Greymouth Petroleum Ltd
Kowhai-D Hydraulic Fracturing

Monitoring Programme
Annual Report
2023/24

Technical Report 2024-97

Taranaki
Regional Council

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Executive summary

Greymouth Petroleum Ltd (the Company) operates the Kowhai-D hydrocarbon exploration site (wellsite) located on Manganui Road, Everett Park located in the Waitara Catchment. This report outlines and discusses the results of the monitoring programme implemented by the Council in relation to hydraulic fracturing activities conducted by the Company at the wellsite over the period 31 August 2023 to 11 January 2024. The report also details the results of the monitoring undertaken and assesses the environmental effects of the Company's activities.

The programme of hydraulic fracturing undertaken by the Company at the Kowhai-D wellsite included the hydraulic fracturing of two wells. The wells targeted for stimulation were the Kowhai-6 and Kowhai-5 wells.

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

The programme of monitoring implemented by the Council in relation to these hydraulic fracturing activities during the 2023/24 monitoring year. Monitoring included pre and post-discharge groundwater sampling in relation to discharges at the Kowhai-D wellsite. In order to characterise the discharges and to determine compliance with consent conditions samples of hydraulic fracturing fluids, and fluids returning to the wellhead post-fracturing, were also collected by the Company and results of the physicochemical analysis undertaken were provided to the Council. This is the fourth monitoring report produced by the Council in relation to the hydraulic fracturing activities at the Kowhai-D wellsite.

The monitoring carried out by the Council indicates that the hydraulic fracturing activities undertaken by the Company 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 the Company in relation to these activities or provisions in regional plans, during the period under review.

For reference, in the 2023/24 year, consent holders were found to achieve a high level of environmental performance and compliance for 864 (89%) of a total of 967 consents monitored through the Taranaki tailored monitoring programmes, while for another 75 (8%) of the consents a good level of environmental performance and compliance was achieved. A further 26 (3%) of consents monitored required improvement in their performance, while the remaining two (<1%) achieved a rating of poor.

This report includes recommendations for the future monitoring of any hydraulic fracturing activities at the Kowhai-D 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 Greymouth Petroleum Ltd (the Company) at the Kowhai-D wellsite, over the period 31 August 2023 to 11 January 2024. The report also assesses the Company's level of environmental performance and compliance with the resource consent held in relation to the activity.

The programme of hydraulic fracturing undertaken by the Company at the Kowhai-D wellsite included the hydraulic fracturing of two wells. The wells targeted for stimulation were the Kowhai-6 and Kowhai-5 wells.

The programme of monitoring implemented by the Council in relation to these hydraulic fracturing activities during the 2023/24 monitoring year. Monitoring included a mixture of groundwater, surface water and discharge monitoring components. This is the fourth monitoring report produced by the Council in relation to hydraulic fracturing activities at the Kowhai-D wellsite.

1.1.2 Structure of this report

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

- consent compliance monitoring under the *Resource Management Act 1991* (RMA) and the Council's obligations;
- the Council's approach to monitoring sites though compliance monitoring programmes;
- the resource consents held by the Company;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted at the Kowhai-D wellsite.

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 Kowhai-D 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 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' in as much 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 performance

Besides discussing the various details of the performance and extent of compliance by the consent holders, 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 2023/24 year, consent holders were found to achieve a high level of environmental performance and compliance for 864 (89%) of a total of 967 consents monitored through the Taranaki tailored monitoring programmes, while for another 75 (8%) of the consents a good level of environmental performance and compliance was achieved. A further 26 (3%) of consents monitored required improvement in their performance, while the remaining two (<1%) achieved a rating of poor.[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

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[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

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 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 (N_2) 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 Kowhai-D wellsite and hydraulic fracturing activities

The Kowhai-D wellsite is located on Manganui Road, Everett Park and lies within the Waitara Catchment. 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 the Company at the Kowhai-D 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
Kowhai-6	GND3040	31/08/2023	3,596.8 – 3,619.8	Mangahewa
Kowhai-5	GND2829	18/12/2023 – 11/01/2024	3,367 – 3,475	

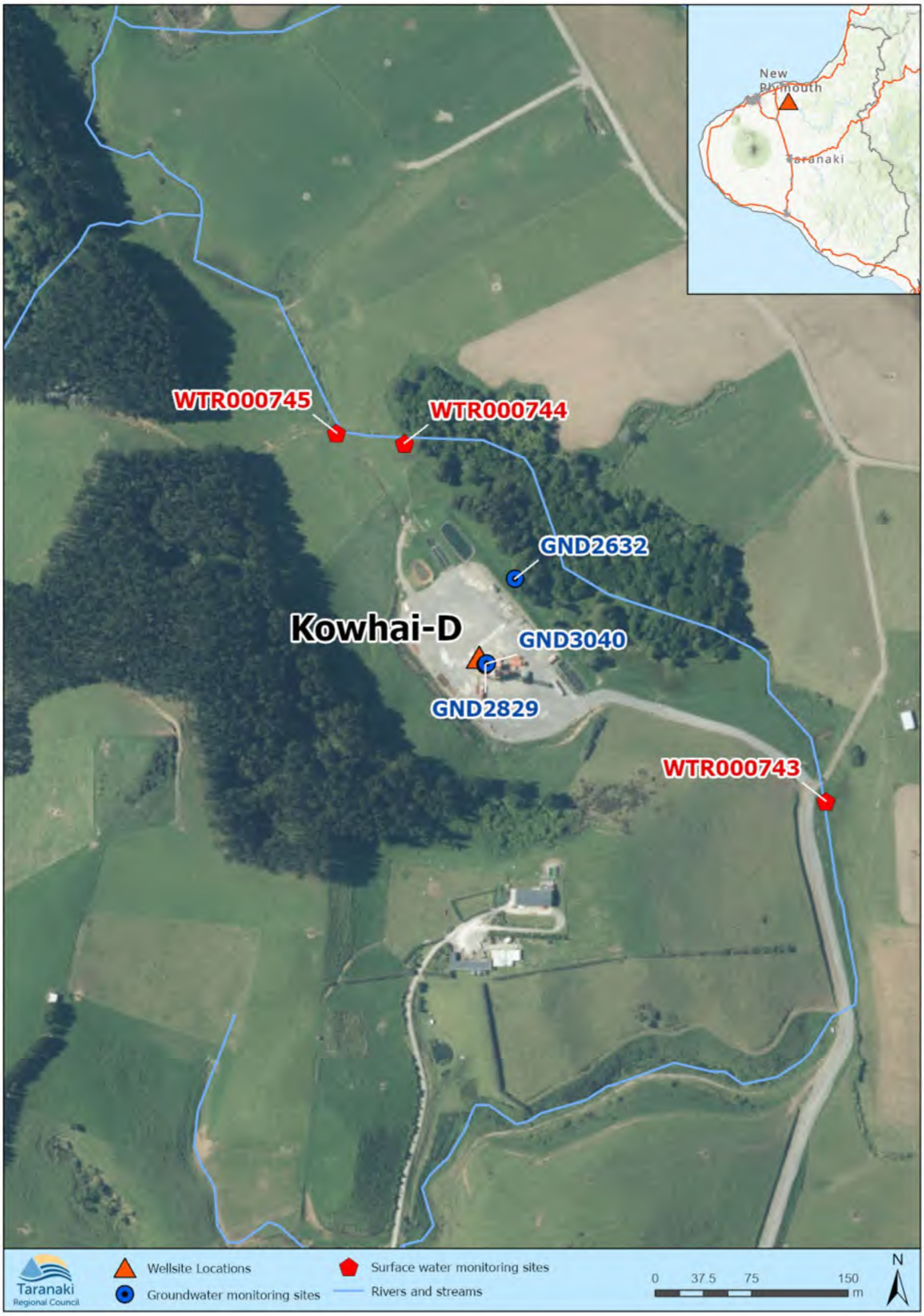

Figure 1 Location map

1.3 Resource consents

The Company holds one resource consent the details of which is 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 in 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
10297-1	To discharge water based hydraulic fracturing fluids into land at depths greater than 3,385m TVDss beneath the Kowhai-D wellsite	24 May 2016	June Annually	01 June 2033
10297-2	To discharge water based hydraulic fracturing fluids into land at depths greater than 3,000m TVDss beneath the Kowhai-D wellsite	21 December 2023	June 2025	01 June 2044

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 Kowhai-D 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;
- 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 10297, the Company submitted pre and post fracturing discharge reports to the Council for each well 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.

The survey of existing sites resulted in no potential groundwater sampling locations being identified. A

As there were no suitable monitoring sites identified, consent conditions required the Company to install a site specific monitoring bore. The new bore installed by the Company is the sole groundwater monitoring site included in the monitoring programme. A summary of bore details are included in Table 3 below.

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

Groundwater samples are collected following standard groundwater sampling methodologies and generally in accordance with the National Environmental Monitoring Standards (NEMS) for discrete groundwater quality sampling (2019). All samples were transported to Hill Laboratories Ltd (Hills) for analysis following standard chain of custody procedures.

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)	Aquifer
GND2632	1710181	5674906	<50	27.0	18-27	Volcanics and fluvial sediments

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) are 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 are collected and sent by the Company to Hills for analysis. Results are provided to the Council on request or in the post fracturing report provided following each fracturing event.

1.4.5 Surface water quality monitoring

A tributary of the Waitara River is located around 120m to the north-east and the main channel of the Waitara River is located approximately 610m north-east of the Kowhai-D wellsite. (Figure 1). Three sites were selected to monitor upstream and downstream of the site and the estimated location of the groundwater/subsurface drainage from the discharge area. Details of the three sites can be found in Table 4. The locations are illustrated in Figure 1. No biomonitoring survey was completed during the hydraulic stimulation events due to flow conditions not being appropriate for sampling.

Table 4 Details of surface water sites included in the monitoring programme

Site code	Eastings	Northings	Location
WTR000743	1710423	5674733	5m upstream of a track to farm shed
WTR000744	1710095	5675012	Downstream edge of wetland
WTR000745	1710042	5675020	50m downstream of wetland

2. Results

2.1 Physicochemical sampling

2.1.1 Groundwater

Hydraulic fracturing activities commenced at the Kowhai-D wellsite on 31 August 2023 and continued until 11 January 2024. A pre-fracturing baseline sample was collected on 4 July 2023. Post fracturing samples were collected at various intervals following commencement of the activities which including hydraulic fracturing in two wells. Interim samples were collected on 13 October 2023 and 26 February. A post fracturing sample was collected on 17 December 2024.

Methane concentrations >1g/m^3 were reported in all of the 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, only one of the samples were sent to Geological and Nuclear Sciences (GNS) for carbon 13 isotope analysis. The presence of carbon 13 isotopes concentrations at less than -50‰ indicate a thermogenic deep gas source and concentrations greater than -50‰ a shallow biogenic gas source. The Carbon 13 concentrations was -60.7‰, indicating a mixed biogenic/thermogenic source of methane at the site.

Overall, samples demonstrate relatively narrow ranges in analyte concentrations over time. The subtle variation in analyte concentrations 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 5. 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 Kowhai-D fracturing events

Sample date	**unit**	**04/07/2023 (pre-frac)**	**13/10/2023 (3 months post-frac**	**26/02/2024 (3 months post-frac)**	**17/12/2024 (1 year post-frac)**
Sample time	**-**	**11:30**	**10:10**	**12:40**	**09:40**
Sample id. TRC	**-**	**TRC2313262**	**TRC2314472**	**TRC2417152**	**TRC2421730**
pH	pH	8.2	8.3	8.3	8.3
Temperature	°C	15.1	15.2	16	15.3
Total alkalinity	g/m^3 CaCO$_3$	150	150	149	150
Bicarbonate	g/m^3 HCO$_3$	180	179	178	180
Total hardness	g/m^3 CaCO$_3$	92	89	87	86
Electrical conductivity	µS/cm	313	307	315	307
Total dissolved solids	g/m^3	184	176	174	166
Dissolved calcium	g/m^3	22	21	20	20
Chloride	g/m^3	11.6	11.6	11.7	11.9
Dissolved magnesium	g/m^3	9	8.6	8.9	8.6
Dissolved potassium	g/m^3	3.2	3.1	3.2	3.2
Dissolved sodium	g/m^3	33	32	34	32
Nitrite	g/m^3 N	<0.002	<0.002	<0.02	< 0.02
Nitrate	g/m^3 N	<0.002	<0.002	0.125	< 0.002
Nitrate & nitrite	g/m^3 N	<0.002	<0.002	0.125	< 0.002
Sulphate	g/m^3	<0.5	<0.5	<0.5	< 0.5
Dissolved barium	g/m^3	<0.005	0.005	<0.0005	0.051
Bromide	g/m^3	0.05	<0.05	0.06	0.07
Dissolved copper	g/m^3	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved iron	g/m^3	0.04	0.04	0.02	0.04
Dissolved manganese	g/m^3	0.0089	0.0091	0.0085	0.0104
Dissolved mercury	g/m^3	< 0.00008	< 0.00008	< 0.00008	< 0.00008
Dissolved Nickel	g/m^3	< 0.0005	<0.0005	< 0.0005	< 0.0005

Sample date	unit	04/07/2023 (pre-frac)	13/10/2023 (3 months post-frac	26/02/2024 (3 months post-frac)	17/12/2024 (1 year post-frac)
Sample time	**-**	**11:30**	**10:10**	**12:40**	**09:40**
Sample id. TRC	**-**	**TRC2313262**	**TRC2314472**	**TRC2417152**	**TRC2421730**
Dissolved zinc	g/m^3	0.0018	<0.0010	0.0021	<0.0010
Ethylene glycol	g/m^3	< 4	< 4	< 4	< 4
Propylene glycol	g/m^3	< 4	< 4	< 4	< 4
Methanol	g/m^3	< 2	< 2	< 2	< 2
Benzene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Toluene	g/m^3	<0.0010	< 0.0010	< 0.0010	<0.0010
Ethylbenzene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
m-Xylene	g/m^3	< 0.002	< 0.002	< 0.002	< 0.002
o-Xylene	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Formaldehyde	g/m^3	< 0.02	<0.02	< 0.02	< 0.02
Ethane	g/m^3	0.008	0.008	0.005	0.003
Ethylene	g/m^3	< 0.004	< 0.004	< 0.001	<0.001
Methane	g/m^3	8.8	9.3	6.2	5.15
C7-C9 hydrocarbons	g/m^3	< 0.10	< 0.10	< 0.10	< 0.10
C10-C14 hydrocarbons	g/m^3	< 0.2	< 0.2	< 0.2	< 0.2
C15-C36 hydrocarbons	g/m^3	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons	g/m^3	< 0.7	< 0.7	< 0.7	< 0.7
δ13C value	‰	Not analysed	Not analysed	-60.7	Not analysed

2.2 Consent holder submitted data

The conclusions from the Kowhai-D post fracturing discharge reports are summarised as follows:

2.2.1 Kowhai-6 post fracturing discharge report

- One zone was fractured on 31 August 2023 at mid-point depths between 3,596.8 to 3,619.8m TVDss.
- A total of 2,146bbls (341.1m^3) of liquid was discharged across the fractured unit. The total proppant weight was 53.5 tonnes (118,016lbs).
- All fluid injected was returned from the well over the flow-back.
- A total of 53.5 tonnes (118,016lbs) of proppant was estimated to have remained within the formation following flow-back.
- No screen outs occurred during hydraulic fracturing of the Kowhai-6 well.
- All return fluid from the Kowhai-6 fracturing operations were disposed of at the Company's Kaimiro-G wellsite under the Company's deep well injection consent.
- 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.

2.2.2 Kowhai-5 post fracturing discharge report

- A total of two zones were fractured over the period 18 December 2023 to 11 January 2024 at mid-point depths between 3,367 to 3,475m TVDss.
- A total of 3,621bbls (575.6m^3) of liquid was discharged across the two fractured units. The total proppant weight was 88.6 tonnes (177,498lbs).
- The majority of the fluid injected was returned from the well over the flow-back period.
- A total of 76.5 tonnes (168,678lbs) of proppant was estimated to have remained within the formation following flow-back.
- One screen out occurred during hydraulic fracturing of the Kowhai-5 well. This occurred during the flush and pump rate was decreased before screen out occurred. This resulted in a decent amount of proppant settled in the wellbore.
- All return fluid from the Kowhai-5 fracturing operations were disposed of at the Company's Turangi-C wellsite under the Company's deep well injection consent.
- 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.

2.2.3 Hydraulic fracturing and return fluids

The results of the analyses carried out on samples of the hydraulic fracturing fluid used in the stimulation of the Kowhai-6 and Kowhai-5 wells are shown below in Table 6. The certificates of analysis are included in Appendix IV.

The results of the analyses carried out on the return fluid samples obtained following the hydraulic fracturing of the Kowhai-6 and Kowhai-5 wells are summarised below in Table 7. The certificates of analysis are included in Appendix IV. The results demonstrate the variability of groundwater composition and hydrocarbon concentrations during flow-back. The relatively high levels of chloride, sodium and hydrocarbons in each sample indicate that the composite samples prepared contained a greater proportion of reservoir fluids than hydraulic fracturing fluids introduced during the fracturing activities, which are comprised predominantly of freshwater.

Table 6 Results of hydraulic fracturing fluid sampling

Well	Unit	Kowhai-5		Kowhai-6
Parameter	**Range**	**Treatment #1**	**Treatment #2**	**Treatment #1**
Ethylene glycol*	g/m^3	620	760	740
Propylene Glycol*	g/m^3	< 2	<4	<2
Methanol*	g/m^3	< 2	< 2	<1
Benzene	g/m^3	0.0012	0.0015	0.0037
Toluene	g/m^3	0.0058	0.0071	0.0127
Ethylbenzene	g/m^3	< 0.001	0.0012	0.0013
m-Xylene	g/m^3	0.005	0.006	0.008
o-Xylene	g/m^3	0.0019	0.0026	0.0032
C7-C9	g/m^3	< 0.5	<0.2	<0.5
C10-C14	g/m^3	< 1	<0.4	<1
C15-C36	g/m^3	< 2	2.7	7
Total hydrocarbons	g/m^3	< 4	2.7	7

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

Table 7 Results of hydraulic fracturing return fluid sampling

Well	Unit	Kowhai-5		Kowhai-6
Parameter	**Range**	**Treatment #1**	**Treatment #2**	**Treatment #1**
pH	pH	7.2	7.4	7
Total Alkalinity	g/m^3 as $CaCO_3$	1,080	1,110	1,160
Total Hardness	g/m^3 as $CaCO_3$	210	177	178
Electrical Conductivity	mS/m	1,307	1,310	1,573
Total Dissolved Solids	9,400	9,400	8,600	11,000
Dissolved Barium	g/m^3	20	4	24
Dissolved Bromine	g/m^3	11.5	34	16.7
Dissolved Calcium	g/m^3	67	56	57
Dissolved Copper	g/m^3	0.117	0.01	0.019
Dissolved Iron	g/m^3	1.75	1.21	1.84
Dissolved Magnesium	g/m^3	11	9	9
Dissolved Manganese	g/m^3	2.1	1.41	2
Total Nickel	g/m^3	0.044	<0.01	<0.032
Total Potassium	g/m^3	90	4.9	105
Total Sodium	g/m^3	2,900	300	3,500
Total Sulphur	g/m^3	9	15	11
Total Zinc	g/m^3	0.39	0.0126	0.031
Chloride	g/m^3	3,800	3,800	4,700
Nitrite	g/m^3 N	<0.10	<0.10	<0.010
Nitrate	g/m^3 N	<0.10	<0.10	0.065
Nitrate+Nitrite	g/m^3 N	<0.10	<0.10	0.29
Sulphate	g/m^3	26	46	32

Well	Unit	Kowhai-5		Kowhai-6
Parameter	**Range**	**Treatment #1**	**Treatment #2**	**Treatment #1**
Ethylene glycol	g/m^3	<4	26	54
Propylene glycol	g/m^3	<4	<2	<2
Methanol	g/m^3	< 2	<2	<11
Benzene	g/m^3	3.2	2.8	18.2
Toluene	g/m^3	2.2	3.6	57
Ethylbenzene	g/m^3	0.136	0.46	8.3
m&p-Xylene	g/m^3	0.6	3.4	58
o-Xylene	g/m^3	0.33	1.39	17.4
Formaldehyde	g/m^3	< 0.15	0.18	0.73
C7-C9	g/m^3	11.9	46	620
C10-C14	g/m^3	39	210	1,100
C15-C3	g/m^3	50	390	240
Total hydrocarbons	g/m^3	101	640	1,970

*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 Incidents, investigations, and interventions

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

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

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

In the 2023/24 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans.

3. Discussion

3.1 Environmental effects of exercise of consent

Two wells, Kowhai-6 and Kowhai-5, were stimulated by hydraulic fracturing at the Kowhai-D wellsite during the period 31 August 2023 to 11 January 2024.

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 the Kowhai-D 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.

There was no surface water monitoring undertaken in relation to hydraulic fracturing activities at the wellsite.

In summary, the monitoring carried out by the Council during the period being reported indicated that the hydraulic fracturing activities undertaken by the Company at the Kowhai-D wellsite have 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 8.

Table 8 Summary of performance for Consent 10297-2

Purpose: To discharge water based hydraulic fracturing fluids into land at depths greater than 3,000 metres true vertical depth subsea (TVDss) beneath the Kowhai-D 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 2039	Assessment of consent holder submitted data	N/A
3. Monitoring and reporting of seismic events within 5km of any discharge location	Notification and post fracturing report	N/A
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 3,000 metres true vertical depth subsea (TVDss) beneath the Kowhai-D 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	Yes
15. 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	Consent Holder provided sample results	Yes
16. Consent holder to adopt best practicable option at all times	Site inspections, sampling and assessment of consent holder submitted data	Yes
17. Fracture fluid comprised of no less than 95% water and proppant by volume	Assessment of consent holder submitted data and sampling of fracturing fluid	Yes
18. Lapse clause	Consent exercised	Yes
19. 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

Table 9 Evaluation of environmental performance over time

Year	Consent numbers	High	Good	Improvement req	Poor
2018-2019	10297-1	1			
2019-2021	10297-1	1			
2023-2024	10297-2	1			

During the monitoring period, the Company demonstrated a high level of environmental and high level of administrative performance with the resource consent as defined in Appendix II.

3.3 Recommendations from the 2019-2021 Report

In the 2019-2021 report, it was recommended:

1. THAT in the first instance, the range of monitoring carried out during the reporting period in relation to the Company's hydraulic fracturing activities be replicated for any future fracturing events at the Kowhai-D 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 2021, as set out in condition 20 of the consent not be exercised.

Recommendation 1 was implemented, recommendation 2 was not required and recommendation 3 was accepted by Council.

3.4 Alterations to monitoring programmes for future hydraulic fracturing activities

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 the Company be replicated for any future fracturing events at the Kowhai-D wellsite.

A recommendation to this effect is 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.

4. Recommendations

1. THAT in the first instance, the range of monitoring carried out during the reporting period in relation to the Company's hydraulic fracturing activities be replicated for any future fracturing events at the Kowhai-D 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 2025, as set out in Condition 19 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 µS/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 (1,000L).
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.

Bibliography and references

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Greymouth Petroleum Ltd (2021): Kōwhai-D Hydraulic Fracturing Monitoring Programme Report 2018-2020 Technical Report 21-03.

Greymouth Petroleum Ltd (2019): Kōwhai-D water quality monitoring programme.

Greymouth Petroleum Ltd (2023): Kōwhai-5 Pre-Stimulation Discharge Report, July 2023.

Greymouth Petroleum Ltd (2023): Kōwhai-6 Pre-Stimulation Discharge Report, July 2023.

Greymouth Petroleum Ltd (2023): Kōwhai-6 Post-Stimulation Discharge Report, August 2023.

Greymouth Petroleum Ltd (2023): Kōwhai-5 Post-Stimulation Discharge Report, March 2024.

Appendix I

Resource Consent held by Greymouth 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:	Greymouth Petroleum Limited
Decision Date:	21 December 2023
Commencement Date:	21 December 2023

Conditions of Consent

Consent Granted:	To discharge contaminants associated with hydraulic fracturing activities into land at depths greater than 3000 mTVDss beneath the Kōwhai-D wellsite
Expiry Date:	1 June 2044
Review Date(s):	June annually
Site Location:	Kowhai D wellsite, 17 Manganui Road, Everett Park
Grid Reference (NZTM)	1710187E-5674875N
Catchment:	Waitara

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

General condition

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

Special conditions

1. The discharge point shall be deeper than 3000 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 2039.

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 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 (Chief Executive) 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 has considered the report and concluded that the environmental risk of recommencing hydraulic fracturing is acceptable and has advised the consent holder accordingly.

   Unless the Chief Executive advises that an alternative method is required this notice shall be served by completing and submitting the ‘Notification of work’ form on the Taranaki Regional Council’s website (http://bit.ly/TRCWorkNotificationForm).

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 1000 mg/l.

6. The consent holder shall undertake a programme of sampling and testing (the ‘Monitoring Programme’) that monitors the effects of the exercise of this consent on fresh water resources to assess compliance with Special Condition 5. The Monitoring Programme shall be certified by 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, as determined by the Chief Executive, 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 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);
   (l) carbon-13 composition of any dissolved methane gas discovered ($^{13}C\text{-}CH_4$)

   Note: *The samples required, under the 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 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 Special Condition 5.

   Note: *The Sampling and Analysis Plan may be combined with the Monitoring Programme required by Special 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. 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 Special Condition 16;
    (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 Special 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 interpreted faults (active or inactive) within 2 km if available of the surface discharge location, and a discussion regarding the potential for adverse 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 and the anticipated maximum well and discharge pressures and the duration of the pressures; and
(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 Special Condition 17.

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

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

12. The consent holder shall notify the Taranaki Regional Council of the date that each discharge is intended to commence. Notification also shall identify the 'Pre-fracturing Discharge Report', required by Special 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. Unless the Chief Executive advises that an alternative method is required this notice shall be served by completing and submitting the 'Notification of work' form on the Taranaki Regional Council's website (http://bit.ly/TRCWorkNotificationForm).

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. Within 90 days of any commencement date as advised under Special Condition 12, the consent holder shall submit a comprehensive 'Post-fracturing Discharge Report' to the Chief Executive. 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 Special Conditions 8, 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 seismic monitoring required by Special Condition 3.

(j) the results of pressure testing required by Special 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 Special Conditions 1 and 5; and
(m) results of the monitoring referred to in Special Condition 11(d);
(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: *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.*

14. Unless the Chief Executive advises that an alternative method is required, the reports required by Special Conditions 11 and 13 shall be provided by completing and submitting the 'Notification of work' form on the Taranaki Regional Council's website (http://bit.ly/TRCWorkNotificationForm).

15. 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.

16. 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.

17. The fracture fluid shall be comprised of no less than 95% water/N_2 and proppant by volume.

18. This consent lapses 5 years after its date of commencement, 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.

19. 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 investigation and report in accordance with Special Condition 4

    For the purpose of:

    (c) 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
    (d) further specifying the best practicable option as required by Special Condition 16; and/or
    (e) 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 21 December 2023

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)

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

☎ **0508 HILL LAB** (44 555 22)
☎ +64 7 858 2000
✉ mail@hill-labs.co.nz
🌐 www.**hill-labs**.co.nz

Certificate of Analysis

Client:	Taranaki Regional Council	**Lab No:**	3742750 SPv1
Contact:	Elizabeth Fynan C/- Taranaki Regional Council Private Bag 713 Stratford 4352	**Date Received:**	18-Dec-2024
		Date Reported:	03-Jan-2025
		Quote No:	47915
		Order No:	303395
		Client Reference:	#10051 - Kowhai D-1 year post frac
		Submitted By:	Josh Dowsing

Sample Type: Aqueous

Sample Name:		TRC2421730 (GND2632) 17-Dec-2024 9:40 am
Lab Number:		3742750.1
Individual Tests		
Gases in Ground Water*‡		See attached report
Sum of Anions	meq/L	3.3
Sum of Cations	meq/L	3.2
pH	pH Units	8.3
Total Alkalinity	g/m^3 as $CaCO_3$	150
Bicarbonate	g/m^3 at 25°C	180
Total Hardness	g/m^3 as $CaCO_3$	86
Electrical Conductivity (EC)	mS/m	30.7
Total Dissolved Solids (TDS)	g/m^3	166
Sample Temperature*†	°C	15.3
Dissolved Barium	g/m^3	< 0.005
Dissolved Calcium	g/m^3	20
Dissolved Copper	g/m^3	< 0.0005
Dissolved Iron	g/m^3	0.04
Dissolved Magnesium	g/m^3	8.6
Dissolved Manganese	g/m^3	0.0104
Dissolved Mercury	g/m^3	< 0.00008
Dissolved Nickel	g/m^3	< 0.0005
Dissolved Potassium	g/m^3	3.2
Dissolved Sodium	g/m^3	32
Dissolved Zinc	g/m^3	< 0.0010
Bromide	g/m^3	< 0.05
Chloride	g/m^3	11.9
Nitrite-N	g/m^3	< 0.002
Nitrate-N	g/m^3	< 0.002
Nitrate-N + Nitrite-N	g/m^3	< 0.002
Sulphate	g/m^3	< 0.5
Propylene Glycol in Water*		
Propylene glycol*	g/m^3	< 4
Ethylene Glycol in Water*		
Ethylene glycol*	g/m^3	< 4
Methanol in Water - Aqueous Solvents*		
Methanol*	g/m^3	< 2

Sample Type: Aqueous

Sample Name:		TRC2421730 (GND2632) 17-Dec-2024 9:40 am
Lab Number:		3742750.1
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
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 Labs cannot be held responsible for the validity of this customer supplied data, or any subsequent calculations that rely on this information.

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

Appendix No.1 - ALS 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 Labs, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Gases in Ground Water*	See attached report. Subcontracted to ALS Environmental - Brisbane.	-	1
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total anions for anion/cation balance check	Calculation: sum of anions as mEquiv/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 : Online Edition.	0.07 meq/L	1
Total cations for anion/cation balance check	Sum of cations as mEquiv/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 : Online Edition.	0.05 meq/L	1
pH	pH meter. APHA 4500-H$^+$ B (modified) : Online Edition. 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) : Online Edition.	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 : Online Edition.	1.0 g/m^3 at 25°C	1
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B : Online Edition.	1.0 g/m^3 as $CaCO_3$	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B : Online Edition.	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) : Online Edition.	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 : Online Edition.	0.005 g/m^3	1
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.05 g/m^3	1
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0005 g/m^3	1
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.02 g/m^3	1
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.02 g/m^3	1
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	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 : Online Edition.	0.0005 g/m^3	1
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.05 g/m^3	1
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.02 g/m^3	1
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0010 g/m^3	1
Bromide	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.05 g/m^3	1
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m^3	1
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) : Online Edition.	0.002 g/m^3	1
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - Nitrite-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) : Online Edition.	0.002 g/m^3	1
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m^3	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID analysis.	4 g/m^3	1
Ethylene Glycol in Water*	Direct injection, dual column GC-FID analysis.	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
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-Dec-2024 and 03-Jan-2025. 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.

K Harrison

Kim Harrison MSc
Client Services Manager - Environmental

CERTIFICATE OF ANALYSIS

Work Order : **EB2445087**
Client : **ANALYTICA LABORATORIES LIMITED - NZ**
Contact : Tamaryn Cronje
Address : RUAKURA RESEARCH CENTRE 10 Bisley Road
HAMILTON WAIKATO, NZ 3240
Telephone : ----
Project : 24-38920
Order number : ----
C-O-C number : ----
Sampler : ----
Site : ----
Quote number : EN/000
No. of samples received : 1
No. of samples analysed : 1

Page : 1 of 2
Laboratory : Environmental Division Brisbane
Contact : Customer Services EB
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : +61-7-3552-8685
Date Samples Received : 23-Dec-2024 09:09
Date Analysis Commenced : 24-Dec-2024
Issue Date : 27-Dec-2024 15:22

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- **EP030-LL analysis is conducted by ALS Environmental, Sydney, NATA accreditation no. 825, Site No. 10911.**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Sample ID*	**24-38920-1 3742750.1**	**----**	**----**	**----**	**----**
			Sampling date / time	17-Dec-2024 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2445087-001**	**--------**	**--------**	**--------**	**--------**
				Result	----	----	----	----
EP033: C1 - C4 Hydrocarbon Gases								
Methane	74-82-8	1	µg/L	**5150**	**----**	**----**	**----**	**----**
Ethene	74-85-1	1	µg/L	<1	**----**	**----**	**----**	**----**
Ethane	74-84-0	1	µg/L	**3**	**----**	**----**	**----**	**----**
Propene	115-07-1	1	µg/L	<1	**----**	**----**	**----**	**----**
Propane	74-98-6	1	µg/L	<1	**----**	**----**	**----**	**----**
Butene	25167-67-3	1	µg/L	<1	**----**	**----**	**----**	**----**
Butane	106-97-8	1	µg/L	<1	**----**	**----**	**----**	**----**

Inter-Laboratory Testing

Analysis conducted by ALS Sydney, NATA accreditation no. 825, site no. 10911 (Chemistry / Biology).

(WATER) EP033: C1 - C4 Hydrocarbon Gases

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

☎ **0508 HILL LAB** (44 555 22)
☎ +64 7 858 2000
mail@hill-labs.co.nz
www.**hill-labs**.co.nz

Certificate of Analysis

Client:	Taranaki Regional Council	**Lab No:**	3478468	SPv1
Contact:	Elizabeth Fynan C/- Taranaki Regional Council Private Bag 713 Stratford 4352	**Date Received:**	27-Feb-2024	
		Date Reported:	12-Apr-2024	
		Quote No:	47915	
		Order No:	300852	
		Client Reference:	#9288 - Kowhai D 3 Month PF	
		Submitted By:	Paloma Craig	

Sample Type: Aqueous

Sample Name:		TRC2417152 (GND2632) 26-Feb-2024 12:40 pm
Lab Number:		3478468.1
Individual Tests		
Gases in Ground Water*‡		See attached report
Sum of Anions	meq/L	3.3
Sum of Cations	meq/L	3.3
pH	pH Units	8.3
Total Alkalinity	g/m^3 as $CaCO_3$	149
Bicarbonate	g/m^3 at 25°C	178
Total Hardness	g/m^3 as $CaCO_3$	87
Electrical Conductivity (EC)	mS/m	31.5
Total Dissolved Solids (TDS)	g/m^3	174
Sample Temperature*†	°C	16.0
Dissolved Barium	g/m^3	< 0.005
Dissolved Calcium	g/m^3	20
Dissolved Copper	g/m^3	< 0.0005
Dissolved Iron	g/m^3	0.02
Dissolved Magnesium	g/m^3	8.9
Dissolved Manganese	g/m^3	0.0085
Dissolved Mercury	g/m^3	< 0.00008
Dissolved Nickel	g/m^3	< 0.0005
Dissolved Potassium	g/m^3	3.2
Dissolved Sodium	g/m^3	34
Dissolved Zinc	g/m^3	0.0021
Bromide	g/m^3	0.06
Chloride	g/m^3	11.7
Nitrite-N	g/m^3	< 0.002
Nitrate-N	g/m^3	0.125
Nitrate-N + Nitrite-N	g/m^3	0.125
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

Sample Type: Aqueous		
	Sample Name:	TRC2417152 (GND2632) 26-Feb-2024 12:40 pm
	Lab Number:	3478468.1
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
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 Labs cannot be held responsible for the validity of this customer supplied data, or any subsequent calculations that rely on this information.

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

Appendix No.1 - ALS 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 Labs, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Individual Tests			
Gases in Ground Water*	See attached report. Subcontracted to ALS Environmental - Brisbane.	-	1
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total anions for anion/cation balance check	Calculation: sum of anions as mEquiv/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 : Online Edition.	0.07 meq/L	1
Total cations for anion/cation balance check	Sum of cations as mEquiv/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 : Online Edition.	0.05 meq/L	1
pH	pH meter. APHA 4500-H^+ B (modified) : Online Edition. 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) : Online Edition.	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 : Online Edition.	1.0 g/m^3 at 25°C	1
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B : Online Edition.	1.0 g/m^3 as $CaCO_3$	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B : Online Edition.	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) : Online Edition.	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 : Online Edition.	0.005 g/m^3	1
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.05 g/m^3	1
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0005 g/m^3	1
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.02 g/m^3	1
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.02 g/m^3	1
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	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 : Online Edition.	0.0005 g/m^3	1
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.05 g/m^3	1
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.02 g/m^3	1
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0010 g/m^3	1
Bromide	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.05 g/m^3	1
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m^3	1
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) : Online Edition.	0.002 g/m^3	1
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - Nitrite-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) : Online Edition.	0.002 g/m^3	1
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m^3	1
Ethylene Glycol in Water*	Direct injection, dual column GC-FID analysis.	4 g/m^3	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID analysis.	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
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 27-Feb-2024 and 12-Apr-2024. 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.

Ara Heron BSc (Tech)
Client Services Manager - Environmental

CERTIFICATE OF ANALYSIS

Work Order : **EB2410475-AA**
Amendment : **1**
Client : **ANALYTICA LABORATORIES LIMITED**
Contact : Default reports
Address : RUAKURA RESEARCH CENTRE 10 Bisley Road
HAMILTON WAIKATO, NZ 3240
Telephone : ----
Project : 24-09159
Order number : ----
C-O-C number : ----
Sampler : ----
Site : ----
Quote number : EN/222
No. of samples received : 1
No. of samples analysed : 1

Page : 1 of 2
Laboratory : Environmental Division Brisbane
Contact : Customer Services EB
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : +61-7-3243 7222
Date Samples Received : 27-Mar-2024 13:47
Date Analysis Commenced : 04-Apr-2024
Issue Date : 12-Apr-2024 10:45

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- **EP033-LL analysis is conducted by ALS Environmental, Sydney, NATA accreditation no. 825, Site No. 10911 (Micro site no. 14913).**
- EP033-LL: Samples not received in a suitable time frame to conduct the analysis within the recommended holding time.

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

			Sample ID	**24-09159-1 3478468.1**	**----**	**----**	**----**	**----**
			Sampling date / time	26-Feb-2024 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2410475-001**	**--------**	**--------**	**--------**	**--------**
				Result	----	----	----	----
EP033: C1 - C4 Hydrocarbon Gases								
Methane	74-82-8	1	µg/L	**6220**	**----**	**----**	**----**	**----**
Ethene	74-85-1	1	µg/L	<1	**----**	**----**	**----**	**----**
Ethane	74-84-0	1	µg/L	**5**	**----**	**----**	**----**	**----**
Propene	115-07-1	1	µg/L	<1	**----**	**----**	**----**	**----**
Propane	74-98-6	1	µg/L	<1	**----**	**----**	**----**	**----**
Butene	25167-67-3	1	µg/L	<1	**----**	**----**	**----**	**----**
Butane	106-97-8	1	µg/L	<1	**----**	**----**	**----**	**----**

Inter-Laboratory Testing

Analysis conducted by ALS Sydney, NATA accreditation no. 825, site no. 10911 (Chemistry) 14913 (Biology).

(WATER) EP033: C1 - C4 Hydrocarbon Gases

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

☎ **0508 HILL LAB** (44 555 22)
☎ +64 7 858 2000
✉ mail@hill-labs.co.nz
www.**hill-labs**.co.nz

Certificate of Analysis

Client:	Taranaki Regional Council	**Lab No:**	3385705 SPv1
Contact:	Jane Harvey C/- Taranaki Regional Council Private Bag 713 Stratford 4352	**Date Received:**	14-Oct-2023
		Date Reported:	25-Oct-2023
		Quote No:	47915
		Order No:	4500011519
		Client Reference:	#8917 - Kowhai D 3 month PF GW
		Submitted By:	Paloma Craig

Sample Type: Aqueous

	Sample Name:	TRC2314472 (GND2632) 13-Oct-2023 10:10 am
	Lab Number:	3385705.1
Individual Tests		
Sum of Anions	meq/L	3.3
Sum of Cations	meq/L	3.3
pH	pH Units	8.3
Total Alkalinity	g/m^3 as $CaCO_3$	150
Bicarbonate	g/m^3 at 25°C	179
Total Hardness	g/m^3 as $CaCO_3$	89
Electrical Conductivity (EC)	mS/m	30.7
Total Dissolved Solids (TDS)	g/m^3	176
Sample Temperature*†	°C	15.2
Dissolved Barium	g/m^3	0.005
Dissolved Calcium	g/m^3	21
Dissolved Copper	g/m^3	< 0.0005
Dissolved Iron	g/m^3	0.04
Dissolved Magnesium	g/m^3	8.6
Dissolved Manganese	g/m^3	0.0091
Dissolved Mercury	g/m^3	< 0.00008
Dissolved Nickel	g/m^3	< 0.0005
Dissolved Potassium	g/m^3	3.1
Dissolved Sodium	g/m^3	32
Dissolved Zinc	g/m^3	< 0.0010
Bromide	g/m^3	< 0.05
Chloride	g/m^3	11.6
Nitrite-N	g/m^3	< 0.002
Nitrate-N	g/m^3	< 0.002
Nitrate-N + Nitrite-N	g/m^3	< 0.002
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
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

Sample Type: Aqueous

Sample Name:		TRC2314472 (GND2632) 13-Oct-2023 10:10 am
Lab Number:		3385705.1
Formaldehyde in Water by DNPH & LCMSMS		
Formaldehyde	g/m^3	< 0.02
Gases in groundwater		
Ethane	g/m^3	0.008
Ethylene	g/m^3	< 0.004
Methane	g/m^3	9.3
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 Labs 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 Labs, 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 mEquiv/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 : Online Edition.	0.07 meq/L	1
Total cations for anion/cation balance check	Sum of cations as mEquiv/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 : Online Edition.	0.05 meq/L	1
pH	pH meter. APHA 4500-H$^+$ B (modified) : Online Edition. 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) : Online Edition.	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 : Online Edition.	1.0 g/m^3 at 25°C	1
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B : Online Edition.	1.0 g/m^3 as CaCO$_3$	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B : Online Edition.	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) : Online Edition.	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 : Online Edition.	0.005 g/m^3	1
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.05 g/m^3	1
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0005 g/m^3	1
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.02 g/m^3	1

Sample Type: Aqueous

Test	**Method Description**	**Default Detection Limit**	**Sample No**
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.02 g/m^3	1
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	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 : Online Edition.	0.0005 g/m^3	1
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.05 g/m^3	1
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.02 g/m^3	1
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.0010 g/m^3	1
Bromide	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.05 g/m^3	1
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m^3	1
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) : Online Edition.	0.002 g/m^3	1
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - Nitrite-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) : Online Edition.	0.002 g/m^3	1
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	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 16-Oct-2023 and 25-Oct-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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Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental

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Certificate of Analysis

Page 1 of 3

Client:	Taranaki Regional Council	**Lab No:**	3315746 SPv1
Contact:	Jane Harvey C/- Taranaki Regional Council Private Bag 713 Stratford 4352	**Date Received:**	05-Jul-2023
		Date Reported:	12-Jul-2023
		Quote No:	47915
		Order No:	4500007241
		Client Reference:	#8677 - GPL Kowhai-D Pre Frac GW
		Submitted By:	Paloma Craig

Sample Type: Aqueous

Sample Name:		TRC2313262(GND2632) 04-Jul-2023 11:30 am
Lab Number:		3315746.1
Individual Tests		
Sum of Anions	meq/L	3.3
Sum of Cations	meq/L	3.3
pH	pH Units	8.2
Total Alkalinity	g/m^3 as $CaCO_3$	150
Bicarbonate	g/m^3 at 25°C	180
Total Hardness	g/m^3 as $CaCO_3$	92
Electrical Conductivity (EC)	mS/m	31.3
Total Dissolved Solids (TDS)	g/m^3	184
Sample Temperature*†	°C	15.1
Dissolved Barium	g/m^3	< 0.005
Dissolved Calcium	g/m^3	22
Dissolved Copper	g/m^3	< 0.0005
Dissolved Iron	g/m^3	0.04
Dissolved Magnesium	g/m^3	9.0
Dissolved Manganese	g/m^3	0.0089
Dissolved Mercury	g/m^3	< 0.00008
Dissolved Nickel	g/m^3	< 0.0005
Dissolved Potassium	g/m^3	3.2
Dissolved Sodium	g/m^3	33
Dissolved Zinc	g/m^3	0.0018
Bromide	g/m^3	0.05
Chloride	g/m^3	11.6
Nitrite-N	g/m^3	< 0.002
Nitrate-N	g/m^3	< 0.002
Nitrate-N + Nitrite-N	g/m^3	< 0.002
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
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

Sample Type: Aqueous

Sample Name:		TRC2313262(GND2632) 04-Jul-2023 11:30 am
Lab Number:		3315746.1
Formaldehyde in Water by DNPH & LCMSMS		
Formaldehyde	g/m^3	< 0.02
Gases in groundwater		
Ethane	g/m^3	0.008
Ethylene	g/m^3	< 0.004
Methane	g/m^3	8.8
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 Labs 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 Labs, 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 mEquiv/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 23rd ed. 2017.	0.07 meq/L	1
Total cations for anion/cation balance check	Sum of cations as mEquiv/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 23rd ed. 2017.	0.05 meq/L	1
pH	pH meter. APHA 4500-H^+ B 23rd 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) 23rd 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 23rd ed. 2017.	1.0 g/m^3 at 25°C	1
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 23rd ed. 2017.	1.0 g/m^3 as $CaCO_3$	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 23rd 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) 23rd 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 23rd ed. 2017.	0.005 g/m^3	1
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.05 g/m^3	1
Dissolved Copper	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0005 g/m^3	1
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	1
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd 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 23rd 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 23rd ed. 2017.	0.0005 g/m^3	1
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.05 g/m^3	1
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	1
Dissolved Zinc	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	1
Bromide	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.05 g/m^3	1
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m^3	1
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. 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) 23rd ed. 2017.	0.002 g/m^3	1
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23rd 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 05-Jul-2023 and 12-Jul-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.

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

Ara Heron BSc (Tech)
Client Services Manager - Environmental

Appendix IV

Certificates of analysis (hydraulic fracturing fluids)

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
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🌐 www.**hill-labs**.co.nz

Certificate of Analysis

Client:	Greymouth Petroleum Limited	**Lab No:**	3434688 SPv1
Contact:	Fiona Campbell	**Date Received:**	21-Dec-2023
	C/- Greymouth Petroleum Limited	**Date Reported:**	05-Jan-2024
	14 Connett Road West	**Quote No:**	85159
	Bell Block	**Order No:**	262953
	New Plymouth 4312	**Client Reference:**	Hydraulic fracturing fluid testing
		Submitted By:	Fiona Campbell

Sample Type: Aqueous

Sample Name:		Kowhai 5 stiml prepumped HF Fluids 18-Dec-2023
Lab Number:		3434688.1
Ethylene Glycol in Water*		
Ethylene glycol*	g/m^3	620
Propylene Glycol in Water*		
Propylene glycol*	g/m^3	< 20
Methanol in Water - Aqueous Solvents*		
Methanol*	g/m^3	< 20
BTEX in Water by Headspace GC-MS		
Benzene	g/m^3	0.0012
Toluene	g/m^3	0.0058
Ethylbenzene	g/m^3	< 0.0010
m&p-Xylene	g/m^3	0.005
o-Xylene	g/m^3	0.0019
Total Petroleum Hydrocarbons in Water		
C7 - C9	g/m^3	< 0.5
C10 - C14	g/m^3	< 1.0
C15 - C36	g/m^3	< 2
Total hydrocarbons (C7 - C36)	g/m^3	< 4

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 Labs, 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 analysis.	4 g/m^3	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID analysis.	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
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 22-Dec-2023 and 05-Jan-2024. 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.

K Harrison

Kim Harrison MSc
Client Services Manager - Environmental

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www.**hill-labs**.co.nz

Certificate of Analysis

Client:	Greymouth Petroleum Limited	**Lab No:**	3443726	SPv1
Contact:	Fiona Campbell C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	**Date Received:**	13-Jan-2024	
		Date Reported:	25-Jan-2024	
		Quote No:	81870	
		Order No:	262953	
		Client Reference:	Return Fluid Composite	
		Submitted By:	Fiona Campbell	

Sample Type: Aqueous

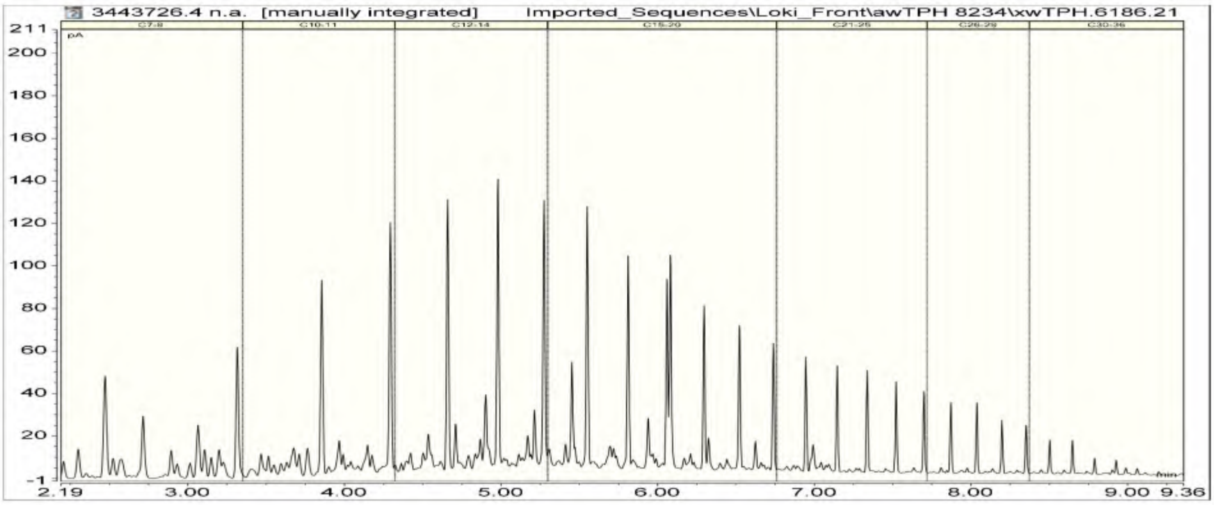
	Sample Name:	Composite of Kowhai 5 Stim1 Return HF Fluid Start, Kowhai 5 Stim1 Return HF Fluid Middle & Kowhai 5 Stim1 Return HF Fluid End
	Lab Number:	3443726.4
Individual Tests		
pH	pH Units	7.2
Total Alkalinity	g/m^3 as $CaCO_3$	1,080
Total Hardness	g/m^3 as $CaCO_3$	210
Electrical Conductivity (EC)	mS/m	1,307
Salinity*		7.5
Total Suspended Solids	g/m^3	240
Total Dissolved Solids (TDS)	g/m^3	9,400
Dissolved Barium	g/m^3	20
Dissolved Bromine	g/m^3	11.5
Dissolved Calcium	g/m^3	67
Dissolved Copper	g/m^3	0.117
Dissolved Iron	g/m^3	1.75
Dissolved Magnesium	g/m^3	11
Dissolved Manganese	g/m^3	2.1
Total Nickel*	g/m^3	0.044
Total Potassium*	g/m^3	90
Total Sodium*	g/m^3	2,900
Total Sulphur	g/m^3	9
Total Zinc*	g/m^3	0.39
Chloride	g/m^3	3,800
Nitrite-N	g/m^3	0.0015
Nitrate-N	g/m^3	< 0.0010
Nitrate	g/m^3	< 0.005
Nitrate-N + Nitrite-N	g/m^3	< 0.0010
Sulphate*	g/m^3	26
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	< 20
BTEX in Water by Headspace GC-MS		
Benzene	g/m^3	3.2
Toluene	g/m^3	2.2
Ethylbenzene	g/m^3	0.136
m&p-Xylene	g/m^3	0.60
o-Xylene	g/m^3	0.33

Sample Type: Aqueous		
Sample Name:		Composite of Kowhai 5 Stim1 Return HF Fluid Start, Kowhai 5 Stim1 Return HF Fluid Middle & Kowhai 5 Stim1 Return HF Fluid End
Lab Number:		3443726.4
Formaldehyde in Water by DNPH & LCMSMS		
Formaldehyde	g/m³	< 0.15
Total Petroleum Hydrocarbons in Water		
C7 - C9	g/m³	11.9
C10 - C14	g/m³	39
C15 - C36	g/m³	50
Total hydrocarbons (C7 - C36)	g/m³	101

3443726.4

Composite of Kowhai 5 Stim1 Return HF Fluid Start, Kowhai 5 Stim1 Return HF Fluid Middle & Kowhai 5 Stim1 Return HF Fluid End

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 Labs, 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.	-	4
Total Digestion	Boiling nitric acid digestion. APHA 3030 E (modified) : Online Edition.	-	4
Total Digestion of Saline Samples*	Nitric acid digestion. APHA 3030 E (modified) : Online Edition.	-	4
pH	pH meter. APHA 4500-H^+ B (modified) : Online Edition. 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	4
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) : Online Edition.	1.0 g/m³ as $CaCO_3$	4
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B : Online Edition.	1.0 g/m³ as $CaCO_3$	4
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B : Online Edition.	0.1 mS/m	4
Salinity*	Conductivity Meter (WTW Cond 340i with nonlinear temperature compensation according to EN 27 888). APHA 2520 B : Online Edition.	0.2	4
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) : Online Edition.	3 g/m³	4
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) : Online Edition.	50 g/m³	4

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Filtration for dissolved metals analysis - Ultratrace	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.	-	4
Dissolved Barium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B : Online Edition.	0.0006 g/m^3	4
Dissolved Bromine	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B : Online Edition.	0.10 g/m^3	4
Dissolved Calcium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B : Online Edition.	1.0 g/m^3	4
Dissolved Copper	Filtered sample, ICP-MS, ultratrace. APHA 3125 B : Online Edition.	0.0010 g/m^3	4
Dissolved Iron	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B : Online Edition.	0.02 g/m^3	4
Dissolved Magnesium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B : Online Edition.	0.4 g/m^3	4
Dissolved Manganese	Filtered sample, ICP-MS, ultratrace. APHA 3125 B : Online Edition.	0.0010 g/m^3	4
Total Nickel*	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B : Online Edition.	0.0070 g/m^3	4
Total Potassium*	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B : Online Edition.	1.1 g/m^3	4
Total Sodium*	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B : Online Edition.	0.42 g/m^3	4
Total Sulphur	Nitric acid digestion, ICP-OES (method may not fully account for H_2S due to volatilisation during digestion). All forms of oxidised and organic sulphur will be determined by this method. APHA 3120 B : Online Edition.	0.5 g/m^3	4
Total Zinc*	Nitric acid digestion, ICP-MS, ultratrace. APHA 3125 B : Online Edition.	0.0042 g/m^3	4
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m^3	4
Nitrite-N	Saline sample. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) : Online Edition.	0.0010 g/m^3	4
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N. In-House.	0.0010 g/m^3	4
Nitrate	Calculation from Nitrate-N.	0.005 g/m^3	4
Nitrate-N + Nitrite-N	Saline sample. Total oxidised nitrogen. Automated cadmium reduction, Flow injection analyser. APHA 4500-NO_3^- I (modified) : Online Edition.	0.0010 g/m^3	4
Total Sulphate*	Calculation: from total sulphur.	2 g/m^3	4
Ethylene Glycol in Water*	Direct injection, dual column GC-FID analysis.	4 g/m^3	4
Propylene Glycol in Water*	Direct injection, dual column GC-FID analysis.	4 g/m^3	4
Methanol in Water - Aqueous Solvents*	GC-FID analysis. In-house.	1.0 g/m^3	4
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	4
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	4
Total Petroleum Hydrocarbons in Water			
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.10 g/m^3	4
C10 - C14	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m^3	4
C15 - C36	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m^3	4
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	4

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

Testing was completed between 17-Jan-2024 and 25-Jan-2024. 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

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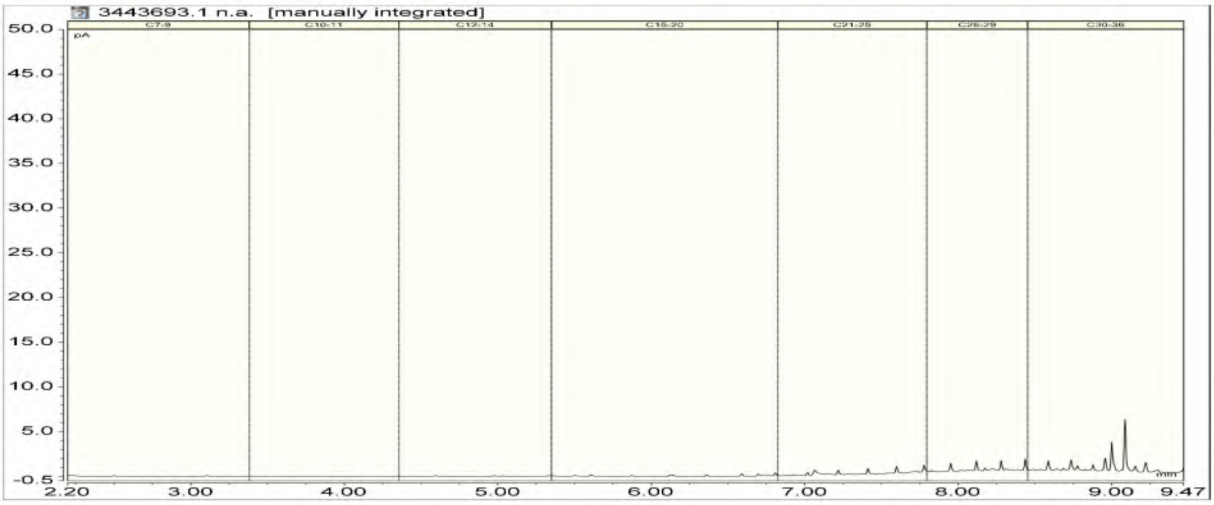
Certificate of Analysis

Client:	Greymouth Petroleum Limited	**Lab No:**	3443693 SPv1
Contact:	Fiona Campbell	**Date Received:**	13-Jan-2024
	C/- Greymouth Petroleum Limited	**Date Reported:**	22-Jan-2024
	14 Connett Road West	**Quote No:**	85159
	Bell Block	**Order No:**	263044
	New Plymouth 4312	**Client Reference:**	Hydraulic fracturing fluid testing
		Submitted By:	Fiona Campbell

Sample Type: Aqueous

Sample Name:		Kowhai 5 Stim 2 Prepumped HF Fluid 11-Jan-2024
Lab Number:		3443693.1
Ethylene Glycol in Water*		
Ethylene glycol*	g/m³	760
Propylene Glycol in Water*		
Propylene glycol*	g/m³	< 400
Methanol in Water - Aqueous Solvents*		
Methanol*	g/m³	< 20
BTEX in Water by Headspace GC-MS		
Benzene	g/m³	0.0015
Toluene	g/m³	0.0071
Ethylbenzene	g/m³	0.0012
m&p-Xylene	g/m³	0.006
o-Xylene	g/m³	0.0026
Total Petroleum Hydrocarbons in Water		
C7 - C9	g/m³	< 0.2
C10 - C14	g/m³	< 0.4
C15 - C36	g/m³	2.7
Total hydrocarbons (C7 - C36)	g/m³	2.7

3443693.1
Kowhai 5 Stim 2 Prepumped HF Fluid 11-Jan-2024
Client Chromatogram for TPH by FID



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

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 Labs, 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 analysis.	4 g/m^3	1
Propylene Glycol in Water*	Direct injection, dual column GC-FID analysis.	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
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 16-Jan-2024 and 22-Jan-2024. 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

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www.**hill-labs**.co.nz

Certificate of Analysis

Client:	Greymouth Petroleum Limited	**Lab No:**	3456320 SPv1
Contact:	Fiona Campbell C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	**Date Received:**	01-Feb-2024
		Date Reported:	12-Feb-2024
		Quote No:	81870
		Order No:	263044
		Client Reference:	Return Fluid Composite
		Submitted By:	Fiona Campbell

Sample Type: Aqueous

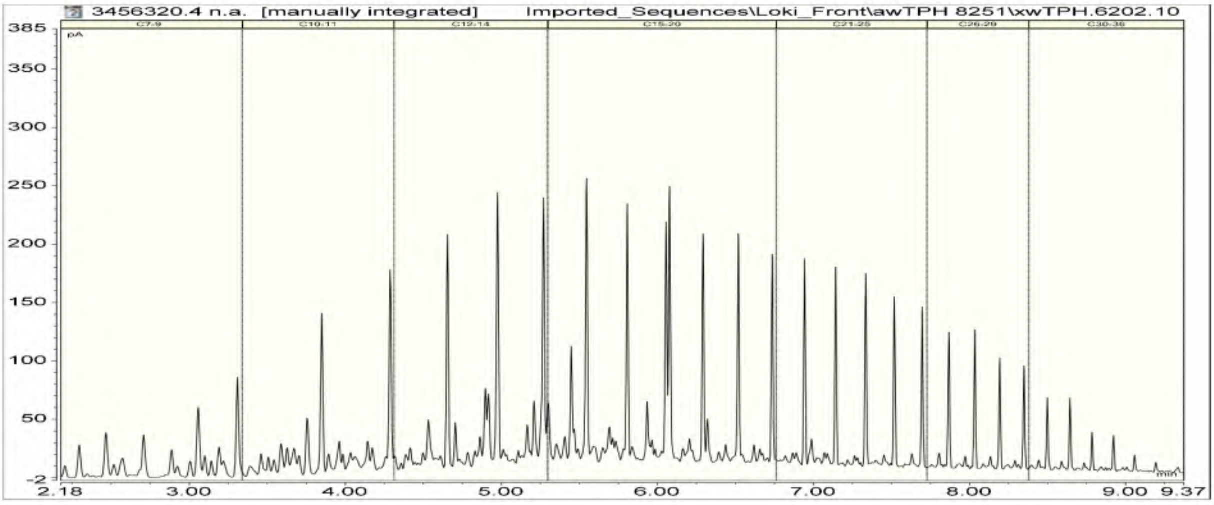
Sample Name:		Composite of Kowhai 5 Stim 2 Return HF Fluid - Start, Kowhai 5 Stim 2 Return HF Fluid - Middle & Kowhai 5 Stim 2 Return HF Fluid - End
Lab Number:		3456320.4
Individual Tests		
pH	pH Units	7.4
Total Alkalinity	g/m^3 as $CaCO_3$	1,110
Total Hardness	g/m^3 as $CaCO_3$	177
Electrical Conductivity (EC)	mS/m	1,310
Salinity*		7.7
Total Suspended Solids	g/m^3	240
Total Dissolved Solids (TDS)	g/m^3	8,600
Dissolved Barium	g/m^3	4.0
Dissolved Bromine	g/m^3	34
Dissolved Calcium	g/m^3	56
Dissolved Copper	g/m^3	0.010
Dissolved Iron	g/m^3	1.21
Dissolved Magnesium	g/m^3	9
Dissolved Manganese	g/m^3	1.41
Total Nickel*	g/m^3	< 0.0070
Total Potassium*	g/m^3	4.9
Total Sodium*	g/m^3	300
Total Sulphur	g/m^3	15
Total Zinc*	g/m^3	0.0126
Chloride	g/m^3	3,800
Nitrite-N	g/m^3	< 0.10 [#1]
Nitrate-N	g/m^3	< 0.10
Nitrate	g/m^3	< 0.5
Nitrate-N + Nitrite-N	g/m^3	< 0.10 [#1]
Sulphate*	g/m^3	46
Ethylene Glycol in Water*		
Ethylene glycol*	g/m^3	26
Propylene Glycol in Water*		
Propylene glycol*	g/m^3	< 20
Methanol in Water - Aqueous Solvents*		
Methanol*	g/m^3	< 20
BTEX in Water by Headspace GC-MS		
Benzene	g/m^3	2.8
Toluene	g/m^3	3.6
Ethylbenzene	g/m^3	0.46
m&p-Xylene	g/m^3	3.4
o-Xylene	g/m^3	1.39

Sample Type: Aqueous		
Sample Name:		Composite of Kowhai 5 Stim 2 Return HF Fluid - Start, Kowhai 5 Stim 2 Return HF Fluid - Middle & Kowhai 5 Stim 2 Return HF Fluid - End
Lab Number:		3456320.4
Formaldehyde in Water by DNPH & LCMSMS		
Formaldehyde	g/m³	0.18
Total Petroleum Hydrocarbons in Water		
C7 - C9	g/m³	46
C10 - C14	g/m³	210
C15 - C36	g/m³	390
Total hydrocarbons (C7 - C36)	g/m³	640

3456320.4

Composite of Kowhai 5 Stim 2 Return HF Fluid - Start, Kowhai 5 Stim 2 Return HF Fluid - Middle & Kowhai 5 Stim 2 Return HF Fluid - End

Client Chromatogram for TPH by FID



Analyst's Comments

[#1] 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 NO2Nsal, NO3Nsal and NOxNsal 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 Labs, 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.	-	4
Total Digestion	Boiling nitric acid digestion. APHA 3030 E (modified) : Online Edition.	-	4
Total Digestion of Saline Samples*	Nitric acid digestion. APHA 3030 E (modified) : Online Edition.	-	4
pH	pH meter. APHA 4500-H⁺ B (modified) : Online Edition. 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	4
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) : Online Edition.	1.0 g/m³ as $CaCO_3$	4
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B : Online Edition.	1.0 g/m³ as $CaCO_3$	4
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B : Online Edition.	0.1 mS/m	4
Salinity*	Conductivity Meter (WTW Cond 340i with nonlinear temperature compensation according to EN 27 888). APHA 2520 B : Online Edition.	0.2	4

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
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) : Online Edition.	3 g/m^3	4
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) : Online Edition.	50 g/m^3	4
Filtration for dissolved metals analysis - Ultratrace	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.	-	4
Dissolved Barium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B : Online Edition.	0.0006 g/m^3	4
Dissolved Bromine	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B : Online Edition.	0.10 g/m^3	4
Dissolved Calcium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B : Online Edition.	1.0 g/m^3	4
Dissolved Copper	Filtered sample, ICP-MS, ultratrace. APHA 3125 B : Online Edition.	0.0010 g/m^3	4
Dissolved Iron	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B : Online Edition.	0.02 g/m^3	4
Dissolved Magnesium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B : Online Edition.	0.4 g/m^3	4
Dissolved Manganese	Filtered sample, ICP-MS, ultratrace. APHA 3125 B : Online Edition.	0.0010 g/m^3	4
Total Nickel*	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B : Online Edition.	0.0070 g/m^3	4
Total Potassium*	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B : Online Edition.	1.1 g/m^3	4
Total Sodium*	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B : Online Edition.	0.42 g/m^3	4
Total Sulphur	Nitric acid digestion, ICP-OES (method may not fully account for H_2S due to volatilisation during digestion). All forms of oxidised and organic sulphur will be determined by this method. APHA 3120 B : Online Edition.	0.5 g/m^3	4
Total Zinc*	Nitric acid digestion, ICP-MS, ultratrace. APHA 3125 B : Online Edition.	0.0042 g/m^3	4
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m^3	4
Nitrite-N	Saline sample. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) : Online Edition.	0.0010 g/m^3	4
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N. In-House.	0.0010 g/m^3	4
Nitrate	Calculation from Nitrate-N.	0.005 g/m^3	4
Nitrate-N + Nitrite-N	Saline sample. Total oxidised nitrogen. Automated cadmium reduction, Flow injection analyser. APHA 4500-NO_3^- I (modified) : Online Edition.	0.0010 g/m^3	4
Total Sulphate*	Calculation: from total sulphur.	2 g/m^3	4
Ethylene Glycol in Water*	Direct injection, dual column GC-FID analysis.	4 g/m^3	4
Propylene Glycol in Water*	Direct injection, dual column GC-FID analysis.	4 g/m^3	4
Methanol in Water - Aqueous Solvents*	GC-FID analysis. In-house.	1.0 g/m^3	4
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	4
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	4
Total Petroleum Hydrocarbons in Water			
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.10 g/m^3	4
C10 - C14	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m^3	4
C15 - C36	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m^3	4
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	4

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

Testing was completed between 05-Feb-2024 and 12-Feb-2024. 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

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Hamilton 3240 New Zealand

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☎ +64 7 858 2000
mail@hill-labs.co.nz
www.**hill-labs**.co.nz

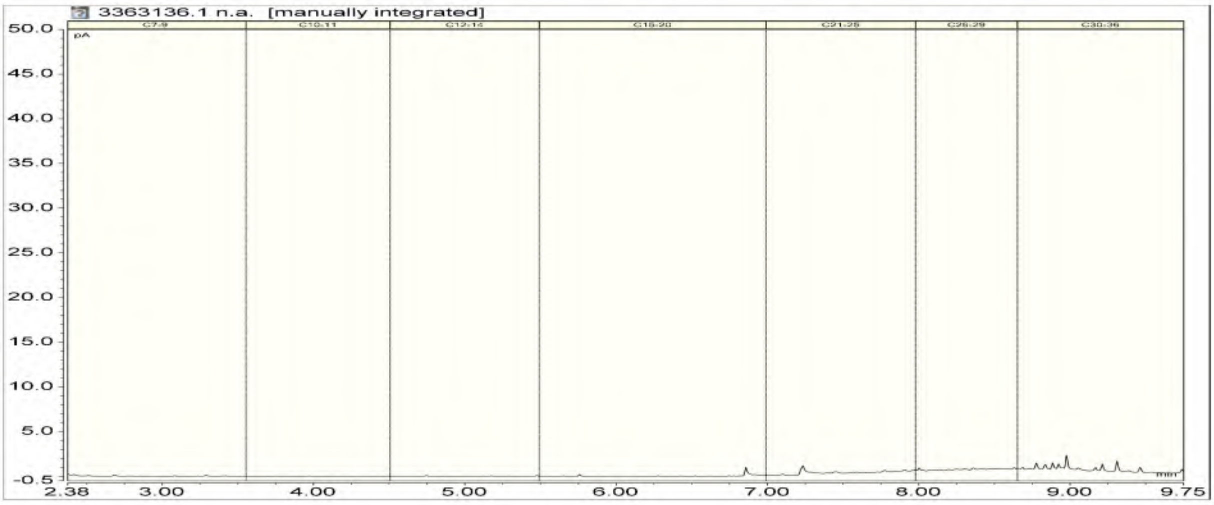
Certificate of Analysis

Client:	Greymouth Petroleum Limited	**Lab No:**	3363136 SPv1
Contact:	Fiona Campbell C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	**Date Received:**	13-Sep-2023
		Date Reported:	25-Sep-2023
		Quote No:	85159
		Order No:	261837
		Client Reference:	Hydraulic fracturing fluid testing
		Submitted By:	Fiona Campbell

Sample Type: Aqueous

Sample Name:		Kowhai 6 Stim 1 Prepumped HF Fluid 31-Aug-2023
Lab Number:		3363136.1
Ethylene Glycol in Water*		
Ethylene glycol*	g/m³	740
Propylene Glycol in Water*		
Propylene glycol*	g/m³	< 20
Methanol in Water - Aqueous Solvents*		
Methanol*	g/m³	< 100
BTEX in Water by Headspace GC-MS		
Benzene	g/m³	0.0037
Toluene	g/m³	0.0127
Ethylbenzene	g/m³	0.0013
m&p-Xylene	g/m³	0.008
o-Xylene	g/m³	0.0032
Total Petroleum Hydrocarbons in Water		
C7 - C9	g/m³	< 0.5
C10 - C14	g/m³	< 1.0
C15 - C36	g/m³	7
Total hydrocarbons (C7 - C36)	g/m³	7

3363136.1
Kowhai 6 Stim 1 Prepumped HF Fluid 31-Aug-2023
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 Labs, 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	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
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 15-Sep-2023 and 25-Sep-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.

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

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Certificate of Analysis

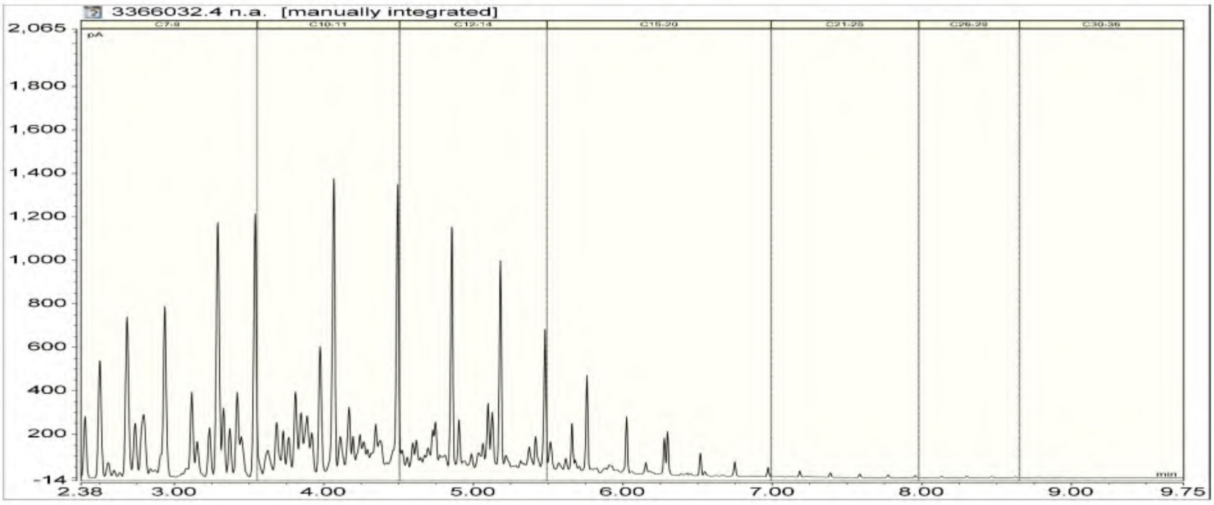
Client:	Greymouth Petroleum Limited	**Lab No:**	3366032	SPv1
Contact:	Fiona Campbell C/- Greymouth Petroleum Limited 14 Connett Road West Bell Block New Plymouth 4312	**Date Received:**	16-Sep-2023	
		Date Reported:	29-Sep-2023	
		Quote No:	81870	
		Order No:	261837	
		Client Reference:	Return Fluid Composite	
		Submitted By:	Fiona Campbell	

Sample Type: Aqueous

	Sample Name:	Composite of Kowhai 6 Stim 1 Return HF Fluid Start, Kowhai 6 Stim 1 Return HF Fluid Middle and Kowhai 6 Stim 1 Return HF Fluid End
	Lab Number:	3366032.4
Individual Tests		
pH	pH Units	7.0
Total Alkalinity	g/m^3 as $CaCO_3$	1,160
Total Hardness	g/m^3 as $CaCO_3$	178
Electrical Conductivity (EC)	mS/m	1,573
Salinity*		9.5
Total Suspended Solids	g/m^3	185
Total Dissolved Solids (TDS)	g/m^3	11,000
Dissolved Barium	g/m^3	24
Dissolved Bromine	g/m^3	16.7
Dissolved Calcium	g/m^3	57
Dissolved Copper	g/m^3	0.019
Dissolved Iron	g/m^3	1.84
Dissolved Magnesium	g/m^3	9
Dissolved Manganese	g/m^3	2.0
Total Nickel*	g/m^3	< 0.032
Total Potassium*	g/m^3	105
Total Sodium*	g/m^3	3,500
Total Sulphur	g/m^3	11
Total Zinc*	g/m^3	0.031
Chloride	g/m^3	4,700
Nitrite-N	g/m^3	< 0.010 [#1]
Nitrate-N	g/m^3	0.065
Nitrate	g/m^3	0.29
Nitrate-N + Nitrite-N	g/m^3	0.072 [#1]
Sulphate*	g/m^3	32
Ethylene Glycol in Water*		
Ethylene glycol*	g/m^3	54
Propylene Glycol in Water*		
Propylene glycol*	g/m^3	< 20
Methanol in Water - Aqueous Solvents*		
Methanol*	g/m^3	< 110
BTEX in Water by Headspace GC-MS		
Benzene	g/m^3	18.2
Toluene	g/m^3	57
Ethylbenzene	g/m^3	8.3
m&p-Xylene	g/m^3	58
o-Xylene	g/m^3	17.4

Sample Type: Aqueous		
Sample Name:		Composite of Kowhai 6 Stim 1 Return HF Fluid Start, Kowhai 6 Stim 1 Return HF Fluid Middle and Kowhai 6 Stim 1 Return HF Fluid End
Lab Number:		3366032.4
Formaldehyde in Water by DNPH & LCMSMS		
Formaldehyde	g/m³	0.73
Total Petroleum Hydrocarbons in Water		
C7 - C9	g/m³	620
C10 - C14	g/m³	1,100
C15 - C36	g/m³	240
Total hydrocarbons (C7 - C36)	g/m³	1,970

3366032.4
Composite of Kowhai 6 Stim 1 Return HF Fluid Start, Kowhai 6 Stim 1 Return HF Fluid Middle and Kowhai 6 Stim 1 Return HF Fluid End
Client Chromatogram for TPH by FID



Analyst's Comments

[#1] 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 NOxN 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 Labs, 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.	-	4
Total Digestion	Boiling nitric acid digestion. APHA 3030 E (modified) 23rd ed. 2017.	-	4
Total Digestion of Saline Samples*	Nitric acid digestion. APHA 3030 E (modified) 23rd ed. 2017.	-	4
pH	pH meter. APHA 4500-H⁺ B 23rd 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	4
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) 23rd ed. 2017.	1.0 g/m³ as $CaCO_3$	4
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 23rd ed. 2017.	1.0 g/m³ as $CaCO_3$	4
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 23rd ed. 2017.	0.1 mS/m	4
Salinity*	Conductivity Meter (WTW Cond 340i with nonlinear temperature compensation according to EN 27 888). APHA 2520 B 23rd ed. 2017.	0.2	4

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
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) 23rd ed. 2017.	3 g/m^3	4
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) 23rd ed. 2017.	50 g/m^3	4
Filtration for dissolved metals analysis - Ultratrace	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 23rd ed. 2017.	-	4
Dissolved Barium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23rd ed. 2017.	0.0006 g/m^3	4
Dissolved Bromine	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23rd ed. 2017.	0.10 g/m^3	4
Dissolved Calcium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23rd ed. 2017.	1.0 g/m^3	4
Dissolved Copper	Filtered sample, ICP-MS, ultratrace. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	4
Dissolved Iron	Filtered sample, ICP-MS with dynamic reaction cell, ultratrace. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	4
Dissolved Magnesium	Filtered sample, ICP-MS, ultratrace level. APHA 3125 B 23rd ed. 2017.	0.4 g/m^3	4
Dissolved Manganese	Filtered sample, ICP-MS, ultratrace. APHA 3125 B 23rd ed. 2017.	0.0010 g/m^3	4
Total Nickel*	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23rd ed. 2017.	0.0070 g/m^3	4
Total Potassium*	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23rd ed. 2017.	1.1 g/m^3	4
Total Sodium*	Nitric acid digestion, ICP-MS, ultratrace level. APHA 3125 B 23rd ed. 2017.	0.42 g/m^3	4
Total Sulphur	Nitric acid digestion, ICP-OES (method may not fully account for H_2S due to volatilisation during digestion). All forms of oxidised and organic sulphur will be determined by this method. APHA 3120 B 23rd ed. 2017.	0.5 g/m^3	4
Total Zinc*	Nitric acid digestion, ICP-MS, ultratrace. APHA 3125 B 23rd ed. 2017.	0.0042 g/m^3	4
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m^3	4
Nitrite-N	Saline sample. Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.0010 g/m^3	4
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m^3	4
Nitrate	Calculation from Nitrate-N.	0.005 g/m^3	4
Nitrate-N + Nitrite-N	Saline sample. Total oxidised nitrogen. Automated cadmium reduction, Flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.0010 g/m^3	4
Total Sulphate*	Calculation: from total sulphur.	2 g/m^3	4
Ethylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m^3	4
Propylene Glycol in Water*	Direct injection, dual column GC-FID.	4 g/m^3	4
Methanol in Water - Aqueous Solvents*	GC-FID analysis. In-house.	1.0 g/m^3	4
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	4
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	4
Total Petroleum Hydrocarbons in Water			
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.10 g/m^3	4
C10 - C14	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m^3	4
C15 - C36	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m^3	4
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	4

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

Testing was completed between 19-Sep-2023 and 29-Sep-2023. For completion dates of individual analyses please contact the laboratory.

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