

NZEC Waihapa Ltd Deep Well Injection
Monitoring Programme
Annual Report
2015-2016

Technical Report 2016-59

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Executive summary

NZEC Waihapa Limited and Taranaki Ventures Limited (the Company) operate a number of wellsites within the Taranaki Region, most notably the Waihapa-D, Waihapa-F and Waitapu wellsites. The Waihapa-F wellsite is located on Bird Road, Stratford. The Waihapa-D and Waitapu wellsites are located on Cheal Road, Stratford. Each wellsite contains varying numbers of producing wells and associated production infrastructure. This report for the period July 2015 to June 2016 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) in relation to the Company's deep well injection (DWI) activities. The report details the results of the monitoring undertaken, assesses the Company's environmental performance during the period under review and the environmental effects of their DWI activities.

The Company holds three resource consents, which include a total of 31 conditions setting out the requirements that the Company must satisfy. Only two of the consents were exercised during the period being reported.

During the monitoring period NZEC Waihapa Limited and Taranaki Ventures Limited demonstrated an overall high level of environmental performance.

The Council's monitoring programme for the year under review included eight inspections, two injectate samples, and four groundwater samples collected for physicochemical analysis. The monitoring programme also included a significant data review component, with all injection data submitted by the company assessed for compliance on receipt.

The monitoring showed that the Company's DWI activities were being carried out in compliance with the conditions of the applicable resource consents. There is no evidence of any issues with any injection well currently in use, or the ability of the receiving formation to accept injected fluids. The results of groundwater quality monitoring undertaken show no adverse effects of the activity at monitored locations. Inspections undertaken during the monitoring year found sites being operated in a professional manner and there were no Unauthorised Incidents in relation to any of the Company's DWI consents.

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

For reference, in the 2015-2016 year, 71% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 24% demonstrated a good level of environmental performance and compliance with their consents.

In terms of overall environmental and compliance performance by the Company over the last several years, this report shows that the Company's performance remains at a high level.

This report includes recommendations to be implemented during the 2016-2017 monitoring period.

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1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2015 to June 2016 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by NZEC Waihapa Limited and Taranaki Ventures Limited (the Company) for deep well injection (DWI) activities. During the period under review, the Company held three resource consents for the subsurface injection of fluids by DWI. The consents authorise discharges from three separate wellsites within the Company's oil and gas fields. The Waihapa-F wellsite, located near Bird Road, 6 kilometres (km) south east of Stratford and the Waihapa-D and Waitapu wellsites located on Cheal Road, Ngaere, approximately 5 km north east of Eltham.

The resource consents held by the Company permit the discharge of a range of fluids by DWI, including produced water, contaminated stormwater, drilling fluids, hydraulic fracturing fluids and production sludges. The consents include a number of special conditions which set out specific requirements the Company must satisfy.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the DWI consents held by the Company. This is the third report to be prepared by the Council to cover the Company's DWI discharges and their effects.

1.1.2 Structure of this report

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

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

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

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

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

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

1.1.3 The Resource Management Act 1991 and monitoring

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

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

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

1.1.4 Evaluation of environmental and administrative performance

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

Environmental performance is concerned with actual or likely effects on the receiving environment from the activities during the monitoring year.

Administrative performance is concerned with the Company’s approach to demonstrating consent compliance in site operations and management including the timely provision of information to Council (such as contingency plans and water take data) in accordance with consent conditions.

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

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

Environmental Performance

- **High:** No or inconsequential (short-term duration, less than minor in severity) breaches of consent or regional plan parameters resulting from the activity; no adverse effects of significance noted or likely in the receiving environment. The Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices or infringement notices in relation to such impacts.
- **Good:** Likely or actual adverse effects of activities on the receiving environment were negligible or minor at most. There were some such issues noted during monitoring, from self reports, or in response to unauthorised incident reports, but these items were not critical, and follow-up inspections showed they have been dealt with. These minor issues were resolved positively, co-operatively, and quickly. The Council was not obliged to issue any abatement notices or infringement notices in relation to the minor non-compliant effects; however abatement notices may have been issued to mitigate an identified potential for an environmental effect to occur.

For example:

- High suspended solid values recorded in discharge samples, however the discharge was to land or to receiving waters that were in high flow at the time;
- Strong odour beyond boundary but no residential properties or other recipient nearby.
- **Improvement required:** Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent minor non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.
- **Poor:** Likely or actual adverse effects of activities on the receiving environment were significant. There were some items noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent moderate non-compliant activity could elevate an 'improvement required' issue to this level. Typically there were grounds for either a prosecution or an infringement notice in respect of effects.

Administrative performance

- **High:** The administrative requirements of the resource consents were met, or any failure to do this had trivial consequences and were addressed promptly and co-operatively.
- **Good:** Perhaps some administrative requirements of the resource consents were not met at a particular time, however this was addressed without

repeated interventions from the Council staff. Alternatively adequate reason was provided for matters such as the no or late provision of information, interpretation of 'best practical option' for avoiding potential effects, etc.

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

For reference, in the 2015-2016 year, 71% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 24% demonstrated a good level of environmental performance and compliance with their consents.

1.2 Process description

The process of DWI involves injecting fluids deep underground into geological formations which are confined from overlying groundwater aquifers by low permeability strata. Injection wells are also designed and constructed to provide multi barrier protection against contaminant migration to groundwater systems.

The subsurface injection of fluids by DWI is often used as a method for disposing of waste fluids generated during oil and gas exploration and production activities. The greatest volume of waste fluids generated through these activities is saline water (brine) that is drawn to the surface with hydrocarbons through producing wells ('produced water'). The DWI consents currently held by the Company also authorise the injection of fluid types other than the produced water. The range of fluid types authorised for injection varies by consent, but includes contaminated stormwater, water based well drilling fluids, hydraulic fracturing fluids and hydraulic fracturing return fluids.

In addition to providing a means to dispose of waste fluids, the subsurface injection of fluids by DWI is also an established oilfield technique for regulating

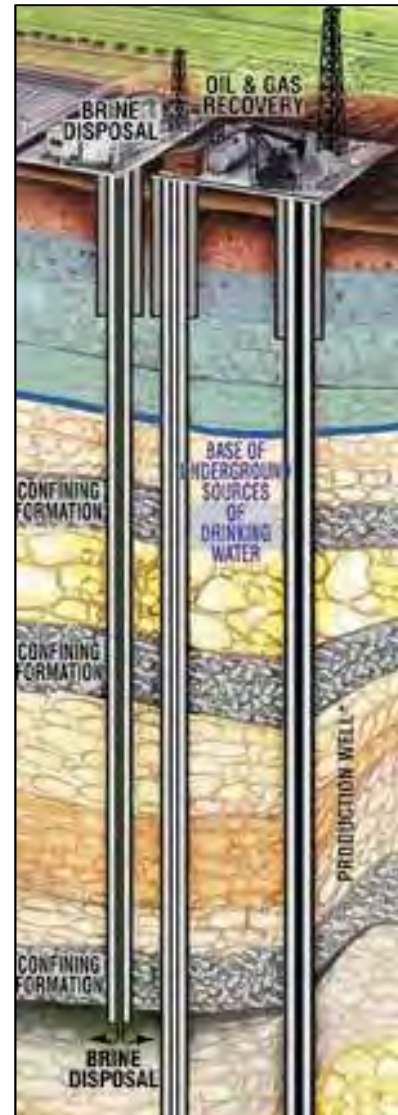


Figure 1 DWI schematic (www.epa.gov/uic)



reservoir pressure as a means of enhancing the rate of hydrocarbon recovery from a reservoir. This process, commonly referred to as water flooding, is often implemented when natural reservoir pressures become reduced due to ongoing production. Fluids can also be heated prior to injection to reduce the viscosity of the oil being produced, improving its flow toward a producing well and upward through the wellbore itself.

The Company has a water flood programme within its Waitapu wellsite under consent 10086-1 to enhance oil production from its Copper Moki site, also located on Cheal Road.

A schematic representation of injection wells for both waste discharge and enhanced oil recovery is presented in Figure 1.

Further details regarding hydrocarbon exploration and production in Taranaki, the DWI process and its history within region can be found in previous compliance reports published by the Council (see Bibliography).

1.3 Resource consents

1.3.1 Discharge permit

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

The Company holds three discharge consents covering their DWI activities (Table 1).

Table 1 DWI consents held by the Company during the 2015-2016 monitoring year

Consent Number	Wellsite	Status	Injection well(s)	TRC bore id.	Formation	Issued	Expiry
3688-2	Waihapa-D	Not active	Waihapa-5	GND1752	Tikorangi	03/09/2013	01/06/2034
4094-2	Waihapa-F	Active	Waihapa-7A	GND1634	Matemateaonga	03/09/2013	01/06/2028
10086-1	Waitapu	Active	Waitapu-2	GND2529	Mt Messenger	31/03/2015	01/06/2034

Consent 3688-2 was issued to the Company by the Council on 3 September 2013 under Section 87(e) of the RMA. It is due to expire on 1 June 2034. The consent authorises the discharge of waste fluids by DWI at the Waihapa-D wellsite, Cheal Road, Stratford (Figure 2).

The current consent has seven special conditions, as summarised below:

- Conditions 1, 3 and 4 refer to the Company's process monitoring and data submission requirements;
- Condition 2 prohibits the discharge from endangering or contaminating any freshwater aquifer;

- Condition 5 limits injection pressures to those which do not fracture the injection formation;
- Condition 6 is a lapse clause; and
- Condition 7 is a consent review provision.

Consent **4094-2** was issued to the Company by the Council on 3 September 2013 under section 87(e) of the RMA. It is due to expire on 1 June 2028. The consent authorises the discharge of waste fluids via the Waihapa-7A well at the Waihapa-F wellsite, Bird Road, Stratford (Figure 2).

The current consent has six special conditions, as summarised below:

- Condition 1 states that the well shall operate in accordance with the “Origin Energy Resource NZ Limited – Deep Well Injection Management Plan;” This plan was superseded by an updated version submitted by NZEC following the acquisition of the Waihapa-F wellsite.
- Condition 2 sets a maximum allowable injection pressure of 85 bar (1,232 psi);
- Condition 3 requires the company adopt the best practicable option as defined in section 2 of the RMA;
- Conditions 4 and 5 refer to the Company’s process monitoring and data submission requirements; and
- Condition 6 is a review provision.

Consent **10086-1** was issued by the Council on 31 March 2015 under section 87(e) of the RMA. It is due to expire on 1 June 2034. The consent authorises the discharge of waste fluids via the Waitapu-2 well at the Waitapu wellsite on Cheal Road, Stratford (Figure 2).

The current consent has eighteen special conditions, as summarised below:

- Condition 1 requires the consent holder to submit a “Injection Operation Management Plan” prior to exercising the consent;
- Condition 2 refers to injection well and subsurface information required for submission;
- Condition 3 limits the injection pressure to below 689 psi;
- Condition 4 stipulates that there shall be no injection after 1 June 2029;
- Condition 5 requires the best practicable option to be adopted for fluid injection;
- Condition 6 limits the injection of fluids to the Mount Messenger Formation, below 1,800 m TVD;
- Condition 7 prohibits the discharge resulting in fracturing of the geological seals confining the injection zone;
- Condition 8 prohibits the discharge from resulting in any contaminants reaching any useable freshwater resources;
- Conditions 9, 10, 11 and 12 refer to process monitoring and data submission requirements;
- Conditions 13, 14 and 15 refer to local groundwater quality monitoring requirements;
- Condition 16 stipulates the annual reporting requirements;
- Condition 17 is a lapse provision; and
- Condition 18 is a review condition.

A copy of each consent is attached to this report in Appendix I.



Figure 2 Waihapa and Waitapu wellsites and consent location map

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 active DWI sites consisted of five primary components.

1.4.2 Programme liaison and management

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

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

1.4.3 Site inspections

The Company's Waitapu and Waihapa-D wellsites were inspected once by Council Officer's during the monitoring period. The Waihapa-F wellsite was inspected six times as part of the Waihapa Production Station Monitoring Programme. With regard to consents for the abstraction of or discharge to water, the main points of interest were plant processes with potential or actual discharges to receiving watercourses, including contaminated stormwater and process wastewaters. Air inspections focused on plant processes with associated actual and potential emission sources and characteristics, including potential odour, dust, noxious or offensive emissions. Sources of data being collected by the Company were identified and accessed, so that performance in respect of operation, internal monitoring, and supervision could be reviewed by the Council. The neighbourhood was surveyed for environmental effects.

An additional two visits to the Company's Waihapa Production Station were undertaken by Council Officer's for injectate sampling purposes as outlined in Section 1.4.4.

1.4.4 Injectate sampling

Injectate samples were obtained for analysis in the Council's IANZ accredited laboratory on two occasions during the monitoring period. The sampling of injectate is carried out in order to characterise the general chemical nature of the discharge and also the variation in its chemical composition across the monitoring period.

Injectate samples were collected from the bulk storage tanks at the Waihapa Production Station, identified on-site as tanks T206A and T206B.

The injectate samples were analysed for the following parameters:

- pH;
- conductivity;
- alkalinity;
- chlorides; and
- total petroleum hydrocarbons.

1.4.5 Groundwater sampling

Groundwater samples were also obtained on two occasions during the monitoring period. This sampling is a continuation of the groundwater monitoring component of this programme which was initiated during the 2012-2013 monitoring period when consent 4094-2 was still held by Origin Energy New Zealand (TAWN) Limited, and has continued after the consent was transferred to the Company.

One groundwater monitoring site was selected for groundwater sampling for the Waihapa-F wellsite. A monitoring bore was specifically drilled by the Company for the purpose of monitoring the Waitapu wellsite, as no suitable existing monitoring bores were available in the vicinity of the wellsite.

Details of the groundwater monitoring sites currently included in the monitoring programme are listed below in Table 2. The location of the groundwater sites in relation to the injection well being monitored are illustrated in Figure 3.

Table 2 Location of groundwater sampling sites

Site code	Wellsite	Distance from injection well (m)	Screened/open depth (m)	Drilled depth (m)	Groundwater level (m BGL)	Aquifer	Sample type
GND1031	Waihapa-F	748	220-303	303.8	26	Matemateaonga	Tap
GND2528	Waitapu	41	38-50	50.3	5.8	Volcanics	Bladder



Figure 3 Groundwater monitoring bore sites in relation to injection wells

Groundwater samples are analysed in the Council's IANZ accredited laboratory for a basic range of chemical parameters as follows:

- pH;
- conductivity;

- chlorides; and
- total petroleum hydrocarbons.

The parameters above are deemed sufficient to enable identification of any significant changes in groundwater quality related to DWI activities.

In addition, baseline samples have been collected and analysed by Hill Laboratories Limited for general ion chemistry, BTEX and dissolved gas concentrations. These more detailed analyses will allow a more in depth assessment of variations in groundwater composition should the need arise in the future.

1.4.6 Assessment of data submitted by the Company

A significant component of the monitoring programme is the assessment of consent holder submitted data. The Company is required to submit a wide range of data under the conditions of their respective DWI consents.

As required by the conditions of their consents, the Company has submitted an Injection Operation Management Plan for each active injection well. The plans are required to include the operational details of the injection activities and to identify the conditions that would trigger concerns about the integrity of the injection well, the receiving formation or overlying geological seals. The plans are also required to detail the action(s) to be taken by the consent holder if trigger conditions are reached. The Company was also required to submit well construction details, an assessment of the local geological environment, results of well integrity testing and details of the proposed monitoring plan for the injection well.

The Company is also required to maintain continuous records of injection volumes, rates and pressures, and to characterise the chemical characteristics of all waste types being discharged. This data is submitted to the Council on a monthly basis where it is assessed for compliance against the relevant consent conditions.

2. Results

2.1 Site inspections

One routine inspection of the Company's Waihapa-D and Waitapu wellsites and six inspections at the Waihapa-D wellsite were conducted as part of the wellsite monitoring programme. Routine inspections included undertaking a general visual assessment of the operational equipment, storage facilities and associated equipment.

The inspecting officer concluded that the wellsites were in good condition and being well managed. There were no issues noted specific to any of the Company's DWI consents.

The Waihapa Production Station was also visited by Council officer's on two occasions during the monitoring year for the purpose of injectate sampling. This involved accessing the Company's bulk liquid storage tanks at the site. No issues were noted by staff during these visits.

2.2 Injectate sampling

Samples of injectate were obtained from the Company's storage tanks on 5 October 2015 and 29 April 2016. The samples were submitted to the Council's laboratory on the same day for physicochemical analysis. Injectate samples are generally a composite of waste water from the Company's wellsites, third party wellsites and other production facilities.

The results of the sample analyses are included below in Table 3. The range of results for each analyte since 2004 is also presented for comparison. The Company also undertakes additional injectate sampling on a monthly basis. The results from the Company's sampling programme are presented in Table 4.

The concentrations of each analyte measured over the 2015-2016 period are within the expected range for produced water samples at this site.

Table 3` Results of injectate sampling undertaken by the Council

Sample details	Unit	Waihapa Production Station			
		Minimum	Maximum	(Tanks T206A and T206B)	
TRC sample number	-	-	-	TRC153163	TRC161437
Sample date	-	2004 - to date		5-Oct-15	29-Apr-16
Sample time	-	-	-	13:15	11:35
pH	pH Units	6	8.5	8	7
Conductivity	mS/m @ 20°C	1,560	4,050	3,330	3,510
Chloride	g/m ³	5,900	69,200	10,600	12,600
Total petroleum hydrocarbons	g/m ³	11	4,600	440	61
Alkalinity	g/m ³ CaCo ³	162	5,580	5,580	-

Table 4 Results of injectate sampling undertaken by the Company (2015-2016)

Sample details	Unit	Waihapa Production Station (Tanks T2016A and T206B)	
		June 2015 -May 2016	
		min	max
pH	-	7.0	7.5
Conductivity	mS/m	3,460	4,637
Chloride	g/m ³	7,600	15,000
Suspended solids	g/m ³	17	552
Total dissolved solids	g/m ³	23,067	27,400
Temperature	°C	16.0	24.2
Salinity	ppt	23	29
Total petroleum hydrocarbons	g/m ³	44	5,540

2.3 Groundwater sampling

Groundwater samples were obtained from one site located in the vicinity of the Waihapa-F wellsite (GND1031) and one site in the vicinity if the Waitapu wellsite (GND2528) on 30 October 2015 and 17 May 2016.

All groundwater samples were collected following standard groundwater sampling methodologies and generally in accordance with the National Protocol for State of the Environment Groundwater Sampling in New Zealand (2006). The samples from GND2528 were taken using a low flow bladder pump and the samples from GND1031 were taken from an outlet tap, as this bore is pumped and there is no direct access to the well head.

The results of analyses carried out are set out below in Tables 5 and 6.

The results show there have been no significant changes in groundwater composition at either site since monitoring commenced. This is demonstrated by the relatively narrow ranges between minimum and maximum analyte concentrations recorded since monitoring commenced. The subtle variation in analyte concentrations at each site are a result of natural seasonal fluctuation and sampling variability.

A low level detection of methane was recoded in the baseline groundwater sample taken at GND2528 during October 2015. Carbon isotope analysis indicates the methane is from a biogenic source and is within the expected range for shallow groundwater across Taranaki.

All results are within the ranges expected for Taranaki groundwater and indicate that there has been no contamination by deep well injection fluids.

Table 5 Results of groundwater sampling undertaken by the Council at GND2528

Sample details	Units	Waitapu wellsite (10086-1)		Sample details	Units	Waitapu wellsite (10086-1)	
		GND2528				GND2528	
TRC sample number	-	TRC153422	TRC161670	TRC sample number	-	TRC153422	TRC161670
Sample date	-	30-Oct-15	17-May-16	Sample date	-	30-Oct-15	17-May-16

Sample details	Units	Waitapu wellsite (10086-1)		Sample details	Units	Waitapu wellsite (10086-1)	
		GND2528				GND2528	
Sample time	NZST	08:05	10:10	Sample time	NZST	08:05	10:10
Static water level	M BTOC	5.785	6.142	Nitrate	g/m ³ N	0.003	-
Chloride	g/m ³	13.4	14	Sulphate	g/m ³	1.3	-
Electrical conductivity	mS/m@20°C	47.4	43.1	Sum of anions	meq/l	5	-
Dissolved oxygen	g/m ³	1.07	1.35	Sum of cations	meq/l	5	-
pH	pH	7.2	7.1	Toluene	g/m ³	<0.0010	-
Temperature	°C	13.3	13.3	o-Xylene	g/m ³	<0.0010	-
Total hydrocarbons	g/m ³	<0.7	<0.5	m-Xylene	g/m ³	<0.002	-
Alkalinity	g/m ³ CaCO ₃	230	-	Barium	mg/kg	0.034	-
Benzene	g/m ³	<0.0010	-	Bromine	g/m ³	0.096	-
Calcium	g/m ³	45	-	Dissolved copper	g/m ³	<0.0005	-
Ethylbenzene	g/m ³	<0.0010	-	Ethane	g/m ³	<0.003	-
Bicarbonate	g/m ³ HCO ₃	280	-	Ethylene	g/m ³	<0.003	-
Hardness	g/m ³ CaCO ₃	180	-	Dissolved iron	g/m ³	4.9	-
Potassium	g/m ³	6.7	-	Methane	g/m ³	19.1	-
Magnesium	g/m ³	16.6	-	Carbon 13	0/000	83.7	-
Sodium	g/m ³	24	-	Dissolved manganese	g/m ³	0.66	-
Total nitrogen	g/m ³ N	0.003	-	Dissolved zinc	g/m ³	0.0089	-
Nitrite	g/m ³ N	<0.002	-	Dissolved Mercury	g/m ³	<0.00008	-

Table 6 Results of groundwater sampling undertaken by the Council at GND1031

Sample details	Units	Waihapa-F wellsite			
		Minimum	Maximum	GND1031	
TRC sample number	-	-	-	TRC153164	TRC161439
Sample date	-	2013 - to date		06-Oct-15	29-Apr-16
Sample time	NZST	-	-	14:11	12:15
Chloride	g/m ³	10.8	13.1	11.5	11.4
Electrical conductivity	mS/m@20°C	33.2	39	33.2	34.2
Dissolved oxygen	g/m ³	1.95	3.45	3.45	1.95
pH	pH	7.8	8.1	8.1	8
Temperature	°C	15.9	18.4	16.7	15.9
Total hydrocarbons	g/m ³	<0.5	<0.5	<0.5	<0.5

2.4 Assessment of data submitted by the Company

The Company provided records of their injection activities during 2015-2016 monitoring period, including daily injection volumes, pumping duration and injection pressure.

Table 7 provides an overview of the Company's injection activities across all consents during the monitoring period.

The majority of fluid discharged during the 2015-2016 review period was disposed of via the Waihapa-7A well at the Waihapa-F wellsite. Injection commenced under consent 10086-1 in November 2016 at the Waitapu wellsite. No injection was undertaken under consent 3688-2 at the Waihapa-D wellsite.

A summary of the Company's historical data for consents 10086-1 and 4094-2 are presented in Table 8 and Table 9 below. The data presented shows that the volume of fluid being injected under consent 4094-2 increased slightly in 2014-2015 and decreased in 2015-2016. The maximum daily injection volume and pressure has reduced slightly during the review period in comparison to previous years.

Table 7 Summary of injection activity during the 2015-2016 monitoring year

Consent	Wellsite	Injection wells	Total volume discharged (m ³)	Discharge period		TRC well ID
				From	To	
3688-2	Waihapa-D	Waihapa-5	0	0	0	-
4094-2	Waihapa-F	Waihapa-7A	194,609.00	01/07/2015	30/06/2016	GND1634
10086-1	Waitapu	Waitapu-2	10,635.53	12/11/2015	30/06/2016	GND2529
Total			205,244.53	-	-	-

Table 8 Summary of injection occurring under consent 10086-1 (2015-2016)

Waitapu Consent 10086-1					
Year	Annual volume (m ³)	Max. injection volume (m ³ /day)	Max. injection rate (m ³ /hr)	Max. injection pressure (psi)	Avg. injection pressure (psi)
Consent limit	-	-	-	689	-
2015-2016	10,635.53	105.28	Not required	217.6	7.3

Table 9 Summary of injection occurring under consent 4094-2 (2013-2016)

Waihapa-F Consent 4094-2					
Year	Annual volume (m ³)	Max. injection volume (m ³ /day)	Max. injection rate (m ³ /hr)	Max. injection pressure (bar)	Avg. injection pressure (bar)
Consent limit	-	-	-	85.0	-
2015-2016	194,609	1,049	93	73.0	55
2014-2015	208,077	1,770	82	85.5	43
2013-2014*	104,967	1,632	97	82	44

*Note injection during the 2013-2014 monitoring period was for 8 months (8-11-13 to 30-06-2014)

The data presented shows that the Company conducted their injection operations within all consented injection limits during the period being reported. The injection data is also presented graphically in Figure 4 to Figure 7 and illustrates that injection operations were undertaken well within consented limits. Injection volumes at Waitapu are much smaller than those at Waihapa-F. Maximum pressure data for Waitapu indicate that little or no pressure is required to inject the fluid into the targeted Mount Messenger Formation confirming the Formation's suitability for water flooding.

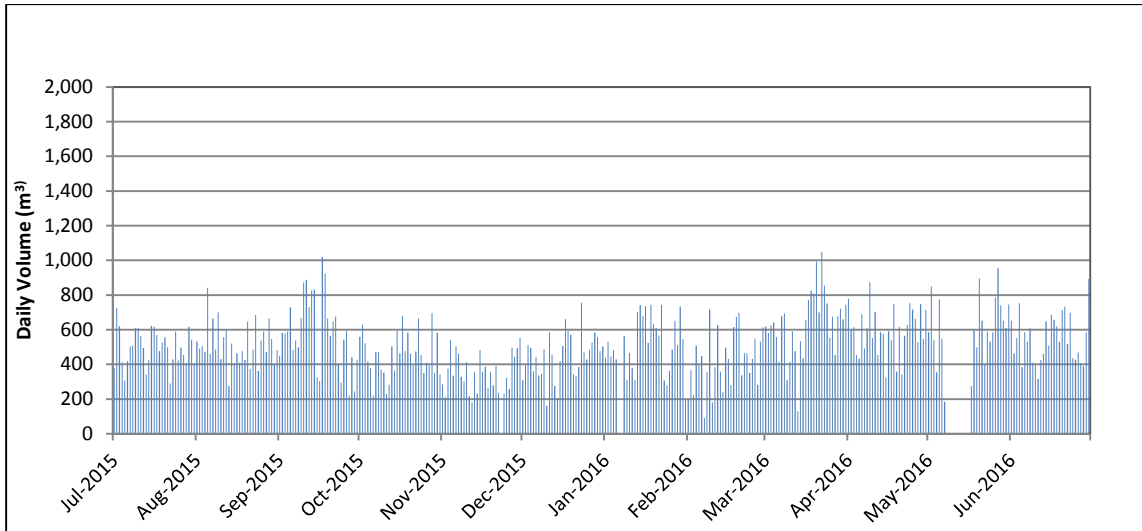


Figure 4 Total daily injection volume consent 4094-2 (2015-2016)

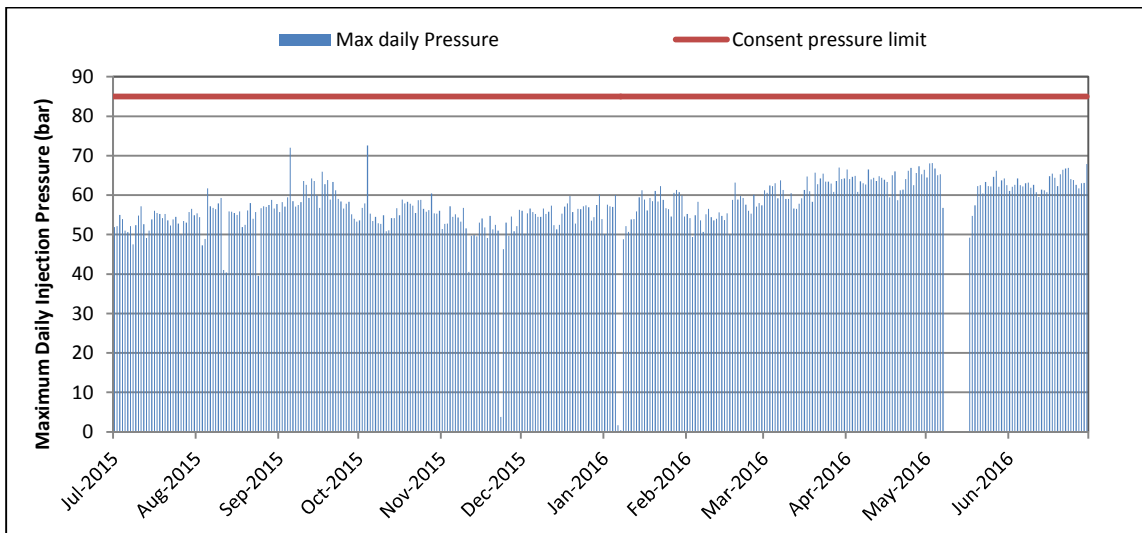


Figure 5 Total daily maximum injection pressure consent 4094-2-1 (2015-2016)

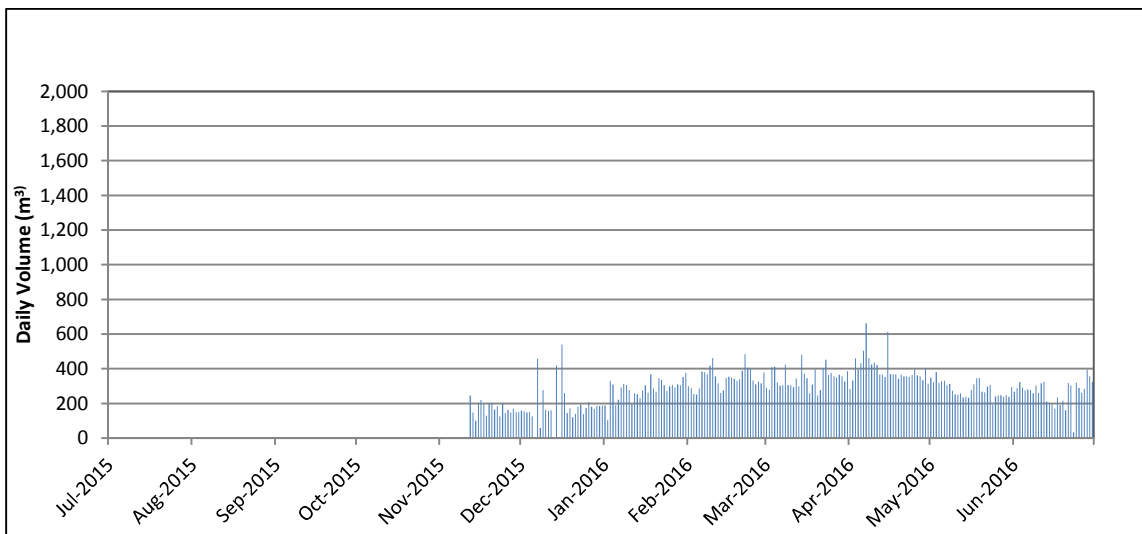


Figure 6 Total daily injection volume consent 10086-1 (2015-2016)

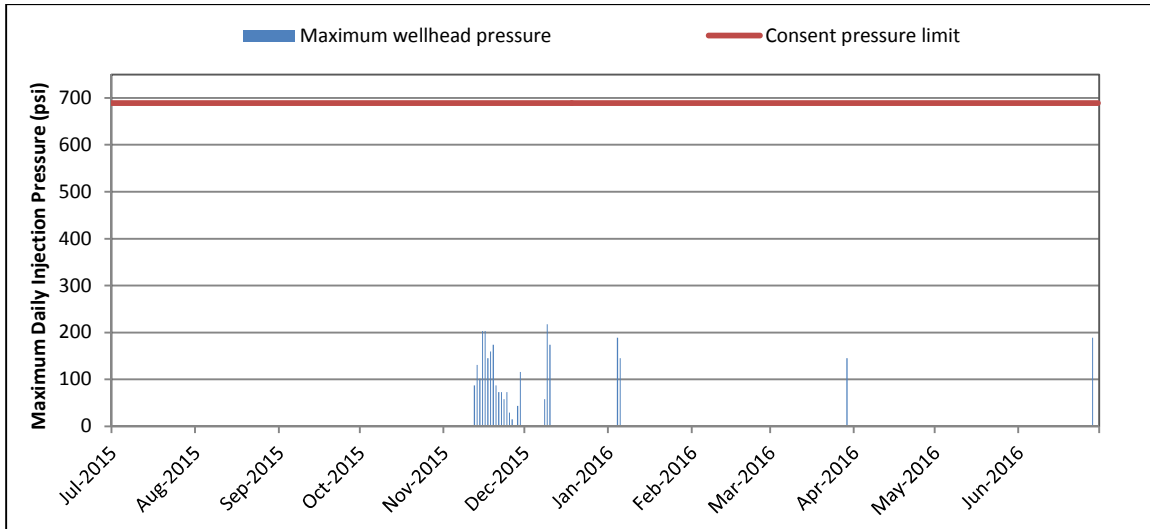


Figure 7 Total daily maximum injection pressure consent 10086-1 (2015-2016)

The daily volume and maximum daily injection pressures over the entire data record for consent 4094-2 are presented in Figure 8 and Figure 9. The volume data presented over the reporting period indicates that average daily injection volumes have decreased and become more evenly spaced throughout the year in comparison to previous periods. A visual assessment of the data suggests the maximum well head pressures have fluctuated since the consent was first exercised with higher pressures correlating with more sustained periods of injection.

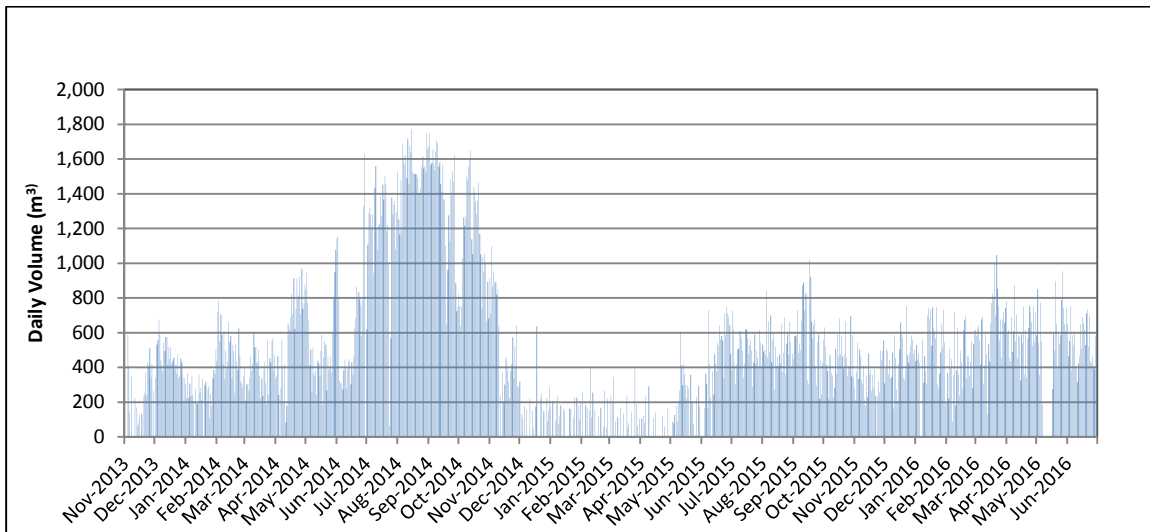


Figure 8 Total daily injection volume consent 4094-2 (2013-2016)

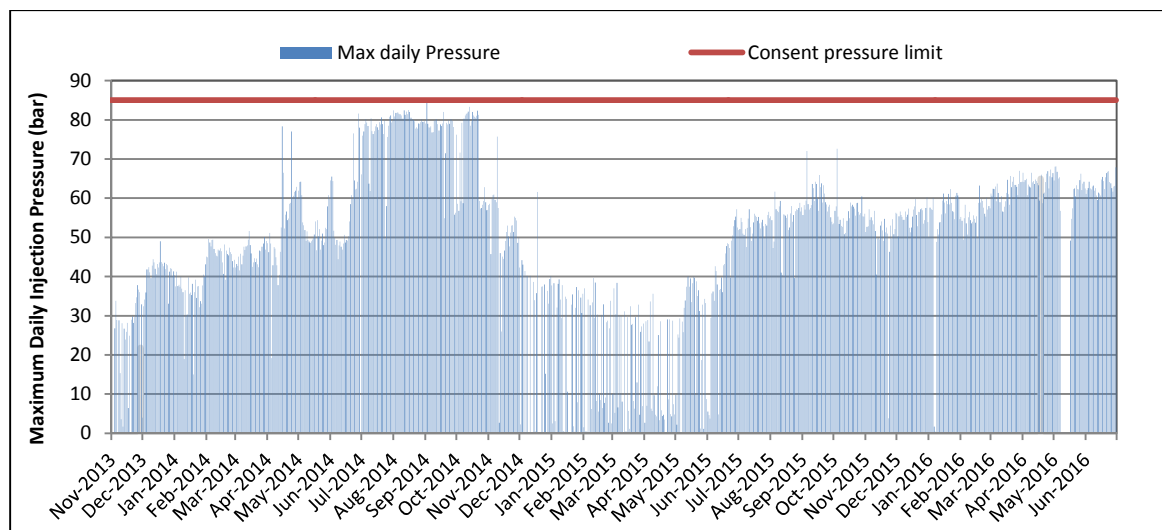


Figure 9 Maximum daily injection pressure consent 4094-2 (2013-2016)

2.5 Investigations, interventions, and incidents

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

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

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

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

3. Discussion

3.1 Discussion of site performance

During the period under review, the Company exercised two resource consents for the injection of fluids by DWI (4094-2 and 10086-1). Consent 4094-2 authorises the injection of fluids into the Matemateaonga Formation and consent 10086-1 authorises injection of fluids into the Mt Messenger Formation below 1,800 mTVD.

The Waihapa-F and Waitapu injection wells are fitted with engineering controls and in built safety systems to protect the wellbore against any process or subsurface related failures. In the event of any sudden pressure losses or increases, safety systems isolate the wellbore and shut down the injectate pumping system.

The operation of the injection well is monitored by Company staff, with automated systems recording the injection data required under the conditions of their consent. Throughout the monitoring period this data was submitted to the Council at the specified frequency.

A review of the 2015-2016 injection data provided by the Company shows that a total of 194,609 m³ of fluid was injected under consent 4094-2 and 10,636 m³ of fluid was injected under consent 10086-1. The data also shows that the maximum daily volume injected was 1,049 m³ for consent 4094-2 and 105 m³ for consent 10086-1. These occurred on 22 March 2016 and 7 April 2016 respectively. The maximum daily injection pressure recorded during the period was 73 bar on 4 October 2016 under consent 4094-2. The maximum daily injection pressure recorded during the period under consent 10086-1 was 218 psi on 9 December 2015. The maximum injection pressures recorded under each consent are within their respective limits of 85 bar and 689 psi respectively.

An assessment of the injection data record over the lifetime of consent 4094-2 (2013-2016) shows that the daily volumes of fluid being injected under consent 4094-2 increased during the winter months in 2014 and decreased significantly during the following summer. Injection volumes and pressures now appear to be more evenly distributed throughout the year and injection pressures are stable.

Routine inspections of the Company's wellsites conducted during the period under review found them to be in good condition and being well managed. The Council was not required to enter any incidents in relation to the exercising of the Company's DWI consents during the review period, nor were any complaints received from the public in relation to these consents.

3.2 Environmental effects of exercise of consents

To date, no adverse environmental effects have been recorded by the Council in relation to any DWI consent exercised by the Company.

The groundwater monitoring component of this programme continued during the period under review, with two samples being taken from two monitoring sites in the vicinity of the Company's active injection wells. The results of the monitoring carried out show that the groundwater composition at each site has remained

stable since the commencement of monitoring at each site. Some very minor fluctuations in analyte concentrations are attributable to seasonal variations in water composition and standard sampling variability. There is no evidence to suggest that injection activities undertaken by the Company during the review period have had any adverse effect on local groundwater quality.

Compliance with the conditions of the Company's DWI consents exercised during the 2015-2016 monitoring period is summarised below in Section 3.3.

3.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Table 10 and Table 11.

Table 10 Summary of performance for consent 4094-2

Purpose: To discharge produced water, contaminated stormwater, water based drilling fluids and hydraulic fracturing fluids, including return fluids, by deep well injection into the Matemateaonga Formation		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Consent holder must operate in accordance in Injection Operation Management Plan.	Receipt of satisfactory information	Yes
2. Injection pressure must not exceed 85 Bar (1232 PSI)	Assessment of consent holder records	Yes
3. Consent holder shall at all times adopt best practicable option (BPO to prevent and/or minimise environmental impact)	Assessment of consent holder records and site inspection results	Yes
4. Provision of records for discharge volumes, rates, and pressures	Receipt of well discharge data	Yes
5. Chemical analysis of discharge and submission to the Council	Receipt of discharge analysis results	Yes
6. Review provision	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		High
Overall assessment of administrative performance in respect of this consent		High

N/A = not applicable

Table 11 Summary of performance for consent 10086-1

Purpose: To discharge produced water generated by hydrocarbon exploration and production operations by deep well injection for water flooding purposes at the Waitapu wellsite.		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Before exercising the consent the consent holder shall submit an "Injection Operation Management Plan."	Receipt of satisfactory "Injection Operation Management Plan."	Yes
2. Injection well, geological and operational data submission requirements. This information can be included in the "Injection Operation Management Plan."	Receipt of satisfactory information	Yes
3. The injection pressure at the wellhead shall not exceed 689 psi	Review and analysis of injection data.	
4. No injection permitted after 1 June 2029.	Assessment of injection records and site inspection notices.	N/A
5. The consent holder shall at all times adopt the best practicable option.	Assessment of consent holder records and site inspection notices.	Yes
6. The injection of fluids shall be confined to the Mount Messenger Formation, deeper than 1,800 metres true vertical depth.	Review of "Water Flooding Operation Management Plan," well construction log and injection data.	Yes
7. The injection of fluids shall not fracture any overlying geological seal.	Review and analysis of injection data.	Yes
8. 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).	Assessment of injection records and results of groundwater sampling and analysis programme.	Yes
9. Maintain full records of injection data.	Receipt and assessment of injection data.	Yes
10. Maintain records and undertake analysis to characterise each type of waste arriving on-site for discharge.	Receipt and assessment of injection data.	Yes
11. If the analysis required by condition 10c is not carried out in a accredited laboratory sampling shall be undertaken in accordance with a certified Quality Assurance Plan	Sampling undertaken by the Council, and submitted to an accredited laboratory.	Yes
12. The data required by conditions 9 & 10 above, for each calendar month, is required to be submitted by the 28th day of the following month.	Receipt of satisfactory data by the date specified.	Yes

Purpose: To discharge produced water generated by hydrocarbon exploration and production operations by deep well injection for water flooding purposes at the Waitapu wellsite.		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
13. 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.	Monitoring Programme submitted to the Chief Executive, Taranaki Regional Council, for certification	Yes
14. All groundwater samples taken for monitoring purposes shall be taken in accordance with recognised field procedures and analysed for: a. pH; b. conductivity; c. chloride; and d. total petroleum hydrocarbons.	Implementation of Groundwater Monitoring Programme and assessment of results.	Yes
15. All groundwater sampling and analysis shall be undertaken in accordance with a Sampling and Analysis Plan, which shall be submitted to the Chief Executive, Taranaki Regional Council for review and certification before the first sampling is undertaken.	Receipt of Sampling and Analysis Plan prior to first round of sampling being undertaken	Yes
16. The consent holder shall provide to the Council, before 31 August each year, a summary of all data collected and a report detailing compliance with consent conditions over the previous 1 July to 30 June period.	Receipt of satisfactory report by 31 August each year.	Yes
17. The consent will lapse on 31 March 2020 unless the consent is exercised before that date	Consent exercised.	Yes
18. Consent review provision.	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		High
Overall assessment of consent compliance and administrative performance in respect of this consent		High

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

3.4 Recommendations from the 2014-2015 Annual Report

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

1. THAT the range of monitoring carried out during the 2014-2015 period in relation to the Company's DWI activities be continued during the 2015-2016 monitoring period.
2. THAT the Council notes there is no requirement at this time for a consent review to be pursued or grounds to exercise the review options.

3.5 Alterations to monitoring programmes for 2016-2017

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

It is proposed that the range of monitoring carried out during the 2014-2015 period in relation to the Company's DWI activities be continued during the 2015-2016 monitoring period.

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

3.6 Exercise of optional review of consent

The next optional review dates for consents 3688-2, 4094-2 and 10086-1 are provided for in June 2017.

The Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent. A review may be required for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Based on the results of monitoring carried out in the period under review, and in previous years as set out in earlier annual compliance monitoring reports, it is considered that there are no grounds to require a consent review to be pursued or grounds to exercise the review options. A recommendation to this effect is presented in Section 4 of this report.

4. Recommendations

1. THAT the range of monitoring carried out during the 2015-2016 period be continued during the 2016-2017 monitoring period.
2. THAT the Council notes there is no requirement at this time for a consent review to be pursued or grounds to exercise the review options.

Glossary of common terms and abbreviations

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

Aquifer (freshwater)	A formation, or group or part of a formation that contains sufficient saturated permeable media to yield exploitable quantities of fresh water.
Conductivity	A measure of the level of dissolved salts in a sample. Usually measured at 20°C and expressed as millisiemens per metre (mS/m) or as Total Dissolved Solids (g/m ³).
Confining layer	A geological layer or rock unit that is impermeable to fluids.
Deep well injection (DWI)	Injection of fluids at depth for disposal or enhanced recovery.
Freshwater/saline water water interface on	The depth in a well at which fresh water becomes saline. The interface may be a gradational or sharp transition, depending on geology. The FW-SW transition is demonstrated by down-hole geophysical logging.
g/m ³	Grams per cubic metre. A measure of concentration which is equivalent to milligrams per litre (mg/l), or parts per million (ppm).
Hydraulic fracturing (HF)	The process of increasing reservoir permeability by injecting fluids at pressures sufficient to fracture rock within the reservoir ("fracking").
Injectate	Fluid disposed of by deep well injection.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
m ³	Cubic metre.
pH	Numerical system for measuring acidity in solutions, with 7 as neutral. Values lower than 7 are acidic and higher than 7 are alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Produced water	Water associated with oil and gas reservoirs that is produced along with the oil and gas. Typically highly saline with salt concentrations similar to seawater and containing low levels of hydrocarbons.
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 subsequent amendments.

TRC	Taranaki Regional Council (the Council).
TVD	True vertical depth.
Water flooding	A method of thermal recovery in which hot water is injected into a reservoir through specially distributed injection wells. Hot water flooding reduces the viscosity of the crude oil, allowing it to move more easily toward production wells.

Bibliography and references

- Ministry for the Environment (2006). A National Protocol for State of the Environment Groundwater Sampling in New Zealand. Ref. ME781.
- Stevens G. 2001. Taranaki : *In: Groundwaters of New Zealand*, M.R, Rosen and P.A. White (eds). New Zealand Hydrological Society Inc., Wellington. P381-386.
- Taranaki Regional Council (2012). Origin Energy Resources New Zealand Limited Deep Well Injection Monitoring Programme Triennial Report (2009-2012). Technical report 2011-85. Document number 1114242.
- Taranaki Regional Council (2015). NZEC Waihapa Limited Deep Well Injection Monitoring Programme Annual Report 2013-2014. Technical report 2014-96. Document number 1468314.
- Taranaki Regional Council (2015). NZEC Waihapa Limited Deep Well Injection Monitoring Programme 2014-2015 Technical report 2015-12. Document number 1545855.

Appendix I

Resource consents held by NZEC Waihapa Limited

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

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

Name of
Consent Holder: NZEC Waihapa Limited
P O Box 8440
NEW PLYMOUTH 4342

Decision Date
(Change): 3 September 2013

Commencement Date
(Change): 3 September 2013 (Granted: 23 June 2003)

Conditions of Consent

Consent Granted: To discharge waste drilling fluids, produced water, hydraulic fracturing fluids, including return fluids, and stormwater from hydrocarbon exploration and production operations by deepwell injection at the Waihapa-D wellsite

Expiry Date: 1 June 2034

Review Date(s): June 2016, June 2022, June 2028

Site Location: Waihapa-D wellsite, Cheal Road, Ngaere, Stratford
(Property owner: A & J Moore)

Legal Description: Lot 1 DP 17294 Blk VII Ngaere SD (Discharge source & site)

Grid Reference (NZTM) 1718010E-5638199N

Catchment: Patea

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

General conditions

- a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.
- b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.
- c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:
 - i) the administration, monitoring and supervision of this consent; and
 - ii) charges authorised by regulations.

Special conditions

1. Prior to the exercise of this consent for each individual well to be used for deep well injection, the consent holder shall submit, to the written satisfaction of the Chief Executive, a log of the injection well, and an injection well operation management plan, to demonstrate that special condition 2 of this consent can be met. The report shall:
 - a) identify the injection zone, including a validated bore log and geophysical log,
 - b) detail the results of fluid sampled from the injection zone, and the proposed wastes to be injected for maximum and mean concentrations for pH, suspended solids, total dissolved solids, salinity, chlorides, and total hydrocarbons;
 - c) demonstrate the integrity of well casing; and
 - d) outline design and operational procedure to isolate the zone.
2. The resource consent holder shall ensure that injection will not contaminate or endanger any actual or potential useable freshwater aquifer.
3. The consent holder shall keep daily records of the amounts of all material injected, including injection pressure and rate, and shall make the records available to the Taranaki Regional Council on a 12 monthly basis, and when there has been a significant pressure change event.
4. The consent holder shall monitor the injected material monthly, and upon the request of the Taranaki Regional Council. Concentrations of suspended solids, total dissolved solids, salinity, chlorides, total hydrocarbons, and pH shall be monitored and the records made available to the Taranaki Regional Council on a 12 monthly basis.
5. The consent holder shall inject fluids at pressures below the pressure that would be required to fracture the stratigraphic seals of injection formation.

Consent 3688-2

6. This consent shall lapse on the expiry of five years after the date of commencement of this consent, 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(b) of the Resource Management Act 1991.
7. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent, by giving notice of review during the month following receipt of information required under special conditions 3 and 4 above, and the month of June 2010 and/or June 2016 and/or June 2022 and/or June 2028 required for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 1 November 2013

For and on behalf of
Taranaki Regional Council



Director-Resource Management

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

Name of
Consent Holder: NZEC Waihapa Limited
P O Box 8440
NEW PLYMOUTH 4342

Decision Date
(Change): 3 September 2013

Commencement Date
(Change): 3 September 2013 (Granted: 10 September 2010)

Conditions of Consent

Consent Granted: To discharge produced water, contaminated stormwater, water based drilling fluids and hydraulic fracturing fluids, including return fluids, by deepwell injection into the Matemateaonga Formation

Expiry Date: 1 June 2028

Review Date(s): June 2016, June 2022

Site Location: Waihapa-F wellsite, 7 Bird Road, Stratford

Legal Description: Sec 10 Blk III Ngaere SD (Discharge source & site)

Grid Reference (NZTM) 1717193E-5642014N

Catchment: Patea

Tributary: Ngaere

*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 consent holder shall operate the well in accordance with the "Origin Energy Resources NZ Limited - Deep Well Injection Management Plan" dated June 2010. In particular, Section 7 of the plan (page 11) which identifies the conditions that would trigger concerns about the integrity of the well, or the injection zone, and the action to be taken by the consent holder if trigger conditions are reached.
2. The injection pressure at the wellhead shall not exceed a maximum injection pressure of 85 bars (1,232 PSI).
3. 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 minimise any actual or likely adverse effect on the environment; in particular, ensuring that the injection material is contained within the injection zone.
4. The consent holder shall keep daily records of:
 - a) maximum injection pressure;
 - b) maximum and average rate of injection; and
 - c) volume of fluid injected;

during operation of the well. These records shall be provided to the Taranaki Regional Council at the end of each month.

5. The consent holder shall measure and record the following constituents of the discharge at the end of each month:
 - a) pH;
 - b) suspended solids concentration;
 - c) temperature;
 - d) salinity;
 - e) chloride concentration; and
 - f) total hydrocarbon concentration.

The consent holder shall provide to Taranaki Regional Council, during the month of May of every year, a summary of all records collected in accordance with this condition. The consent holder must also provide any details on the major changes in characteristics or sources of injected fluid.

Consent 4094-2

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

Signed at Stratford on 1 November 2013

For and on behalf of
Taranaki Regional Council



Director-Resource Management

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

Name of
Consent Holder: Taranaki Ventures Limited
PO Box 8440
New Plymouth 4342

Decision Date: 31 March 2015

Commencement Date: 31 March 2015

Conditions of Consent

Consent Granted: To discharge produced water generated by hydrocarbon exploration and production operations by deep well injection for waterflooding purposes at the Waitapu wellsite

Expiry Date: 1 June 2034

Review Date(s): June annually

Site Location: Waitapu wellsite, 326 Cheal Road, Ngaere
(Property owner: WK Slattery)

Legal Description: Secs 49, 73, 75, 80, 81 Blk VI Ngaere SD
(Discharge source & site)

Grid Reference (NZTM) 1715783E-5637623N

Catchment: Patea

Tributary: Ngaere

*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. Before exercising this consent, the consent holder shall submit an "Injection Operation Management Plan." The plan shall include the operational details of the injection activities and identify the conditions that would trigger concerns about the integrity of the injection well, the receiving formation or overlying geological seals. The plan shall also detail the action(s) to be taken by the consent holder if trigger conditions are reached.
2. Before exercising this consent, the consent holder shall provide to the Chief Executive, Taranaki Regional Council:
 - a) a geological assessment of the environment in which the well is located, including the injection zone, the geological seals confining the injection zone and any associated faulting;
 - b) details of the injection well design and its structural integrity;
 - c) an assessment of the suitability of the injection well for the proposed activity;
 - d) details of how the integrity of the injection well will be monitored and maintained;
 - e) confirmation of the depth to which fresh water resources, as defined in condition 8, are encountered below the site; and
 - f) a chemical assessment of the receiving formation water which confirms its Total Dissolved Solids concentration, and also demonstrates that the mixing of formation and injection fluids will not result in any adverse effects on the receiving formation or the injection well.

(Note: The information required by condition 2 may be included within the "Injection Operation Management Plan" required by condition 1).

3. The injection pressure at the wellhead shall not exceed 689 psi.
4. There shall be no injection of any fluids after 1 June 2029.
5. 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 minimise any actual or likely adverse effect on the environment.
6. The injection of fluids shall be confined to the Mount Messenger Formation, and be injected at a minimum depth of 1,800 metres true vertical depth below ground level.
7. The consent holder shall ensure that the discharge authorised by this consent does not result in the fracturing of the geological seals confining the injection zone.

Consent 10086-1.0

8. 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). Useable fresh groundwater is defined as any groundwater having a Total Dissolved Solids concentration of less than 1,000 mg/l.
9. Once the consent is exercised, the consent holder shall keep daily records of the:
 - a) injection hours;
 - b) volume of fluid discharged; and
 - c) maximum and average injection pressure.
10. For each waste stream arriving on site for discharge, the consent holder shall characterise the fluids by recording the following information:
 - a) type of fluid;
 - b) source of fluid (site name and company);
 - c) an analysis of a representative sample of the fluid for:
 - i. pH;
 - ii. conductivity;
 - iii. suspended solids concentration;
 - iv. temperature;
 - v. salinity;
 - vi. chloride concentration; and
 - vii. total hydrocarbon concentration.

The analysis required by condition 10(c) above is not necessary if a sample of the same type of fluid, from the same source, has been taken, analysed and provided to the Chief Executive, Taranaki Regional Council within the previous 6 months.

11. If the analysis required by condition 10(c) above is not carried out in an International Accreditation New Zealand accredited laboratory, it shall be undertaken in accordance with a "Quality Assurance Plan" that has been certified by the Chief Executive, Taranaki Regional Council, as meeting the requirements of condition 10. The Council may also, at its discretion, carry out an audit of the consent holder's sampling and analysis regime to assess adherence to the Quality Assurance plan.
12. The information required by conditions 9 and 10 above, for each calendar month, shall be provided to the Chief Executive, Taranaki Regional Council before the 28th day of the following month.
13. The consent holder shall undertake a programme of sampling and testing that monitors the effects of the exercise of this consent on fresh water resources within an Area of Review to assess compliance with condition 8 (the 'Monitoring Programme'). The Monitoring Programme shall be designed to characterise local groundwater quality, and be submitted to the Chief Executive, Taranaki Regional Council, for certification before the exercising of this consent, and shall include:
 - a) the location of sampling sites;
 - b) well/bore construction details; and
 - c) sampling frequency.

The Area of Review shall extend 1,000 metres from the point of injection. It is a requirement that at least one suitable monitoring bore be located within 500 metres of the well head. If no suitable existing bores are available, it will be necessary for the Monitoring Programme to include installation of, and sampling from, a suitable bore. The bore would be of a depth, location and design determined after consultation with the Chief Executive, Taranaki Regional Council and installed in accordance with NZS 4411:2001.

14. All groundwater samples taken for monitoring purposes shall be taken in accordance with recognised field procedures and analysed for:
- a) pH;
 - b) conductivity;
 - c) chloride; and
 - d) total petroleum hydrocarbons.

Note: The samples required, under conditions 13 and 14, could be taken and analysed by the Taranaki Regional Council or other contracted party on behalf of the consent holder.

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

Note: The Sampling and Analysis Plan may be combined with the Monitoring Programme required by condition 13.

16. The consent holder shall provide to the Chief Executive, Taranaki Regional Council, before 31 August each year, a summary of all data collected and a report detailing compliance with consent conditions over the previous 1 July to 30 June period. Based on the data provided, the report shall also provide:
- a) an assessment of injection well performance;
 - b) an assessment of the on-going integrity and isolation of the wellbore;
 - c) an assessment of the on-going integrity and isolation of the receiving formation; and
 - d) an updated injection modeling report, demonstrating the ability of the receiving formation to continue to accept additional waste fluids and an estimation of remaining storage capacity.

17. This consent shall lapse on 31 March 2020, 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.

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

Signed at Stratford on 31 March 2015

For and on behalf of
Taranaki Regional Council

B G Chamberlain
Chief Executive

