5.	1.0 g/m ³ as CaCO ₃	2
Electrical Conductivity (EC)	Saline water, Conductivity meter, 25°C. APHA 2510 B 23 rd ed. 2017.	0.10 mS/m	1
Electrical Conductivity (EC)*	Conductivity meter, 25°C. APHA 2510 B 23 rd ed. 2017.	0.1 mS/m	2
Total Suspended Solids	Saline sample. Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D (modified) 23 rd ed. 2017.	3 g/m ³	1-2
Bromide*	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.05 g/m ³	2
Chloride*	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.5 g/m ³	1-2
Nitrite-N	Saline sample. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) 23 rd ed. 2017.	0.0010 g/m ³	2

Sample Type: Saline			
Test	Method Description	Default Detection Limit	Sample No
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO ₂ N. In-House.	0.0010 g/m ³	2
Nitrate*	Calculation from Nitrate-N.	0.005 g/m ³	2
Nitrate-N + Nitrite-N	Saline sample. Total oxidised nitrogen. Automated cadmium reduction, Flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) 23 rd ed. 2017.	0.0010 g/m ³	2
Total Petroleum Hydrocarbons in Water			
C7 - C9*	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.10 g/m ³	1-2
C10 - C14*	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m ³	1-2
C15 - C36*	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m ³	1-2
Total hydrocarbons (C7 - C36)*	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	0.7 g/m ³	1-2

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

Testing was completed between 19-Feb-2022 and 04-Mar-2022. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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Ara Heron BSc (Tech)
Client Services Manager - Environmental



Certificate of Analysis

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Client:	Taranaki Regional Council	Lab No:	2879132	SPv1
Contact:	Jane Harvey	Date Received:	18-Feb-2022	
	C/- Taranaki Regional Council	Date Reported:	03-Mar-2022	
	Private Bag 713	Quote No:	50522	
	Stratford 4352	Order No:	4500002828	
		Client Reference:	#7410 - Hydraulic Fracturing Fluid Kapuni-3	
		Submitted By:	Sarah Larkin	

Sample Type: Aqueous

Sample Name:	TRC225405 KA22 Zone 5 02/12/21-03/12/22	Composite of TRC2255400 KA21 Zone 1-1 Bottle 1-4 02/12/20-07/12/21	Composite of TRC225401 KA21 Zones 5-8 Bottle 1-4 08/12/21-10/12/21	Composite of TRC225402 KA21 Zone 9-11 Bottle 1-3 14/12/21-29/12/21	Composite of TRC225403 KA22 Zone 1-2 Bottle 1-2 18/12/21-19/12/21
Lab Number:	2879132.16	2879132.17	2879132.18	2879132.19	2879132.20
Ethylene Glycol in Water*					
Ethylene glycol*	g/m ³	< 400	< 400	< 400	< 400
Propylene Glycol in Water*					
Propylene glycol*	g/m ³	< 400	< 400	< 400	< 400
Methanol in Water - Aqueous Solvents*					
Methanol*	g/m ³	< 200	< 200	< 200	< 200
BTEX in Water by Headspace GC-MS					
Benzene	g/m ³	< 0.010	< 0.010	< 0.010	< 0.010
Toluene	g/m ³	< 0.010	< 0.010	< 0.010	< 0.010
Ethylbenzene	g/m ³	< 0.010	< 0.010	< 0.010	< 0.010
m&p-Xylene	g/m ³	< 0.019	< 0.02	< 0.02	< 0.02
o-Xylene	g/m ³	< 0.010	< 0.010	< 0.010	< 0.010
Total Petroleum Hydrocarbons in Water					
C7 - C9	g/m ³	< 6	< 0.8	< 0.8	< 0.8
C10 - C14	g/m ³	2,400	680	165	280
C15 - C36	g/m ³	370	97	43	144
Total hydrocarbons (C7 - C36)	g/m ³	2,800	770	210	420

Sample Name:	Composite of TRC225404 KA22 Zones 3-4 Bottle 1-2 23/12/21-24/12/21				
Lab Number:	2879132.21				
Ethylene Glycol in Water*					
Ethylene glycol*	g/m ³	< 400	-	-	-
Propylene Glycol in Water*					
Propylene glycol*	g/m ³	< 400	-	-	-
Methanol in Water - Aqueous Solvents*					
Methanol*	g/m ³	< 200	-	-	-
BTEX in Water by Headspace GC-MS					
Benzene	g/m ³	< 0.010	-	-	-
Toluene	g/m ³	< 0.010	-	-	-
Ethylbenzene	g/m ³	0.013	-	-	-
m&p-Xylene	g/m ³	< 0.02	-	-	-
o-Xylene	g/m ³	< 0.010	-	-	-



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Sample Type: Aqueous

Sample Name: Composite of
TRC225404 KA22
Zones 3-4 Bottle
1-2
23/12/21-24/12/21

Lab Number: 2879132.21

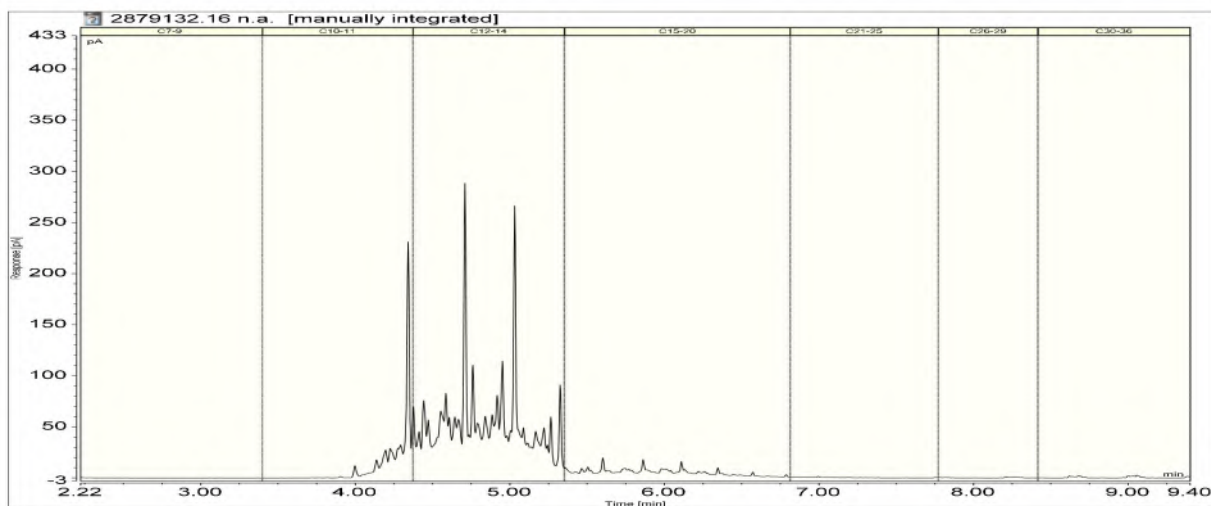
Total Petroleum Hydrocarbons in Water

C7 - C9	g/m ³	1.2	-	-	-	-
C10 - C14	g/m ³	1,130	-	-	-	-
C15 - C36	g/m ³	230	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m ³	1,360	-	-	-	-

2879132.16

TRC225405 KA22 Zone 5 02/12/21-03/12/22

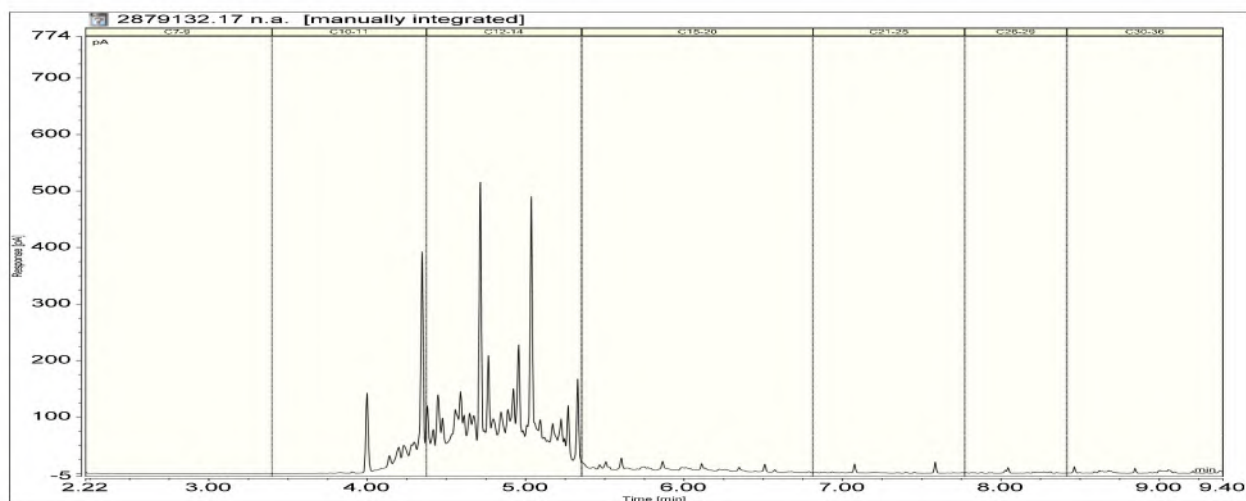
Client Chromatogram for TPH by FID



2879132.17

Composite of TRC2255400 KA21 Zone 1-1 Bottle 1-4 02/12/20-07/12/21

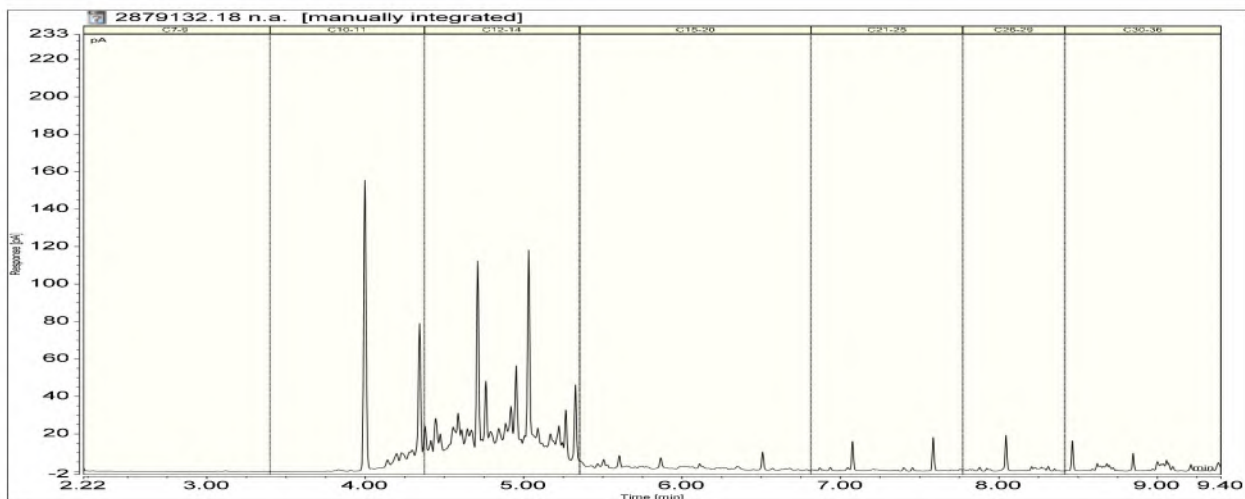
Client Chromatogram for TPH by FID



2879132.18

Composite of TRC225401 KA21 Zones 5-8 Bottle 1-4 08/12/21-10/12/21

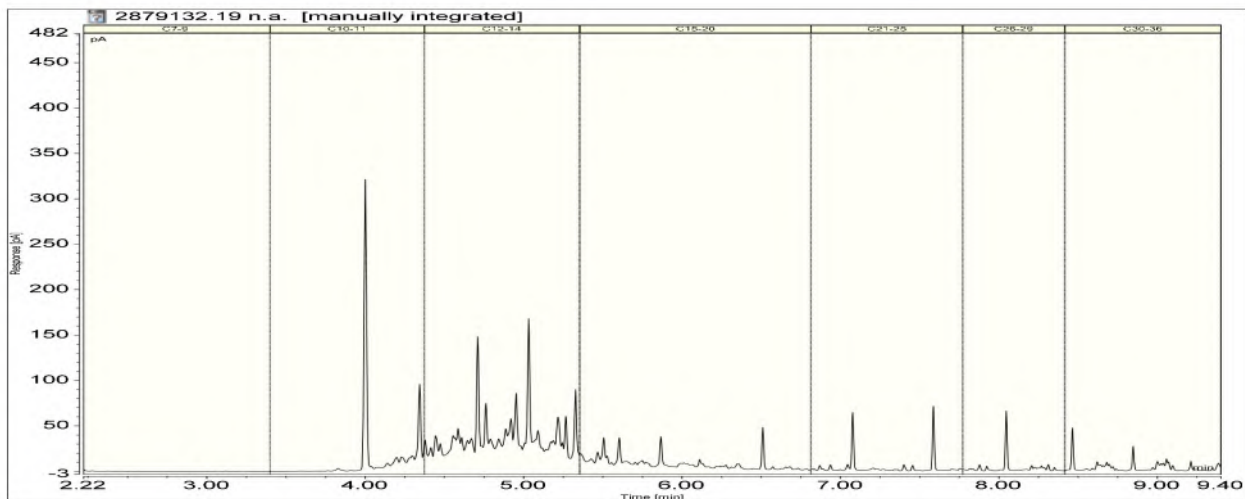
Client Chromatogram for TPH by FID



2879132.19

Composite of TRC225402 KA21 Zone 9-11 Bottle 1-3 14/12/21-29/12/21

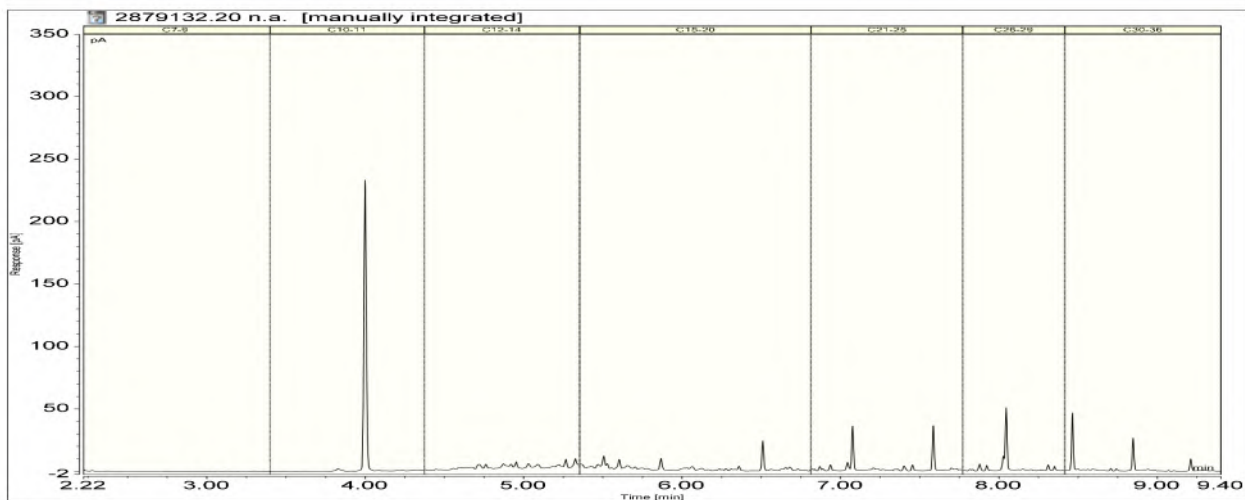
Client Chromatogram for TPH by FID



2879132.20

Composite of TRC225403 KA22 Zone 1-2 Bottle 1-2 18/12/21-19/12/21

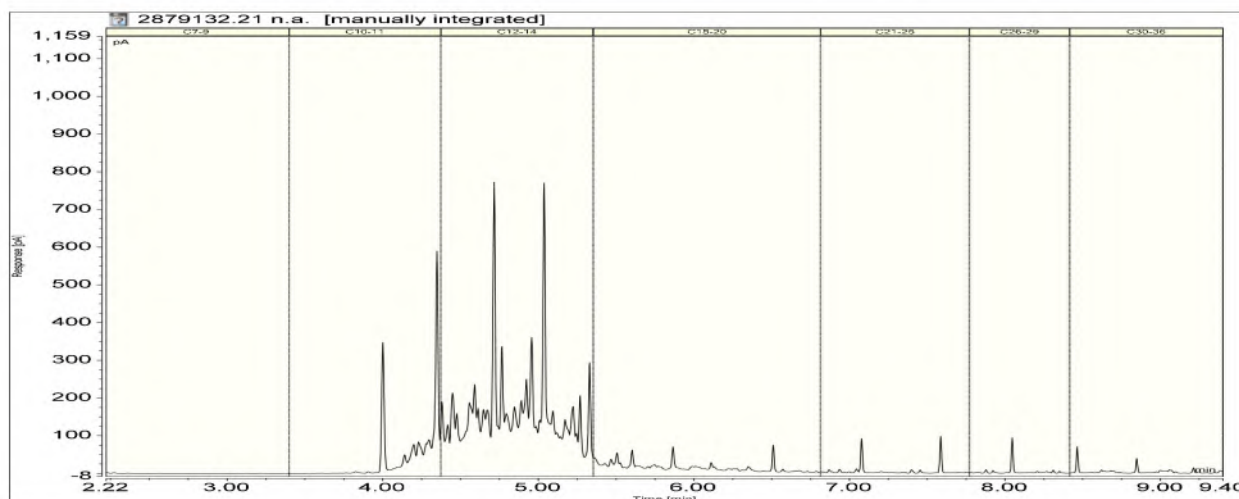
Client Chromatogram for TPH by FID



2879132.21

Composite of TRC225404 KA22 Zones 3-4 Bottle 1-2 23/12/21-24/12/21

Client Chromatogram for TPH by FID



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 simple 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. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Ethylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m ³	16-21
Propylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m ³	16-21
Methanol in Water - Aqueous Solvents*	GC-FID analysis. In-house.	1.0 g/m ³	16-21
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis. In-house based on US EPA 8260 and 5021.	0.0010 - 0.002 g/m ³	16-21
Total Petroleum Hydrocarbons in Water			
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.10 g/m ³	16-21
C10 - C14	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m ³	16-21
C15 - C36	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m ³	16-21
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	0.7 g/m ³	16-21

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

Testing was completed between 25-Feb-2022 and 03-Mar-2022. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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Client Services Manager - Environmental



Certificate of Analysis

Page 1 of 3

Client:	Taranaki Regional Council	Lab No:	2983062	SPV1
Contact:	Jane Harvey	Date Received:	11-May-2022	
	C/- Taranaki Regional Council	Date Reported:	23-May-2022	
	Private Bag 713	Quote No:	50522	
	Stratford 4352	Order No:	72831	
		Client Reference:	#7563 - Hydraulic Fracturing Kapuni J KA23 & KA24	
		Submitted By:	Finnley Binsbergen	

Sample Type: Aqueous

Sample Name:	Composite of TRC226406 (KA23FF) Zone1-2 [A] and TRC226406 (KA23FF) Zone1-2 [B] 12-Mar-2022	Composite of TRC226407 (KAF23 FF) Zone 4-6 [A], TRC226407 (KAF23 FF) Zone 4-6 [B] and TRC226407 (KAF23 FF) Zone 4-6 [C] 22-Mar-2022	Composite of TRC226408 (KA23 FF) Zone 7-9 [A], TRC226408 (KA23 FF) Zone 7-9 [B] and TRC226408 (KA23 FF) Zone 7-9 [C] 28-Mar-2022	Composite of TRC226409 (KA24 FF) Zone 1-5 [A], TRC226409 (KA24 FF) Zone 1-5 [B], TRC226409 (KA24 FF) Zone 1-5 [C], TRC226409 (KA24 FF) Zone 1-5 [D]], TRC226409 (KA24 FF) Zone 1-5 [E]] and TRC226409 (KA24 FF) Zone 1-5 [F] 14-Mar-2022		
	Lab Number:	2983062.15	2983062.16	2983062.17	2983062.18	
Ethylene Glycol in Water*						
Ethylene glycol*	g/m³	31	< 20	47	28	-
Propylene Glycol in Water*						
Propylene glycol*	g/m³	< 20	< 20	< 20	< 20	-
Methanol in Water - Aqueous Solvents*						
Methanol*	g/m³	230	460	163	210	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m³	0.054	0.050	0.047	< 0.0010	-
Toluene	g/m³	0.28	0.28	0.22	0.0027	-
Ethylbenzene	g/m³	0.023	0.023	0.0125	0.0031	-
m&p-Xylene	g/m³	0.192	0.199	0.111	< 0.002	-
o-Xylene	g/m³	0.031	0.032	0.0177	< 0.0010	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m³	0.7	0.9	0.50	0.51	-
C10 - C14	g/m³	104	73	96	250	-
C15 - C36	g/m³	46	49	46	67	-
Total hydrocarbons (C7 - C36)	g/m³	151	122	142	320	-

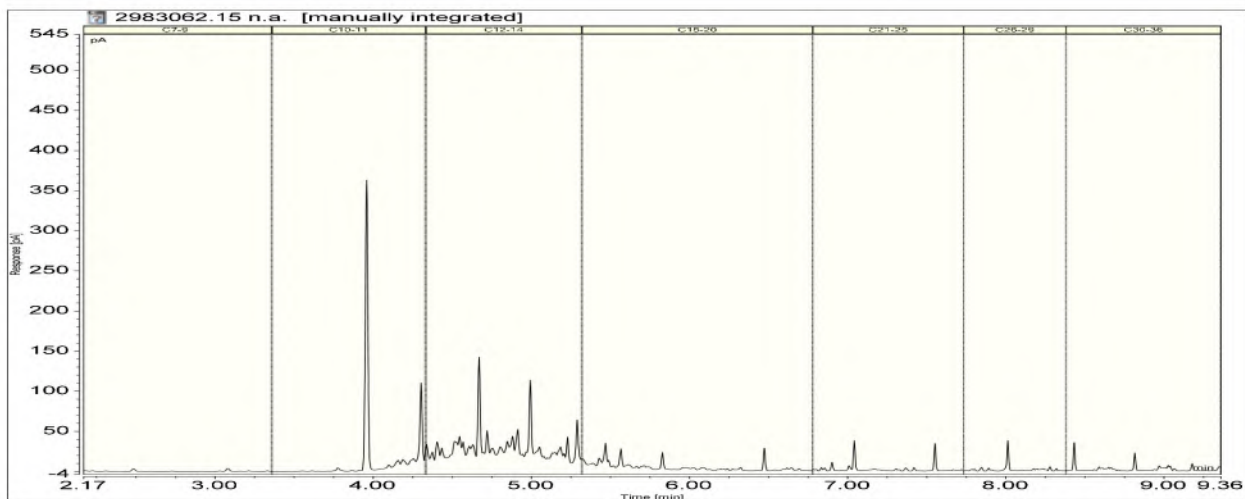


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2983062.15

Composite of TRC226406 (KA23FF) Zone1-2 [A] and TRC226406 (KA23FF) Zone1-2 [B] 12-Mar-2022

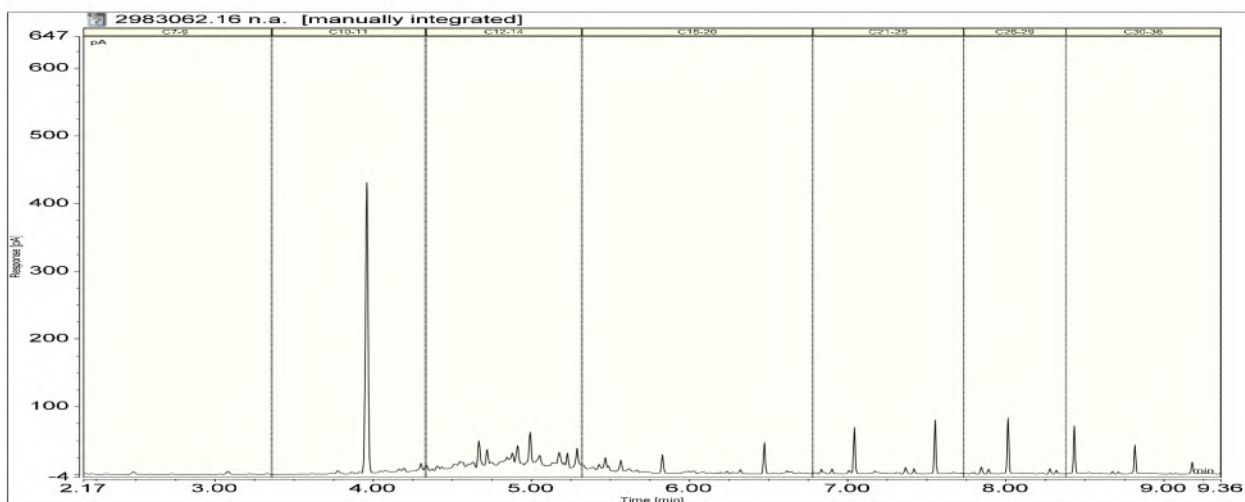
Client Chromatogram for TPH by FID



2983062.16

Composite of TRC226407 (KAF23 FF) Zone 4-6 [A], TRC226407 (KAF23 FF) Zone 4-6 [B] and TRC226407 (KAF23 FF) Zone 4-6 [C]

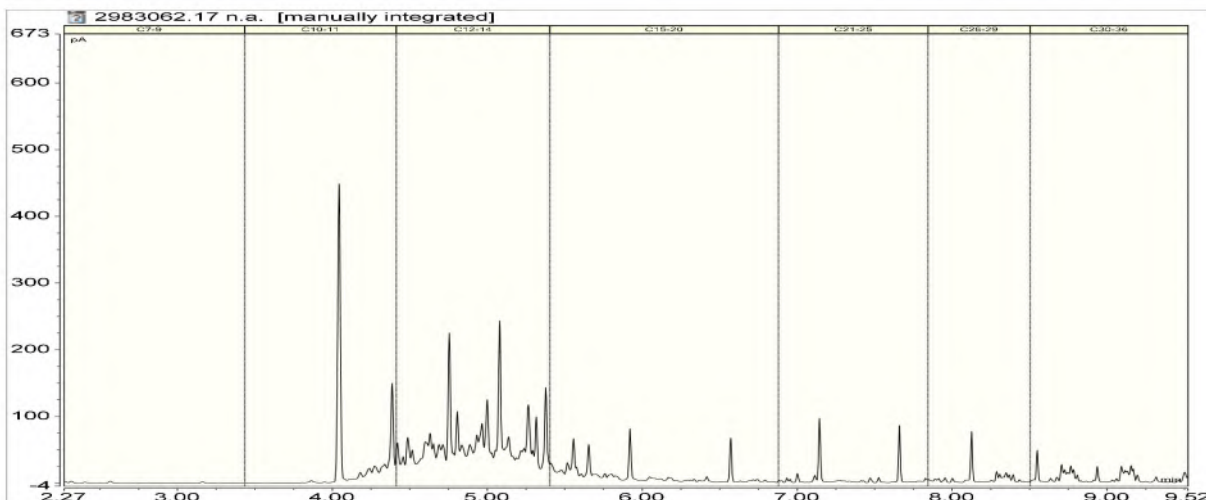
Client Chromatogram for TPH by FID



2983062.17

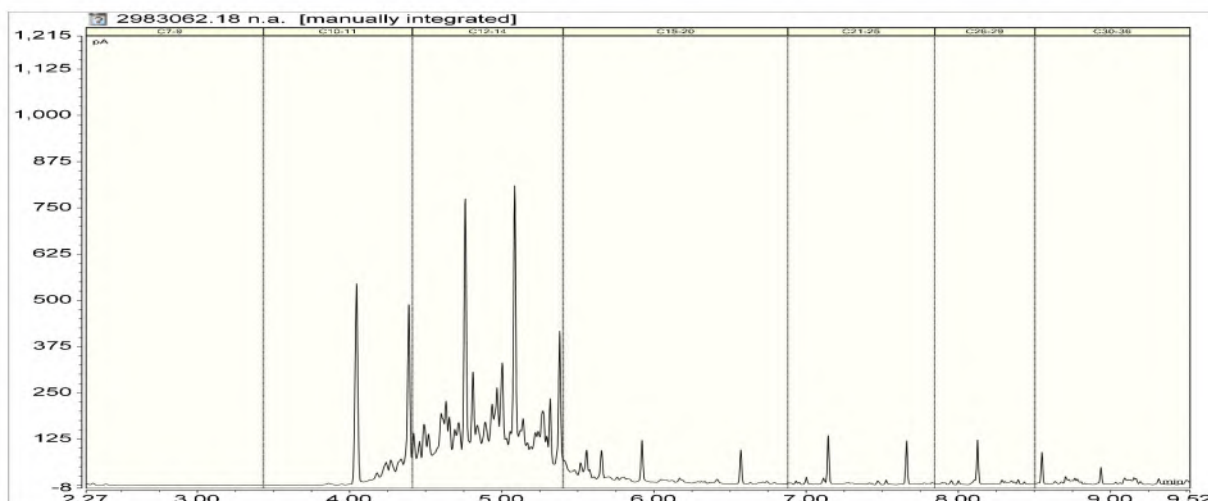
Composite of TRC226408 (KA23 FF) Zone 7-9 [A], TRC226408 (KA23 FF) Zone 7-9 [B] and TRC226408 (KA23 FF) Zone 7-9 [C]

Client Chromatogram for TPH by FID



2983062.18

Composite of TRC226409 (KA24 FF) Zone 1-5 [A], TRC226409 (KA24 FF) Zone 1-5 [B], TRC226409 (KA24 FF) Zone 1-5 [C], TRC226409 Client Chromatogram for TPH by FID



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 simple 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. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Ethylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m ³	15-18
Propylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m ³	15-18
Methanol in Water - Aqueous Solvents*	GC-FID analysis. In-house.	1.0 g/m ³	15-18
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis. In-house based on US EPA 8260 and 5021.	0.0010 - 0.002 g/m ³	15-18
Total Petroleum Hydrocarbons in Water			
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.10 g/m ³	15-18
C10 - C14	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m ³	15-18
C15 - C36	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m ³	15-18
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	0.7 g/m ³	15-18

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

Testing was completed between 18-May-2022 and 23-May-2022. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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Martin Cowell - BSc
Client Services Manager - Environmental



Certificate of Analysis

Page 1 of 5

Client:	Taranaki Regional Council	Lab No:	2983063	SPV1
Contact:	Jane Harvey	Date Received:	11-May-2022	
	C/- Taranaki Regional Council	Date Reported:	31-May-2022	
	Private Bag 713	Quote No:	71307	
	Stratford 4352	Order No:	72831	
		Client Reference:	#7563 - Hydraulic Fracturing Kapuni J KA23 & KA24	
		Submitted By:	Finnley Binsbergen	

Sample Type: Saline

Sample Name:	Composite of TRC226410 (KA24 FF) [A], TRC226410 (KA24 FF) [B] and TRC226410 (KA24 FF) [C] 13-Mar-2022	Composite of TRC226411 (KA24 FF) [A] and TRC226411 (KA24 FF) [B] 22-Mar-2022	Composite of TRC226412 (KA24 FF) [A] and TRC226412 (KA24 FF) [B] 04-Apr-2022	Composite of TRC226413 (KA24 FF) [A] and 20-Mar-2022		
Lab Number:	2983063.10	2983063.11	2983063.12	2983063.13		
Individual Tests						
pH*	pH Units	7.9	7.9	8.0	8.0	-
Total Alkalinity*	g/m³ as CaCO₃	7,000	11,300	10,600	10,700	-
Analysis Temperature for Bicarbonate*	°C	20	20	21	21	-
Bicarbonate*	g/m³ at Analysis Temperature	6,200	7,580	10,010	7,310	-
Total Hardness*	g/m³ as CaCO₃	133	153	170	162	-
Electrical Conductivity (EC)*	mS/m	2,000	2,040	2,170	1,948	-
Total Dissolved Solids (TDS)*	g/m³	16,300	16,800	20,000	15,800	-
Total Barium	g/m³	6.5	5.4	4.8	5.0	-
Total Calcium	g/m³	38	38	45	42	-
Total Copper	g/m³	0.023	0.0089	< 0.0053	0.025	-
Total Iron	g/m³	13.0	5.3	3.8	8.8	-
Total Magnesium	g/m³	9.1	14.4	14.2	13.7	-
Total Manganese	g/m³	2.0	2.8	1.55	1.79	-
Total Mercury*	g/m³	< 0.0015	< 0.0015	< 0.0015	< 0.0015	-
Total Nickel	g/m³	0.22	0.102	0.060	0.27	-
Total Potassium	g/m³	115	76	125	117	-
Total Sodium	g/m³	5,500	6,200	7,500	5,500	-
Total Sulphur*	g/m³	35	68	66	66	-
Total Zinc	g/m³	0.028	0.053	< 0.021	0.056	-
Bromide*	g/m³	15	13	14	11	-
Chloride*	g/m³	3,600	2,800	2,200	2,700	-
Nitrite-N	g/m³	0.016	0.123	0.031	< 0.010	-
Nitrate-N	g/m³	0.038	< 0.010	< 0.010	< 0.010	-
Nitrate*	g/m³	0.17	< 0.05	< 0.05	< 0.05	-
Nitrate-N + Nitrite-N	g/m³	0.054	0.123	0.033	< 0.010	-
Sulphate*	g/m³	104	200	199	196	-
Ethylene Glycol in Water*						
Ethylene glycol*	g/m³	< 400	< 400	< 400	< 400	-



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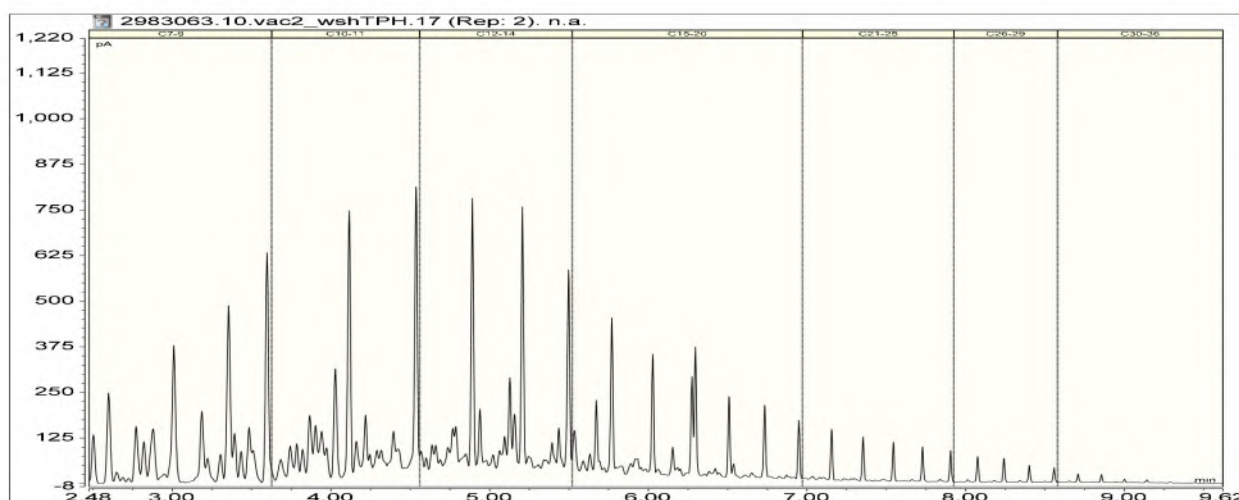
Sample Type: Saline

Sample Name:	Composite of TRC226410 (KA24 FF) [A], TRC226410 (KA24 FF) [B] and TRC226410 (KA24 FF) [C] 13-Mar-2022	Composite of TRC226411 (KA24 FF) [A] and TRC226411 (KA24 FF) [B] 22-Mar-2022	Composite of TRC226412 (KA24 FF) [A] and TRC226412 (KA24 FF) [B] 04-Apr-2022	Composite of TRC226413 (KA24 FF) [A] and 20-Mar-2022		
Lab Number:	2983063.10	2983063.11	2983063.12	2983063.13		
Propylene Glycol in Water*						
Propylene glycol*	g/m³	< 400	< 400	< 400	-	
Methanol in Water - Aqueous Solvents*						
Methanol*	g/m³	< 20	134	73	94	-
BTEX in Water by Headspace GC-MS*						
Benzene*	g/m³	23	1.17	1.48	0.91	-
Toluene*	g/m³	250	1.16	2.1	0.55	-
Ethylbenzene*	g/m³	56	0.076	0.22	0.031	-
m&p-Xylene*	g/m³	490	0.58	1.67	0.21	-
o-Xylene*	g/m³	142	0.25	0.71	0.119	-
Formaldehyde in Water by DNPH & LCMSMS*						
Formaldehyde*	g/m³	17.3	< 1.5	< 1.5	< 1.5	-
Total Petroleum Hydrocarbons in Water*						
C7 - C9*	g/m³	540	3.4	28	1.79	-
C10 - C14*	g/m³	1,240	16.4	101	11.9	-
C15 - C36*	g/m³	730	20	116	26	-
Total hydrocarbons (C7 - C36)*	g/m³	2,500	40	240	40	-

2983063.10

Composite of TRC226410 (KA24 FF) [A], TRC226410 (KA24 FF) [B] and TRC226410 (KA24 FF) [C] 13-Mar-2022

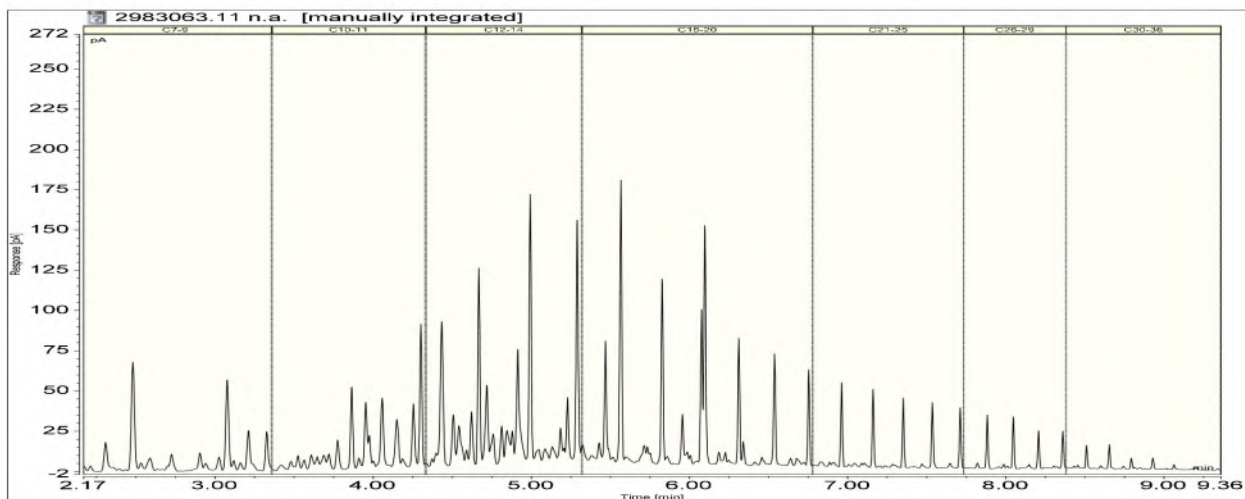
Client Chromatogram for TPH by FID



2983063.11

Composite of TRC226411 (KA24 FF) [A] and TRC226411 (KA24 FF) [B] 22-Mar-2022

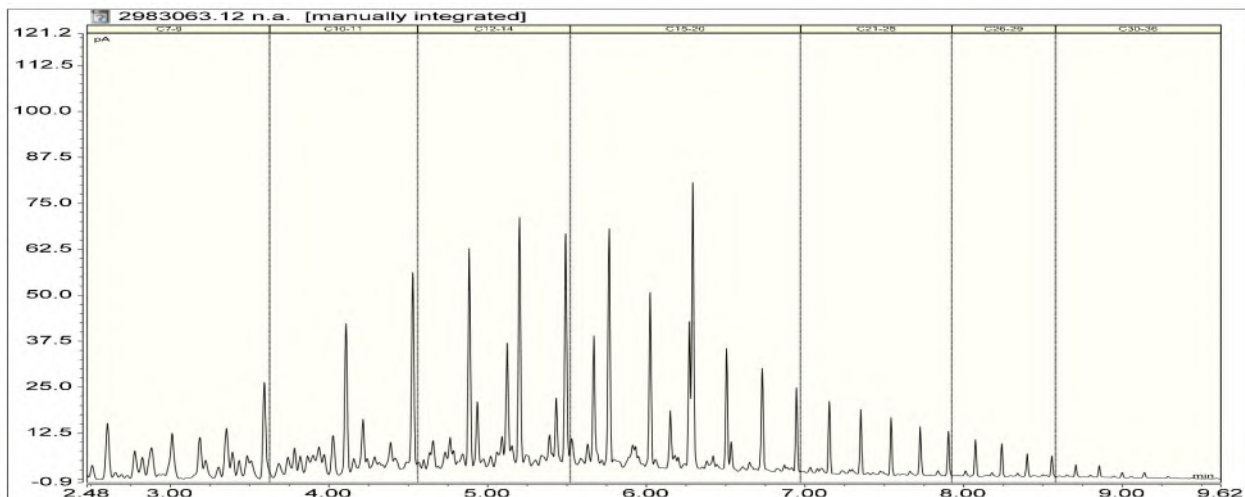
Client Chromatogram for TPH by FID



2983063.12

Composite of TRC226412 (KA24 FF) [A] and TRC226412 (KA24 FF) [B] 04-Apr-2022

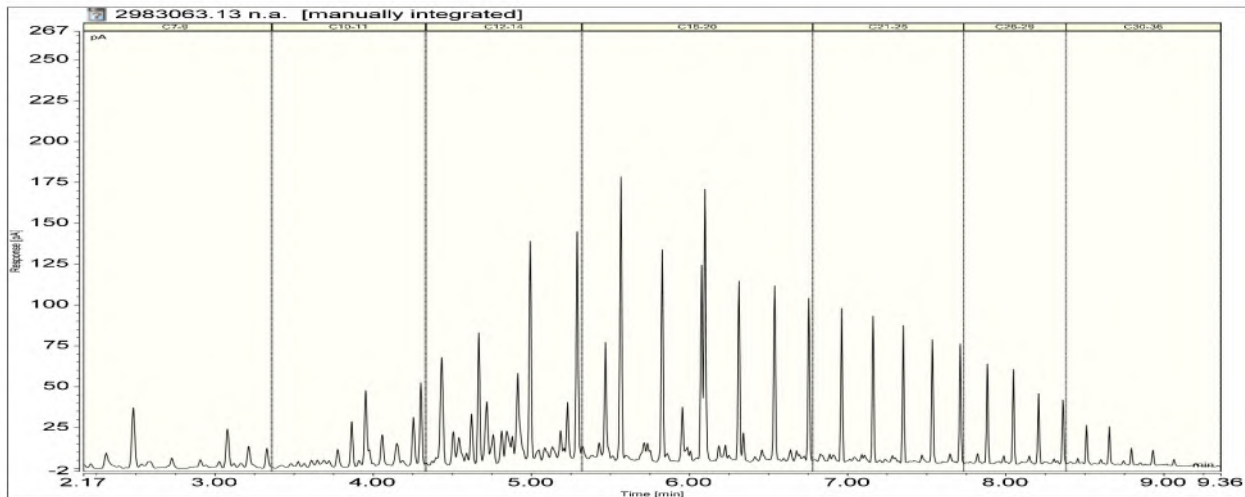
Client Chromatogram for TPH by FID



2983063.13

Composite of TRC226413 (KA24 FF) [A] and 20-Mar-2022

Client Chromatogram for TPH by FID



Analyst's Comments

* Analysis subcontracted to an external provider. Refer to the Summary of Methods section for more details.

Appendix No.1 - GNS Report

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 simple 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. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Saline			
Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Filtration, Unpreserved*	Sample filtration through 0.45µm membrane filter.	-	10-13
Total Digestion*	Boiling nitric acid digestion. APHA 3030 E (modified) 23 rd ed. 2017.	-	10-13
Total Digestion of Saline Samples*	Nitric acid digestion. APHA 3030 E (modified) 23 rd ed. 2017.	-	10-13
pH*	pH meter. APHA 4500-H ⁺ B 23 rd ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	10-13
Total Alkalinity*	Saline water, Titration to pH 4.5.	1.0 g/m ³ as CaCO ₃	10-13
Analysis Temperature for Bicarbonate	Temperature at which Bicarbonate titration was conducted as reported by Geological & Nuclear Sciences, Wairakei.	1.0 °C	10-13
Bicarbonate	Bicarbonate (HCO ₃) Titration Method conducted at reported temperature. Subcontracted to Geological & Nuclear Sciences, Wairakei. ASTM Standards D513-82 Vol.11.01 of 1988.	20 g/m ³ at Analysis Temperature	10-13
Total Hardness*	Calculation from Calcium and Magnesium. APHA 2340 B 23 rd ed. 2017.	1.0 g/m ³ as CaCO ₃	10-13
Electrical Conductivity (EC)*	Conductivity meter, 25°C. APHA 2510 B 23 rd ed. 2017.	0.1 mS/m	10-13
Total Dissolved Solids (TDS)*	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 23 rd ed. 2017.	50 g/m ³	10-13
Total Barium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 rd ed. 2017.	0.00063 g/m ³	10-13
Total Calcium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 rd ed. 2017.	1.1 g/m ³	10-13
Total Copper	Nitric acid digestion, ICP-MS, ultratrace. APHA 3125 B 23 rd ed. 2017.	0.0011 g/m ³	10-13
Total Iron	Nitric acid digestion, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23 rd ed. 2017.	0.0042 g/m ³	10-13
Total Magnesium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 rd ed. 2017.	0.42 g/m ³	10-13
Total Manganese	Nitric acid digestion, ICP-MS, ultratrace. APHA 3125 B 23 rd ed. 2017.	0.0011 g/m ³	10-13
Total Mercury*	Bromine Oxidation followed by Atomic Fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m ³	10-13
Total Nickel	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 rd ed. 2017.	0.0070 g/m ³	10-13
Total Potassium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 rd ed. 2017.	1.1 g/m ³	10-13
Total Sodium	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23 rd ed. 2017.	0.42 g/m ³	10-13
Total Sulphur*	Nitric acid digestion, ICP-OES (method may not fully account for H ₂ S due to volatilisation during digestion). All forms of oxidised and organic sulphur will be determined by this method. APHA 3120 B 23 rd ed. 2017.	0.5 g/m ³	10-13
Total Zinc	Nitric acid digestion, ICP-MS, ultratrace. APHA 3125 B 23 rd ed. 2017.	0.0042 g/m ³	10-13
Bromide*	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.05 g/m ³	10-13
Chloride*	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23 rd ed. 2017.	0.5 g/m ³	10-13
Nitrite-N	Saline sample. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO ₂ ⁻ I (modified) 23 rd ed. 2017.	0.0010 g/m ³	10-13
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO ₂ N. In-House.	0.0010 g/m ³	10-13

Sample Type: Saline			
Test	Method Description	Default Detection Limit	Sample No
Nitrate*	Calculation from Nitrate-N.	0.005 g/m ³	10-13
Nitrate-N + Nitrite-N	Saline sample. Total oxidised nitrogen. Automated cadmium reduction, Flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) 23 rd ed. 2017.	0.0010 g/m ³	10-13
Total Sulphate*	Calculation: from total sulphur.	2 g/m ³	10-13
Ethylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m ³	10-13
Propylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m ³	10-13
Methanol in Water - Aqueous Solvents*	GC-FID analysis. In-house.	1.0 g/m ³	10-13
BTEX in Water by Headspace GC-MS*	Headspace GC-MS analysis. In-house based on US EPA 8260 and 5021.	0.0010 - 0.002 g/m ³	10-13
Formaldehyde in Water by DNPH & LCMSMS*	Derivatisation, SPE extraction, LC-MS/MS analysis. In-house based on US EPA 8315A.	0.02 g/m ³	10-13
Total Petroleum Hydrocarbons in Water			
C7 - C9*	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.10 g/m ³	10-13
C10 - C14*	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m ³	10-13
C15 - C36*	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m ³	10-13
Total hydrocarbons (C7 - C36)*	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	0.7 g/m ³	10-13

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

Testing was completed between 17-May-2022 and 31-May-2022. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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Ara Heron BSc (Tech)
Client Services Manager - Environmental



ANALYTICAL LABORATORY
114 Karetoto Rd Wairakei
RD4 Taupo 3384
Phone: (07) 374 8211
Email: w.labmanager@gns.cri.nz

CERTIFICATE OF ANALYSIS
EnvSubGNS_Wairakei 136
Report No: 2022051701
Customer Ref:157863

Ara Heron
RJ Hill Laboratories (Hamilton)
Environmental Reports Officers
Private Bag 3205
Hamilton

GNS Lot No: 2022051701



GNS Sample No.	2022002565	2022002566	2022002567	2022002568
Collection Date				
Site ID	2983063.10	2983063.11	2983063.12	2983063.13
Field ID				
Date Received	17/05/2022	17/05/2022	17/05/2022	17/05/2022

Bicarbonate (Total)	mg/l	6201	7582	10006	7311
pH		8.27	8.02	8.18	8.27
HCO ₃ Analysis Temperature	°C	20	20	21	21
HCO ₃ Analysis Date		23/05/2022	23/05/2022	25/05/2022	23/05/2022

SUMMARY OF METHODS AND DETECTION LIMITS

The following table gives a brief description of the methods used to conduct the analyses on this report.
The detection limits given below are those attainable in a relatively clean matrix.

Parameter	Method	*Detection Limit
Bicarbonate (total)	HCO ₃ Titration Method ASTM Standards D513-82 Vol.11.01 1988	20 mg/l
pH	Electrometric Method - APHA 4500-H+ B 23rd Edition 2017	-

*Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.



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outside the scope of the
laboratory's accreditation

..... were collected by yourselves (or your agent) and analysed as received at the laboratory. This report must not be reproduced, except in full, without the written consent of the signatory. Samples are held at the laboratory after reporting for a period of 2 to 6 months, dependent on sample type.



Moya Appleby
Principal Technician