Westside New Zealand Limited
Deep Well Injection
Monitoring Programme
Annual Report
2016-2017

Technical Report 2017-26

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Executive summary

Westside New Zealand Limited (the Company) currently operates the Manutahi, Rimu, Kauri and Pohutukawa wellsites located between Hawera and Patea in South Taranaki. Each wellsite contains varying numbers of producing wells and associated production infrastructure. This report for the period July 2016 to June 2017 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) in relation to the deep well injection (DWI) activities, undertaken at the Manutahi-D wellsite in compliance with consent 7905-1. 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 held one resource consent for DWI activities during the review period, which included a total of 11 conditions setting out the requirements that the Company must satisfy.

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

The Council's monitoring programme for the year under review included an annual inspection, two injectate samples, and two 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 consent. 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 the site being operated in a professional manner and there were no Unauthorised Incidents in relation to the Company's DWI consents.

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

For reference, in the 2016-2017 year, consent holders were found to achieve a high level of environmental performance and compliance for 74% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 21% of the consents, a good level of environmental performance and compliance was achieved.

This report includes recommendations to be implemented during the 2017–2018 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 2016 to June 2017 by the Taranaki Regional Council (the Council) on the monitoring programme associated with the resource consent held by Westside New Zealand Limited (the Company) for deep well injection (DWI) activities. The Company held one consent for the subsurface injection of fluids by DWI. The consent authorises discharges via two injection wells at the Manutahi-D wellsite located in the South Taranaki region.

The resource consent held by the Company permits the discharge of a range of fluids by DWI, including heated water and produced water. The consent includes 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 consent held by the Company. This is the first report to be prepared by the Council to cover the Company's DWI discharges and their effects. Prior to November 2016 consent 7905-1 was held by Origin Energy Resources Limited (Origin) and any information covering the period prior to the 2016-2017 monitoring period can be found in previous compliance reports published by the Council covering Origin's DWI activities.

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 though 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 2017-2018 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 *Resource Management Act 1991* (RMA) primarily addresses environmental 'effects' which are defined as positive or adverse, temporary or permanent, past, present or future, or cumulative. Effects may arise in relation to:

a. the neighbourhood or the wider community around an activity, and may include cultural and social-economic effects;

b. physical effects on the locality, including landscape, amenity and visual effects;

c. ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;

d. natural and physical resources having special significance (for example recreational, cultural, or aesthetic); and

e. risks to the neighbourhood or environment.

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

1.1.4. Evaluation of environmental and administrative performance

Besides discussing the various details of the performance and extent of compliance by the Company, this report also assigns 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 2016-2017 year, consent holders were found to achieve a high level of environmental performance and compliance for 74% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 21% of the consents, a good level of environmental performance and compliance was achieved.

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').

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 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 DWI consent currently held by the Company authorises the injection of heated water, including produced water for the purpose of water flooding.

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).

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

1.3. Resource consents

1.3.1. Discharges of wastes to land

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

The Company held one consent covering their DWI activities during the review period (Table 1). This consent was transferred to the Company in November 2016 along with a number of other petroleum consents held by Origin covering activities at the Manutahi, Rimu, Kauri and Pohutukawa wellsites. Origin still holds a number of consents for the Kupe wellsites; including one consent (6544-1) covering DWI activities at the Kupe Production Station. This consent has not been exercised to date and will therefore not be reported on for the 2016-2017 review period.

Table 1 DWI consents held by the Company during the 2016-2017 monitoring year

Consent number	Wellsite	Status	Injection well(s)	TRC bore id.	Formation	Issued	Expiry
7905-1	Manutahi-D	Active	D2H	GND2307	Manutahi	16/09/2011	01/06/2028
			D4HST1	GND2309			

Consent 7905-1 was issued by the Council on 16 September 2011 under Section 87(e) of the RMA. It is due to expire on 1 June 2028. The consent authorises the discharge of fluids for water flooding purposes at the Manutahi-D wellsite. A water flood trial was initially carried out in September 2011, which resulted in the injection of 113 m^3 of heated fluids into the Manutahi Formation. The water flooding programme commenced in August 2012. The consent was transferred to the Company on 1 November 2016.

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

- Condition 1 states that prior to exercising the consent, the consent holder shall submit an updated "Injection Operation Management Plan";
- Condition 2 refers to the injection well and receiving formation information requirements;
- Condition 3 limits the injection pressure;
- Condition 4 limits the volume of waste that can be injected;
- Condition 5 requires the consent holder to adopt best practicable option;
- Conditions 6 and 7 relate to the monitoring of injected wastes and provision of data;
- Condition 8 requires the consent holder to notify the Council prior to the first exercising of the consent;
- Condition 9 prohibits the discharge from endangering or contaminating any freshwater aquifer;
- Condition 10 is a lapse clause; and
- Condition 11 is a review provision.

This summary of consent conditions may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consent appended to this report (Appendix I).

Figure 2 Manutahi-D wellsite and associated consent

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 DWI site consisted of four primary components.

1.4.2. Programme liaison and management

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

- ongoing liaison with resource consent holders over consent conditions and their interpretation and application;
- in discussion over monitoring requirements;
- preparation for any 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. Site inspections

The Company's wellsites were visited once during the monitoring period and inspected for any signs of environmental impact. With regard to consents for DWI activities, the main points of interest are general housekeeping and any processes with potential or actual discharges, including any surface water runoff, and their receiving environments.

An additional two visits to the Company's Manutahi-D wellsite were undertaken by a Council Officer for 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 Manutahi-D wellsite, identified on-site as Tank 041 and shown below on Figure 3. The injectate samples were analysed for the following parameters:

- pH;
- electrical conductivity;
- 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 the consent was held by Origin.

Details of the groundwater monitoring site included in the monitoring programme are summarised below in Table 2. The location of the groundwater site in relation to the injection wells being monitored is illustrated in Figure 3.

Table 2 Location of groundwater monitoring bore

Site code	Wellsite	Distance from wellsite (m)	Screened (m)	Total depth (m)	Groundwater level (mbmp)	Aquifer	Sample method
GND2372	Manutahi-D	71	15.0-25.0	25.0	7.0	Volcanics	Bladder pump

Note: Mbmp- metres below measuring point

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

- pH;
- electrical 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 were collected and analysed by Hills for general ion chemistry, BTEX and dissolved gas concentrations. This more detailed analyses will allow a more in depth assessment of variations in groundwater composition should the need arise in the future.

Figure 3 Location of groundwater sampling site in relation to injection wells being monitored

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 consent holder is required to submit a wide range of data under the conditions of the DWI consent.

As required by the conditions of the consent, an injection Operation Management Plan was submitted for the active injection wells. These 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 an 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 consent also requires the submission of 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 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. Inspections

An annual inspection of the Company's Manutahi-D wellsite was conducted as part of the wellsite monitoring programme. Routine inspections include undertaking a general visual assessment of the operational equipment, storage facilities and associated equipment.

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

The Manutahi-D wellsite was also visited by a Council officer 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 17 October 2016 and 27 April 2017. 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 2012 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 range in analyte concentrations over the period indicate that fluid composition can change significantly from month to month. If fluids are found to be acidic (<6.5 pH) they are treated, to be pH neutral prior to injection, to ensure the integrity of the well is maintained. The concentrations of each analyte measured over the 2016-2017 period are within the expected range for produced water samples at this site.

Table 3 Results of injectate sampling undertaken by the Council (2016-2017)

Parameter	Unit	Manutahi-D (Tank T041)				
		Minimum	Maximum	Mean	-	-
Date	-	1-Jul-2012 to 30-Jun-2016			17-Oct-16	27-Apr-17
Time	NZST	-	-	-	10:50	10:20
TRC sample number	-	-	-	-	TRC163438	TRC171509
pH	pH Units	6.9	8.0	7.2	7.0	7.0
Electrical conductivity	mS/m @ 20°C	566	1,780	1,317	145	1,960
Chloride	g/m^3	2,240	7,340	5,133	349	7,570
Total petroleum hydrocarbons	g/m^3	1	780	191	200	39

Table 4 Results of the Company's monthly injectate sampling (2016-2017)

Sample details	Units	Manutahi-D		
		Minimum	Maximum	Mean
Date	-	1-Jun-2016 to 30-May-2017*		
pH	pH units	5.8	7.6	6.8
Electrical conductivity	µS/m	2	21	12
Suspended solids	g/m^3	12	877	112
Temperature	Deg°C	13.8	20.6	19.1
Salinity	TDS g/m^3	0.9	12.5	6.4
Chloride	g/m^3	403	8,016	4,599
Total petroleum hydrocarbons	g/m^3	8	543	102

*Note *Consent conditions require the company to report waste water quality data in May of each year*

2.3. Groundwater sampling

Groundwater samples were obtained on two occasions during the monitoring period from monitoring bore GND2372. This sampling is a continuation of the groundwater monitoring component of this programme which was initiated during the 2012-2013 monitoring period.

The 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 sampling carried out at GND2372 was undertaken using a bladder pump, following a low flow methodology.

The results of the analyses are set out below in Table 5.

The results show there have been no significant changes in groundwater composition at the 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 the site are a result of natural seasonal fluctuation and sampling variability.

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 (2016-2017)

Sample details	Units	GND2372				
		Minimum	Maximum	Mean	-	-
Date	-	1-Jul-2013 to 30-June-2016			17-Oct-16	27-Apr-17
Time	NZST	-	-	-	12:25	11:50
TRC sample number	-	-	-	-	TRC163439	TRC171510
pH	pH units	7.1	7.4	7.3	7.5	7.6
Electrical conductivity	mS/m@20°C	44.8	52.5	46.3	47.1	47.1
Chloride	g/m^3	62.8	75.0	66.7	63.9	62.6
Total petroleum hydrocarbons*	g/m^3	<0.7	0.7	<0.7	<0.5	<0.5

*Note *The trace of hydrocarbons reported (0.7 g/m$^{3)}$ was within the laboratory percentage error for hydrocarbons (TRC, 2014).*

2.4. Provision of consent holder data

The Company provided records of their injection activities during 2016-2017 monitoring period, including daily injection volumes, pumping duration and injection pressure.

Table 6 provides an overview of the Company's injection activities during the monitoring period. Table 7 provides a summary of the volumes injected under consent 7905-1 since 2009 and Table 8 presents a summary of injection activity since 2012.

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 within consented limits. The majority of fluid (67%) was discharged via the D4HST2 well during the review period.

Maximum pressure and volume data over the monitoring period indicates that slightly higher maximum pressures and lower volumes of fluid were required to maintain the reservoir pressures required to achieve the Company's water flooding objectives in comparison to the 2015-2016 review period.

Table 6 Summary of injection activity during the 2016-2017 monitoring year

Consent	Wellsite	Injection wells	Total volume discharged (m^3) 01/07/16 – 30/06/17	Discharge period		TRC well ID
				From	To	
7905-1	Manutahi-D	D2H	4,000.87	01/07/2016	30/06/2017	GND2307
	Manutahi-D	D4HST2	8,163.37	01/07/2016	30/06/2017	GND2309
Total			12,164.23	-	-	-

Table 7 Summary of the historical injection volumes under consent 7905-1

Period*	Total volume discharged (m^3)
2016-2017	12,164
2015-2016	19,276
2014-2015	11,310
2013-2014	20,827
2012-2013	23,677
2009-2012	113 (water flood trial)

*Note *Prior to November 2016 consent 7905-1 was held by Origin.*

Table 8 Summary of the injection activity under consent 7905-1 (2012-2017)

Deep well injection undertaken at Manutahi-D wellsite				
Year	Annual volume (m3)	Max. injection volume* (m^3/day)	Max. injection pressure (bar)	Avg. injection pressure D2H/D4HST2 (bar)
Consent limits	-	318	50	-
2016-2017	12,164	116	45	26/26
2015-2016	19,276	198	39	23/22
2014-2015	11,310	133	39	17/17
2013-2014	20,827	146	40	31/31
2012-2013	23,677	144	41	21/17

Note The maximum injection rate is the same as maximum injection volume at this site as rate is reported in volumes per day.*

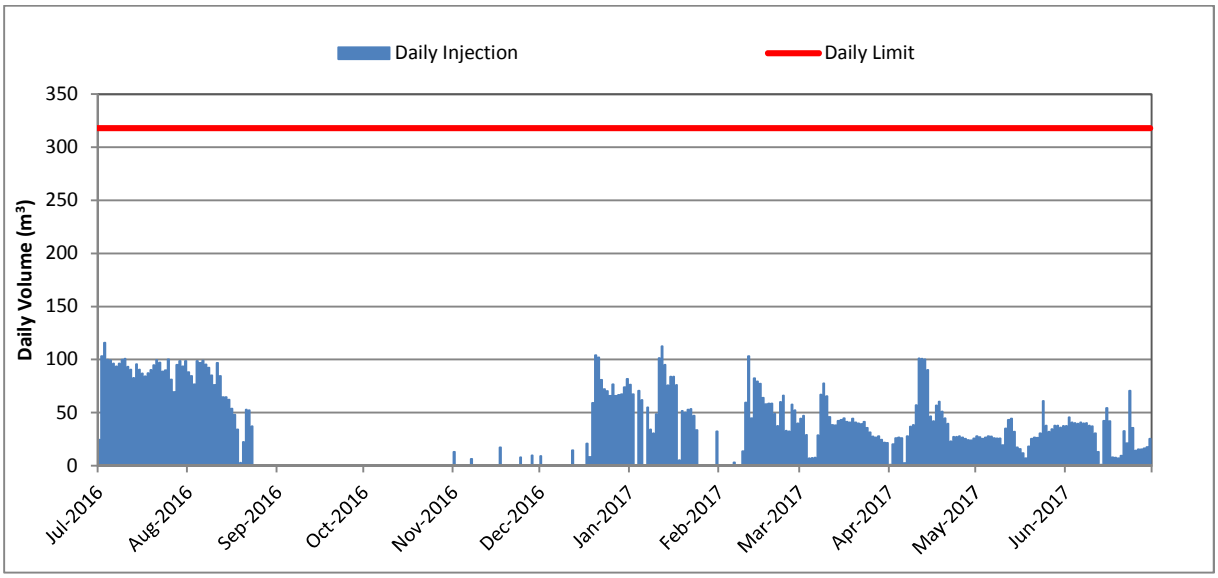

Figure 4 Total daily injection volume consent 7905-1 (2016-2017)

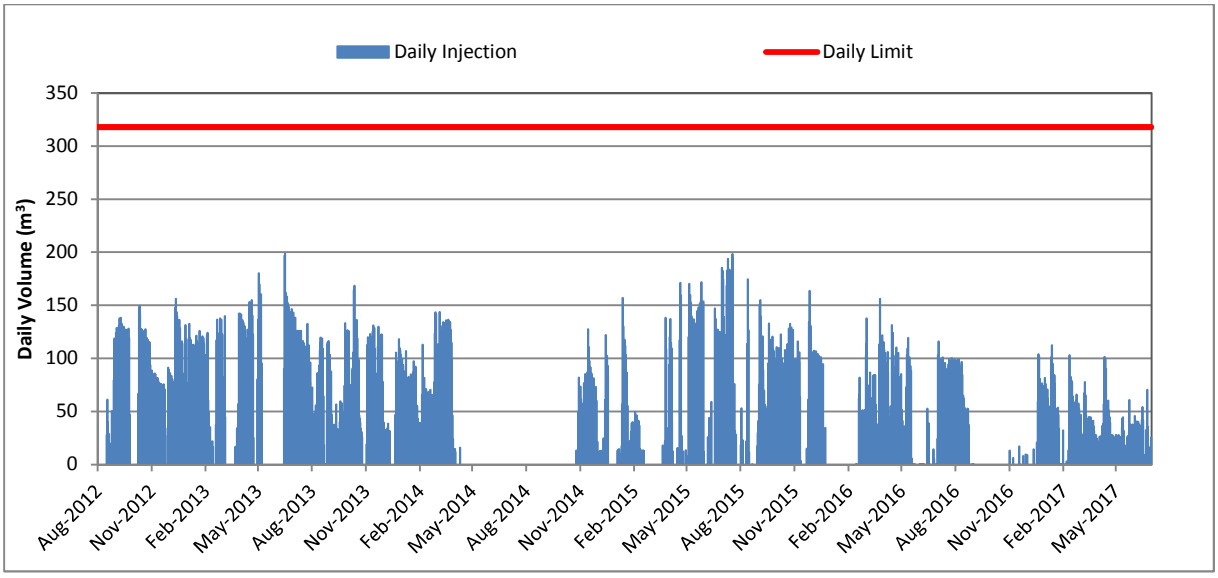

Figure 5 Total daily injection volume consent 7905-1 Manutahi-D (2012-2017)

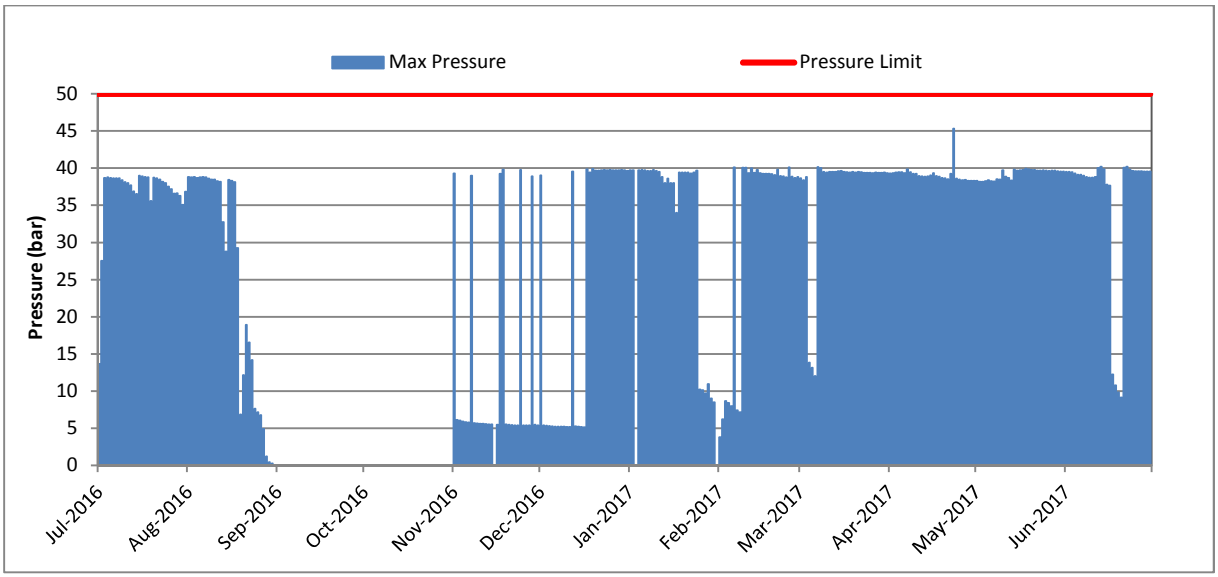

Figure 6 Manutahi-D (D2H injection well) maximum daily injection pressures (2016-2017)

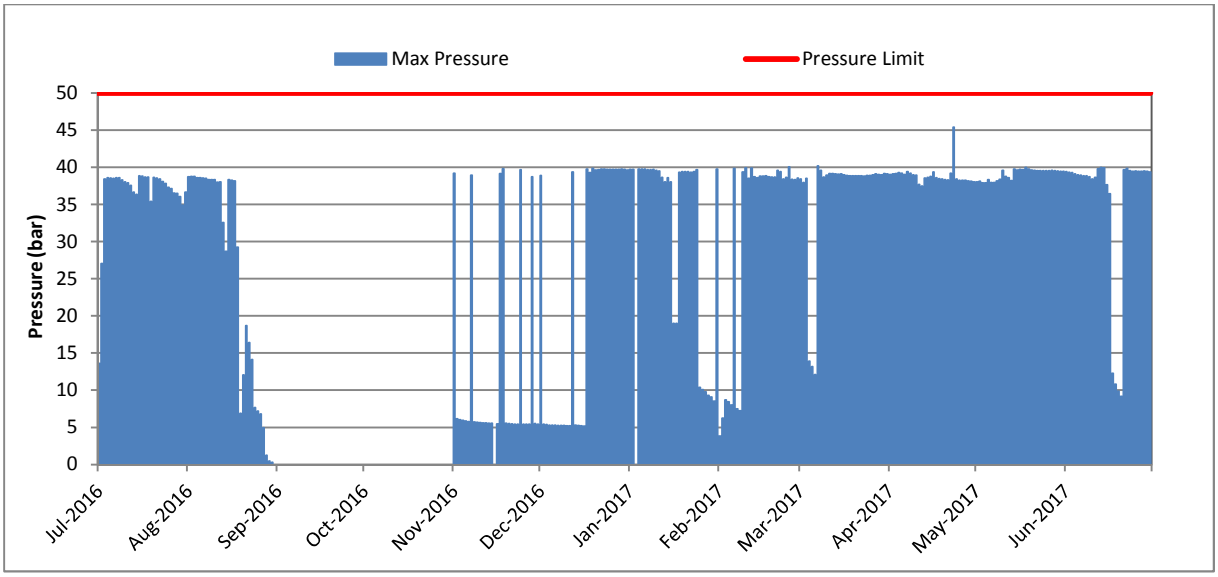

Figure 7 Manutahi-D (D4HST2 injection well) maximum daily injection pressures (2016-2017)

The daily volume and maximum daily injection pressures over the entire data record for consent 7905-1 are presented in Figure 8 and Figure 9. A visual assessment of the data suggests the maximum well head pressures have remained relatively stable in the D2H injection well and have increased slightly in the DH4ST2 injection well since the consent was first exercised. No injection was undertaken via the D2H or D4HST2 wells between April 2014 and November 2014 and limited injection was undertaken between September 2016 and November 2016.

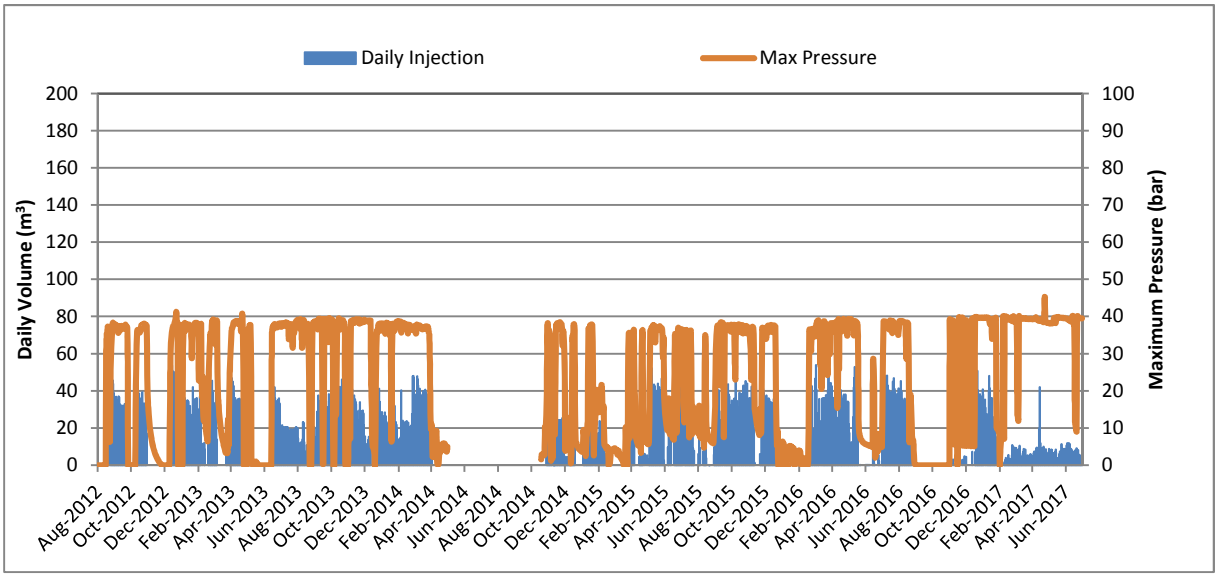

Figure 8 Manutahi-D (D2H injection well) daily injection volume and maximum pressures (2012-2017)

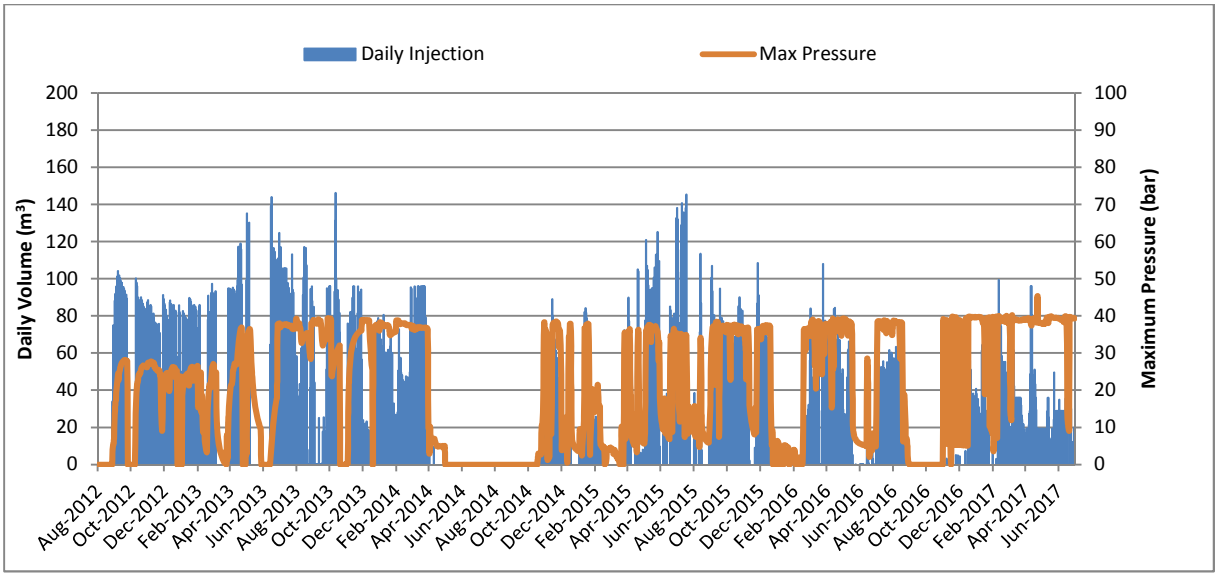

Figure 9 Manutahi-D (D4HST2 injection well) daily injection volume and maximum pressures (2012-2017)

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 causes of non-compliance or failure to maintain good practices. A pro-active approach that in the first instance avoids issues occurring is favoured.

The Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The incident register includes events where the 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 2016-2017 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 one resource consent for the injection of fluids by DWI (7905-1). The consent authorises the injection of heated fluids into the Manutahi Formation. Injection into the Formation is via the D2H and D4HST2 injection wells.

The 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. It should also be noted that maximum pressure that can be generated by the injectate pumps is well below the safe operating pressures of the wellhead, casing and tubing.

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 2016-2017 injection data provided by the Company shows that a total of 12,164.23 m^3 of fluid was injected under consent 7905-1. The majority (8,163.37 m^3) of fluid was injected via the D2H injection well. The remaining 4,000.87 m^3 was discharged via the D4HST2 well. The data also shows that the maximum daily volume injected was 115.90 m^3, which occurred on 3 July 2016. The maximum injection pressure of 45.39 bar was recorded on 23 April 2017 in the D4HST2 injection well. Both the daily injection volumes and maximum injection pressures recorded were within the respective limits of 318 m^3/day and 50 bar.

An assessment of the injection data record over the lifetime of the consent (2012-2017) shows annual volumes fluctuate from year to year. The site is used purely for water flooding and the volume injected will fluctuate in response to the requirements of the hydrocarbon abstraction via the producing wells rather than the volume of fluid requiring disposal.

Routine inspections of the Company's Manutahi-D wellsite conducted during the period under review found the site 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 the 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 one monitoring site in the vicinity of the Company's active injection wells. The results of the monitoring carried out show that the groundwater composition at the site has remained stable since the commencement of monitoring. 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 consent exercised during the 2016-2017 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 9 and 10.

Table 9 Summary of performance for consent 7905-1

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 submit an Injection Operation Management Plan	Receipt of satisfactory Injection Operation Management plan	Yes
2. Provision of well and injection zone information	Receipt of satisfactory information	Yes
3. Injection pressure must not exceed 50 Bar (721 PSI)	Assessment of consent holder records	Yes
4. Daily volume of fluid injected must not exceed 318 m3	Assessment of consent holder records	Yes
5. The consent holder shall at all times adopt the best practicable option	Assessment of consent holder records and site inspection notices	Yes
6. Provision of records for discharge volumes, rates, and pressures	Receipt of well discharge data	Yes
7. Provision of records of chemical analysis of discharge	Receipt of discharge analytical results	Yes
8. Notification provision	Received five working days prior to consent exercise	Yes
9. No contamination of freshwater aquifers	Assessment of consent holder records	Yes
10. Lapse clause	Receive notice of exercise of consent	Yes
11. 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**

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 2015-2016 Annual Report

In the 2015-2016 Annual Report, it was recommended:

1. THAT the range of monitoring carried out during the 2015-2016 period in relation to the Company's DWI activities 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.
3. The recommendations above were implemented during the period under review.

3.5. Alterations to monitoring programmes for 2017-2018

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 the range of monitoring carried out during the 2016-2017 period be continued during the 2017-2018 monitoring period.

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

It should be noted that the proposed programme represents a reasonable and risk-based level of monitoring for the site in question. The Council reserves the right to subsequently adjust the programme from that initially prepared, should the need arise if potential or actual non-compliance is determined at any time during 2017-2018.

3.6. Exercise of optional review of consent

The next optional review date for consent 7905-1 is provided for in June 2018. Condition 11 allows the Council to review the consent, if there are grounds that the conditions are not adequate to deal with any adverse effects on the environment arising from the exercise of the resource consent, which were either not foreseen at the time the application was considered or which was not appropriate to deal with at the time.

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

4. Recommendations

1. THAT in the first instance monitoring of consented activities in the 2017-2018 year continues at the same level as in the 2016-2017 monitoring period.
2. THAT should there be issues with environmental or administrative performance in 2017-2018, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.
3. THAT 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.
Fracture gradient	A measure of how the pressure required to fracture rock in the earths crust changes with depth. It is usually measured in units of "pounds per square inch per foot" (psi/ft) and varies with the type of rock and the strain of the rock.
Freshwater-saline-water interface	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 ("fraccing").
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.
IR	Unauthorised Incident Register – contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
L/s	Litres per second.
m BGL	Metres below ground level.
mbmp	Metres below measuring point.
mS/m	Millisiemens per metre.
m TVD	Metres true vertical depth
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).
UI	Unauthorised Incident.
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.

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Taranaki Regional Council (2016): Origin Energy Resources New Zealand Limited Deep Well Injection Monitoring Programme Annual Report 2015-2016. Technical Report 2016-60. Doc no. 1736148.

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Taranaki Regional Council (2013): Origin Energy Resources New Zealand Limited Deep Well Injection Monitoring Programme Annual Report 2012-2013. Technical Report 2013-40. Doc no. 1241469.

Taranaki Regional Council (2011): Origin Energy Resources New Zealand Limited Deep Well Injection Monitoring Programme Triennial Report 2009-2012. Technical Report 2011-85.

Appendix I

Resource consents held by Westside New Zealand 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:	Westside New Zealand Limited Level 17 300 Queen Street Brisbane QLD 4000 AUSTRALIA
Decision Date:	16 September 2011
Commencement Date:	16 September 2011

Conditions of Consent

Consent Granted:	To discharge heated water, including produced water to ground at the Manutahi-D wellsite for water flooding purposes
Expiry Date:	1 June 2028
Review Date(s):	June 2022
Site Location:	Manutahi-D wellsite, Lower Ball Road, Kakaramea (Property Owner: NA Schrider & PW Campbell)
Grid Reference (NZTM)	1719971E-5603672N
Catchment:	Mangaroa

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 this consent is exercised, except for an initial injection trial of up to 64 cubic metres of produced water per well, the consent holder shall submit an updated "Injection Operation Management Plan" which includes the details of this waterflooding pilot project and 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. Before this consent is exercised the consent holder shall provide to the Chief Executive of the Taranaki Regional Council:

   a) Subsurface construction details, including design of the exterior surface casing, the intermediate protective casing, and the innermost casing, tubing, and packer;
   b) A log of the well, or a representative nearby well, from 0.0 mbgl to 1000 mbgl; clearly showing the freshwater/brine water interface zone;
   c) Annular pressure; pressure testing which demonstrates well integrity [MIT];
   d) Receiving Formation fracture pressure and geological seal fracture pressure;
   e) A chemical analysis of the formation-water;
   f) Cementing details.

3. The injection pressure at the wellhead shall not exceed a maximum injection pressure of 721 PSI [50 Bars].

4. The volume of liquid re-injected shall not exceed 318 cubic metres per day.

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; in particular, ensuring that the injection material is contained within the injection zone.

6. 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.

7. The consent holder shall measure and record the following constituents of the discharge 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.

8. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least 5 working days prior to the first exercise of this consent, except for an initial injection trial of up to 64 cubic metres of produced water per well. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz.

9. The consent holder shall ensure that the exercise of this consent not contaminate or put at risk actual or potential usable freshwater aquifer.

10. This consent shall lapse on the 30 September 2016, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(b) of the Resource Management Act 1991.

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

Transferred at Stratford on 1 November 2016

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management