Todd Energy Limited Deep Well Injection Monitoring Programme Annual Report 2015-2016

Technical Report 2016-62

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Executive summary

Todd Energy Limited (the Company) operates a number of wellsites across North Taranaki, including the Tuhua, Pouri, and Mckee wellsites, located east of New Plymouth. 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 four resource consents for DWI activities, which include a total of 71 conditions setting out the requirements that the Company must satisfy. Three of the four consents were exercised during the period being reported.

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 six site inspections, two injectate samples and five 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 Todd Energy Limited (the Company) for deep well injection (DWI) activities. During the period under review, the Company held four resource consents for the subsurface injection of fluids by DWI. The consents authorise discharges from four separate wellsites within the Company's Mckee and Mangahewa oil and gas fields, located east of New Plymouth, North Taranaki.

The resource consents held by the Company permit the discharge of a range of fluids by DWI, including produced water, contaminated stormwater, well drilling fluids, hydraulic fracturing (HF) fluids production sludges and any other fluids approved in writing by the Council. 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 sixth 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:

- 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 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 consent holders, this report also assigns a rating as to each Company's 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 the produced water. The range of fluid types authorised for injection varies by consent, but includes well workover fluids, well drilling fluids, hydraulic fracturing fluids and hydraulic fracturing return fluids.

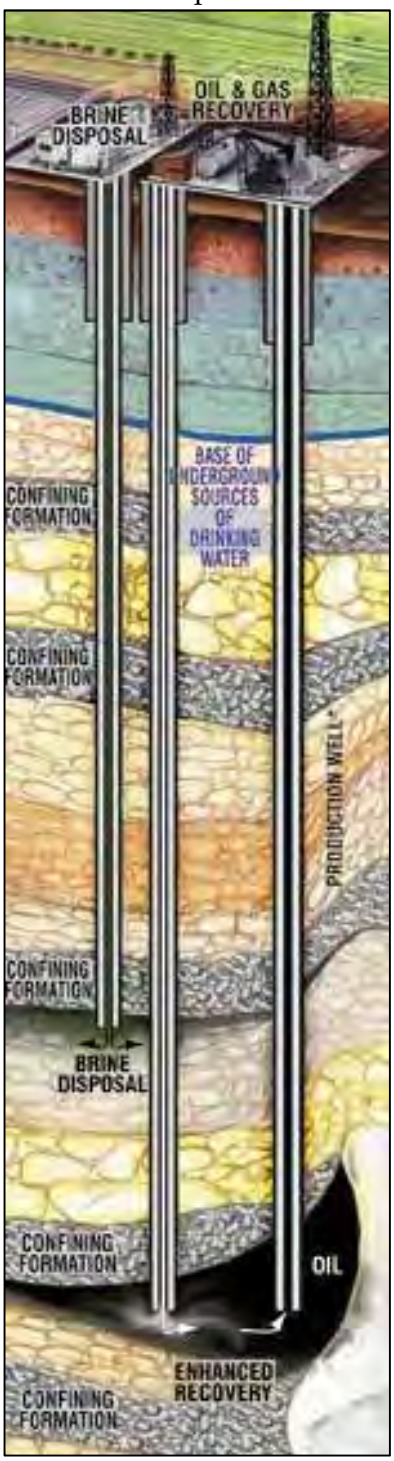


Figure 1 DWI schematic (www.epa.gov/uic)

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.

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 the region can be found in previous compliance reports published by the Council (see Bibliography).

1.3 Resource consents

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 four discharge consents covering their DWI activities (Table 1). One of these consents (5037-2.1) was issued during the period under review.

Table 1 Current DWI consents

Consent Number	Wellsite	Status	Injection Well(s)	Formation	Issued	Expiry
1315-1	Tuhua-B	Active	McKee Disposal-1	Mount Messenger	08/08/1984	01/06/2023
4182-2	McKee-A	Active	McKee-1	McKee	01/10/2013	01/06/2033
5037-2.1	Pouri-A	Active	Pouri-1A	McKee	15/10/2015	01/06/2033
5052-2	McKee-B	Active	McKee-4	Mount Messenger	27/052014	01/06/2033

Consent **1315-1** was issued by the Council on 8 August 1984 and was transferred to the Company by the previous holder on 31 May 2006. A variation to the consent was granted on 1 October 2013 which included the changing of the purpose of the consent and adding thirteen conditions to take the total number of conditions to seventeen. It is due to expire on 1 June 2023. The consent authorises the discharge of fluid waste generated by oil and gas exploration and production activities to the Mount Messenger Formation by deep well injection at the Tuhua-B wellsite

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

Special condition 1 required to consent holder to submit an "Injection Operation Management Plan" prior to exercising the consent;

Special condition 2 requires the consent holder to submit well completion information following drilling;

Special condition 3 requires the discharge to cease 5 years prior to consent expiry date to allow for on-going environmental monitoring after the discharge has ceased;

Special condition 4 refers to the best practicable option requirements;

Special condition 5 requires injected fluids to be contained within the Mount Messenger Formation, deeper than 1,200 m BGL;

Special condition 6 prohibits the fracturing of the geological seals confining the injection zone;

Special condition 7 prohibits the discharge from endangering or contaminating any freshwater aquifer;

Special condition 8 limits the range of fluids that may be injected;

Special conditions 9, 10, 11 & 12 refer to process monitoring and data submission requirements;

Special condition 13, 14 & 15 relate to the requirement for the consent holder to implement a groundwater monitoring programme;

Special condition 16 is an annual reporting requirement; and

Special condition 17 is a review provision.

Consent **4182-2** was issued by the Council on 1 October 2013 under Section 87(e) of the RMA. It is due to expire on 1 June 2033. The consent authorises the discharge of fluid waste generated by oil and gas exploration and production activities to the McKee Formation by deep well injection at the McKee-A wellsite.

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

Special condition 1 required to consent holder to submit an "Injection Operation Management Plan" prior to exercising the consent;

Special condition 2 requires the consent holder to submit well completion information following drilling;

Special condition 3 requires the discharge to cease 5 years prior to consent expiry date to allow for on-going environmental monitoring after the discharge has ceased;

Special condition 4 refers to the BPO requirements;

Special condition 5 requires injected fluids to be contained within the McKee Formation, below deeper than 2,300 m BGL;

Special condition 6 prohibits the fracturing of the geological seals confining the injection zone;

Special condition 7 prohibits the discharge from endangering or contaminating any freshwater aquifer;

Special condition 8 limits the range of fluids that may be injected;

Special condition 9, 10,11 & 12 refer to process monitoring and data submission requirements;

Special condition 13, 14 & 15 relate to the requirement for the consent holder to implement a groundwater monitoring programme;

Special condition 16 is an annual reporting requirement; and

Special condition 17 is a review provision.

Consent **5037-2.1** was issued by the Council on 15 October 2015 under Section 87(e) of the RMA. It is due to expire on 1 June 2033. The consent authorises the discharge of waste drilling fluids, water, produced water and stormwater from hydrocarbon exploration and production operations by deep well injection at the Pouri-A wellsite.

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

Special condition 1 required to consent holder to submit an "Injection Operation Management Plan" prior to exercising the consent;

Special condition 2 requires the consent holder to submit well completion information following drilling;

Special condition 3 requires the discharge to cease 5 years prior to consent expiry date to allow for on-going environmental monitoring after the discharge has ceased;

Special condition 4 refers to the best practicable option requirements;

Special condition 5 requires injected fluids to be contained within the Mckee Formation, deeper than 2,338 metres true vertical depth below ground level. (m TVD);

Special condition 6 limits the injection pressure at the wellhead to below 4000 psi (276 bar);

Special condition 7 prohibits the fracturing of the geological seals confining the injection zone;

Special condition 8 prohibits the discharge from endangering or contaminating any freshwater aquifer;

Special condition 9 and 10 limits the range of fluids that may be injected;

Special conditions 11, 12, 13 & 14 refer to process monitoring and data submission requirements;

Special condition 15, 16 & 17 relate to the requirement for the consent holder to implement a groundwater monitoring programme;

Special condition 18 is an annual reporting requirement; and

Special condition 19 is a review provision.

Consent **5052-2** was issued by the Council on 27 May 2014 under Section 87(e) of the RMA. It is due to expire on 1 June 2033. The consent authorises the discharge of fluid waste generated by oil and gas exploration and production activities to the Mount Messenger Formation by deep well injection at the Mckee-B wellsite

The consent has eighteen special conditions, as summarised below:

Special condition 1 required to consent holder to submit an "Injection Operation Management Plan" prior to exercising the consent;

Special condition 2 requires the consent holder to submit well completion information following drilling;

Special condition 3 requires that no fluids be injected after 1 June 2028.

Special condition 4 refers to the BPO requirements;

Special condition 5 requires the injected fluids to be confined to the Mount Messenger Formation, and to be injected at a minimum depth of 945 m BGL;

Special condition 6 prohibits the fracturing of the geological seals confining the injection zone;

Special condition 7 prohibits the discharge from endangering or contaminating any freshwater aquifer;

Special condition 8 limits the range of fluids that may be injected;

Special conditions 9, 10, 11 and 12 refer to process monitoring and data submission requirements;

Special condition 13, 14 & 15 relate to the requirement for the consent holder to implement a groundwater monitoring programme;

Special condition 16 is an annual reporting requirement;

Special condition 17 is a lapse clause; and

Special condition 18 is a review provision.

Figure 2 shows the location of the DWI consents held by the Company during the period under review.

Copies of the current consent certificates are attached in Appendix I.

Figure 2 Location of the Company's consented DWI sites 2015-2016

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 Tuhua-B, Mckee-A wellsites were inspected by Council Officer's on six occasions during the monitoring period. 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. Pouri-A has not undergone a site inspection since injection began in February 2016.

An additional two visits to the Company's Mckee Production Station were undertaken by Council Officer's 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 tank at the Mckee Production Station identified on-site as tank T-100 (Table 2).

The injectate samples were analysed for the following parameters:

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

Table 2 Injectate sample locations

Consent	Wellsite	Injection well	Site code	Sample point
1315-1	Tuhua-B wellsite	McKee-Disposal-1	GND1749	Tank T100 (McKee Production Station)
4182-2	McKee-A wellsite	McKee-1	GND0443	
5037-2.1	Pouri-A wellsite	Pouri-1A	GND1508	

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 2013-2014 monitoring period.

Four monitoring sites were sampled during the review period. Including two dedicated monitoring bores which were installed by the company under the conditions of consent 4182-2 and 5037-2.1. One in the vicinity of the Mckee-A wellsite (GND2455), completed 19 March 2014, and the second in the vicinity of the Pouri-A wellsite (GND3005), completed 15 March 2016.

To date only baseline groundwater monitoring has been undertaken in the vicinity of the Pouri-A wellsite, given that the DWI consent pertaining to the site has only recently been exercised.

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

Table 3 Location of groundwater sampling sites

Site code	Distance from injection well (m)	wellsite	Casing depth (m)	Drilled depth (m)	Groundwater level (m bgl)	Aquifer
GND2453	169	Tuhua-B	-	Spring	-	Volcanics
GND2454	161	Tuhua-B	-	Spring	-	Volcanics
GND2455	38	McKee-A	28.5	35.5	0.91	Volcanics
GND3005	45	Pouri-A	30.6	35.0	+0.30 (artesian)	Marine Terraces

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 consent holder

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.

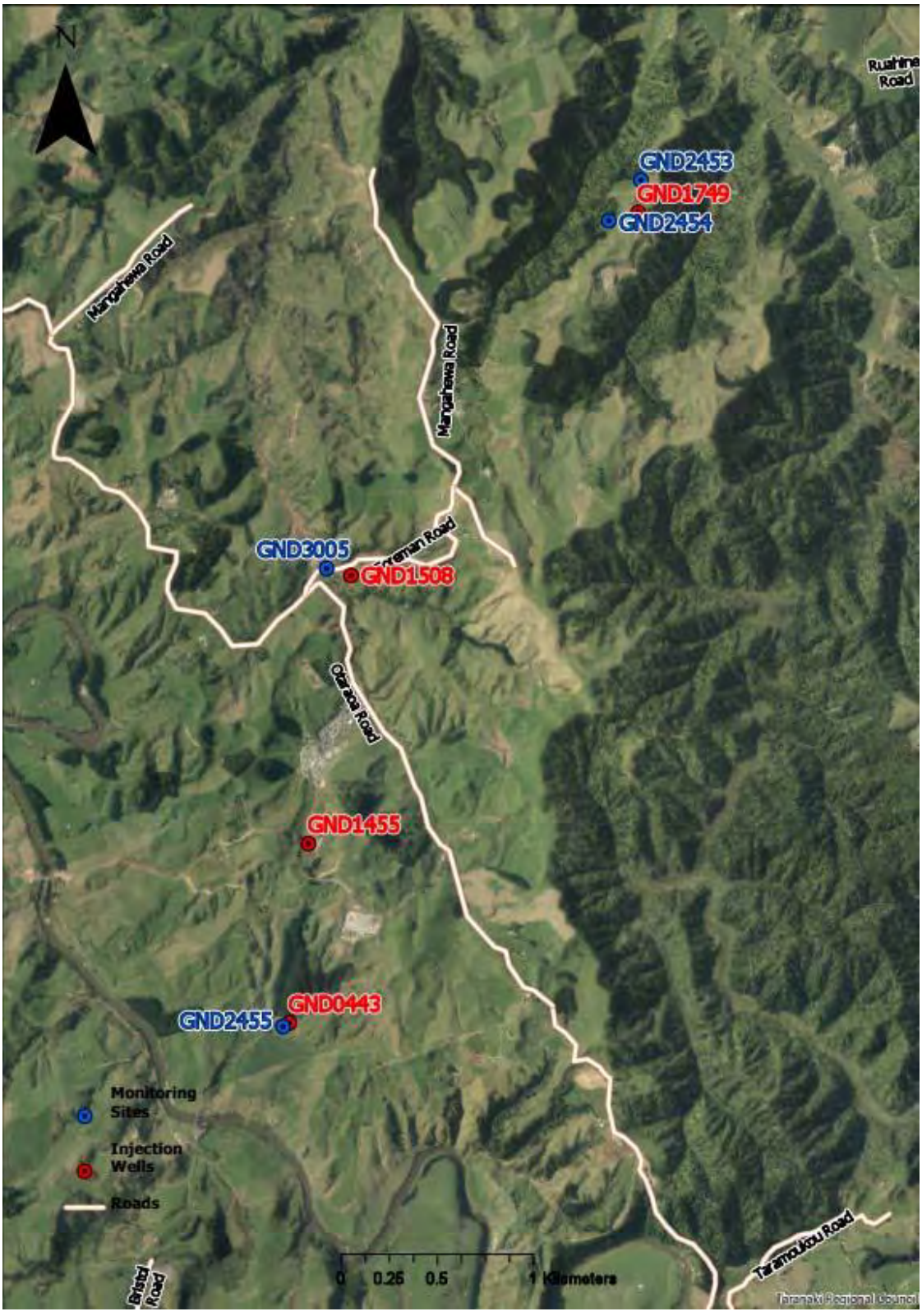


Figure 3 Location of groundwater sampling sites in relation to injection wells being monitored

2. Results

2.1 Site inspections

Six routine inspections of the Company's Tuhua-B and Mckee-A wellsites were conducted during the period under review. 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 site was also visited by Council officer's on two occasion during the monitoring year for the purpose of injectate sampling. This involved accessing the Company's bulk liquid storage tanks at the Mckee Production Station. No issues were noted by staff during these visits.

2.2 Injectate sampling

Samples of injectate were obtained from the Company's Mckee Production Station on 22 October 2015 and 4 may 2016. All fluids for disposal are handled and controlled through the production station. The samples were submitted to the Council's laboratory on the same day for physicochemical analysis.

The results of the sample analyses are included below in Table 4. The range of results for each analyte since 2004 is also presented for comparison.

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

Table 4 Biannual injectate samples

Parameter	Unit	McKee-B Sample Range June 2004 – to date		McKee Production Station (Sample point T100)	
		min	max	22/10/2015	4/05/2015
Time	NZST			13:30	08:15
TRC sample number	-			TRC137387	TRC161511
pH	pH Units	7.5	9.0	8	8
Conductivity @ 20^{o}C	mS/m @ 20^{o}C	188	2,520	2,120	2,520
Chloride	g/m^{3}	5,000	14,600	14,600	9,110
Total petroleum hydrocarbons	g/m^{3}	0.8	480	128	110

The Company also provided analytical results from the different fluids that made up the composite injection fluid stored in the T-100 tank at the Mckee Production Station prior to injection (Table 5).

Table 5 Results of the Company's sampling (2015-2016)

Date	Sample Location	pH	Conductivity	Suspended Solids	Temperature	Total Dissolved	Chloride	Hydrocarbons
	Units		µS/m	g/m³	Deg°C	Solids g/m³	mg/L	g/m³
15-Sep-15	McKee Disp 01	7.3	2,850	11	N/A	19,400	8,000	N/A
09-Nov-15	McKee Disp 01	6.8	2,760	22	12	18,000	8,600	30
22-Jan-16	McKee Disp 01	7.0	2,700	28	N/A	18,300	8,200	N/A
04-Feb-16	McKee Disp 01	7.4	2,600	52	N/A	17,700	6,100	N/A
25-Feb-16	McKee Disp 01	6.9	2,560	15	N/A	16,500	6,200	N/A
26-Apr-16	McKee-01	7.0	2,840	18	N/A	18,500	8,000	N/A
12-May-16	Mangahewa C	6.9	1,060	91	15	5,900	3,348	5.4
15-May-16	Mangahewa D	7.0	3,250	48	N/A	20,100	10,796	57.2
01-Jun-16	McKee Disp 01	7.1	2,890	7	N/A	18,500	8,300	N/A
08-Jun-16	Mangahewa D	6.6	1,145	46	N/A	500	352	4.3
16-Jun-16	McKee Disp 01	7.1	2,890	7	N/A	18,500	8,300	N/A
16-Jun-16	McKee-01	7.1	2,870	8	11	18,800	8,500	32

N/A – not available

The range of concentration for each parameter illustrates the variability in the composition of injectate across the monitoring period. The composition varies depending on the origin and volumetric proportion of each fluid type being injected at the time of sampling.

2.3 Groundwater sampling

Groundwater samples were obtained from three sites during the review period, GND2453, GND2454 in the vicinity of the Tuhua-B wellsite and GND2455 in the vicinity of the Mckee-B wellsite. A baseline sample was also obtained from GND3005. A baseline sample was also collected from site GND3005, located near the Pouri-A wellsite, on 14 April 2016 following the commenced of injection at this site on 3 February 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 results of analyses carried out are set out below in Tables 6, 7 and 8. Data since 2014 has also been provided for comparison.

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.

Results from the sampling undertaken at GND2455 during June 2014 indicated the presence of dissolved methane and ethane at this location.

The methane result in GND2455 is within the expected range for shallow groundwater across Taranaki and when taken in context with the other parameters, which show only minor fluctuations, indicates there has been no impact from DWI activities. However, the trace quantity of ethane, the slight decrease in temperature and the increase in pH in this sample could indicate a inflow from another contaminated water source. Therefore, it is recommended that during the next sampling round analysis is also undertaken for methane including a carbon isotope analysis if present to confirm whether the source of the methane is biogenic or thermogenic.

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

Table 6 Results of groundwater sampling undertaken by the Council at Tuhua-B sites GND2453 and GND2454

Sample details	Units	GND2453					GND2454				
TRC sample number	-	TRC149834	TRC1411645	TRC151560	TRC153208	TRC161509	TRC149835	TRC1411644	TRC151561	TRC153207	TRC161510
Sample date	-	24-Apr-14	29-Oct-14	24-Apr-15	08-Oct-15	04-May-16	24-Apr-14	29-Oct-14	24-Apr-15	08-Oct-15	04-May-16
Sample time	NZST	09:45	09:37	11:50	13:35	12:00	10:15	09:53	12:05	13:45	12:15
Chloride	g/m^3	24.8	20.9	18.9	24.6	27.8	11.7	8.4	9.9	9.9	10.5
Electrical conductivity	mS/m@20°C	13.5	11.8	12.3	14.7	14.7	9.2	6.4	8.8	9.1	9.4
Dissolved oxygen	g/m^3	-	-	2.66	11.33	8.1	-	-	2.68	11.98	-
Total hydrocarbons	g/m^3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
pH	pH	6.5	6.3	6.4	6.4	6.4	6.6	6.3	6.6	7.5	6.4
Temperature	°C	15	15	15.7	15	15.2	14.9	14.2	15.1	14.4	

Table 7 Results of groundwater sampling undertaken by the Council at Mckee-B site GND2455

Sample details	Units	GND2455					
TRC sample number	-	TRC1410102	TRC1410368	TRC1411646	TRC151562	TRC153210	TRC161508
Sample date	-	28-May-14	12-Jun-14	29-Oct-14	24-Apr-15	08-Oct-15	04-May-16
Sample time	NZST	09:35	11:35	11:45	10:31	12:35	11:01
Chloride	g/m^3	15.2		15	14	13.5	13.2
Electrical conductivity	mS/m@20°C	36.6	32.3	35.4	37.4	37.7	39.1
Dissolved oxygen	g/m^3	-	-	0.2	0.1	0.79	1.75
Total hydrocarbons	g/m^3	<0.5	-	<0.5	<0.5	<0.5	<0.5
pH	pH	7.3	9.7	8.3	8	7.9	7.8
Temperature	°C	15.3	12.9	15.8	17.1	15.1	16.8
Ethane	g/m^3	-	0.021	-	-	-	-
Ethylene	g/m^3	-	<0.003	-	-	-	-
Methane	g/m^3	-	17.7	-	-	-	-
Alkalinity	g/m^3 $CaCO_3$	197	-	-	-	-	-
Suspended solids	g/m^3	11	-	-	-	-	-

Table 8 Results of baseline groundwater sampling at Pouri-A undertaken by the Council

GND3005					
Sample date	14-Apr-16				
Sample time (NZST)	9:55				
Sample details	Units	TRC161505	Sample details	Units	TRC161505
Chloride	g/m^3	10.4	Dissolved copper	g/m^3	<0.0005
Electrical conductivity	mS/m@20°C	25.7	Magnesium	g/m^3	8
Dissolved oxygen	g/m^3	0.38	Dissolved bromine	g/m^3	0.027
pH	pH	8	Dissolved barium	g/m^3	0.0055
Temperature	°C	14.7	Dissolved mercury	g/m^3	<0.00008
Dissolved oxygen	g/m^3	0.038	Dissolved nickel	g/m^3	<0.0005
Sulphates	g/m^3	3.6	Dissolved zinc	g/m^3	0.0014
Alkalinity	g/m3 $CaCO_3$	124	Sum of cations	meq/L	2.8
Bicarbonate	g/m3 $CaCO_3$	150	Methane	g/m^3	0.027
Hardness	g/m3 $CaCO_3$	106	Toluene	g/m^3	<0.0010
Total Nitrogen	g/m^3 N	<0.002	o-Xylene	g/m^3	<0.0010
Nitrite	g/m^3 N	<0.002	m-Xylene	g/m^3	<0.002
Nitrate	g/m^3 N	<0.002	Benzene	g/m^3	<0.0010
Sum of anions	meq/L	2.9	Ethylbenzene	g/m^3	<0.0010
Calcium	g/m^3	29	Ethane	g/m^3	<0.003
Potassium	g/m^3	2.9	Ethylene	g/m^3	<0.004
Sodium	g/m^3	14.1	Total hydrocarbons	g/m^3	<0.7
Dissolved iron	g/m^3	0.11	-	-	-

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 9 provides an overview of the Company's injection activities across all consents during the monitoring period and injection data is summarised in Table 10.

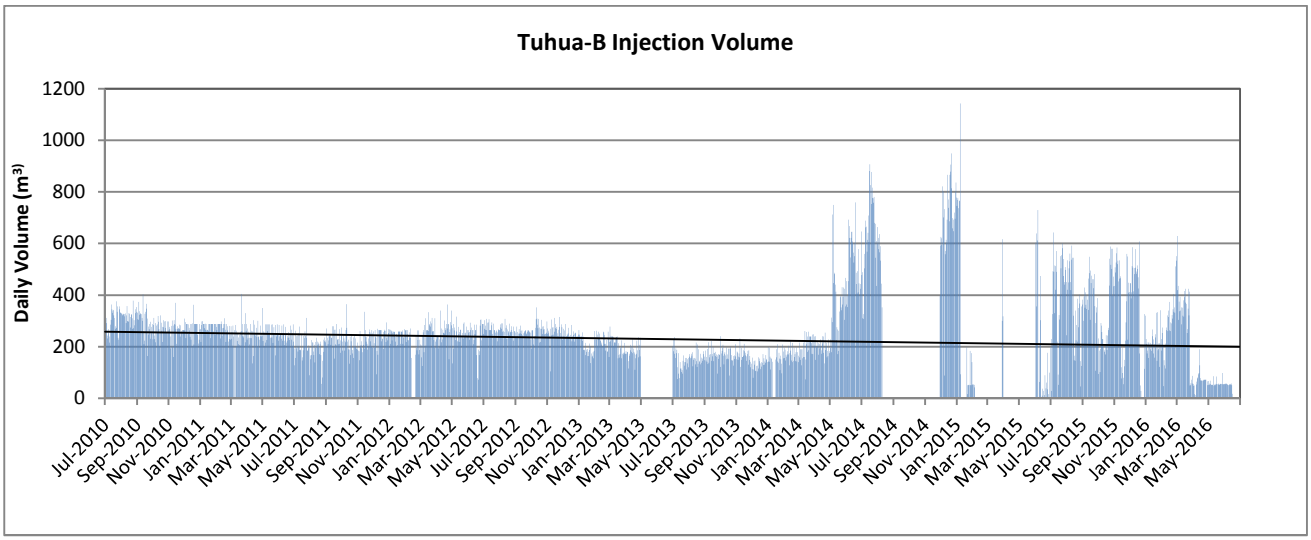
Table 9 Total annual volume injected

Consent	Wellsite	Injection wells	Total volume discharged (m^3) 01/07/15 – 30/06/16	Discharge period		TRC well ID
				From	To	
1315-1	Tuhua-B	McKee Disposal-1	95,406.37	01/07/2015	30/06/2016	GND1749
4182-2	McKee-A	McKee-1	125,875.52	01/07/2015	30/06/2016	GND0443
5037-2.1	Pouri-A	Pouri-1A	19,016.26	03/02/2016	30/06/2016	GND1508
5052-2	McKee-B	McKee-4	0.00	-	-	GND1455
Total			240,298.15			

Table 10 Summary of 2015-2016 injection data

1315-1 - McKee Disposal-1 injection well			
	Volume injected (m^3)	**Maximum Pressure (Bar)**	**Injection rate (m^3/hr)**
Total	95,406.37	-	-
Daily maximum	642.40	58.00	28.5
Daily average	260.67	58.00	11.40
4182-2 - McKee-1 injection well			
	Volume injected (m^3)	**Maximum Daily Pressure (Bar)**	**Injection rate (m^3/hr)**
Total	125,875.52	-	-
Daily maximum	1,203.30	38.00	166.0
Daily average	343.92	38.00	26.28
5037-2.1 – Pouri-1A injection well			
	Volume injected (m^3)	**Maximum Daily Pressure (Bar) Limit 276 bar**	**Injection rate (m^3/hr)**
Total	19,016.26	-	-
Daily maximum	311.98	48.00	45.9
Daily average	127.63	48.00	7.15

The daily volume, maximum daily injection pressure and a comparison pf volume and maximum daily pressure over the entire data record for consent 1315-1 (Tuhua-B) is presented in Figure 4. A visual assessment of the data suggests there may have been some changes in the use of Tuhua-B over the course of the monitoring year with injection daily volumes increasing and the frequency of use decreasing as other sites become active. A trend line has been fitted to the volume data for indicative purposes only.



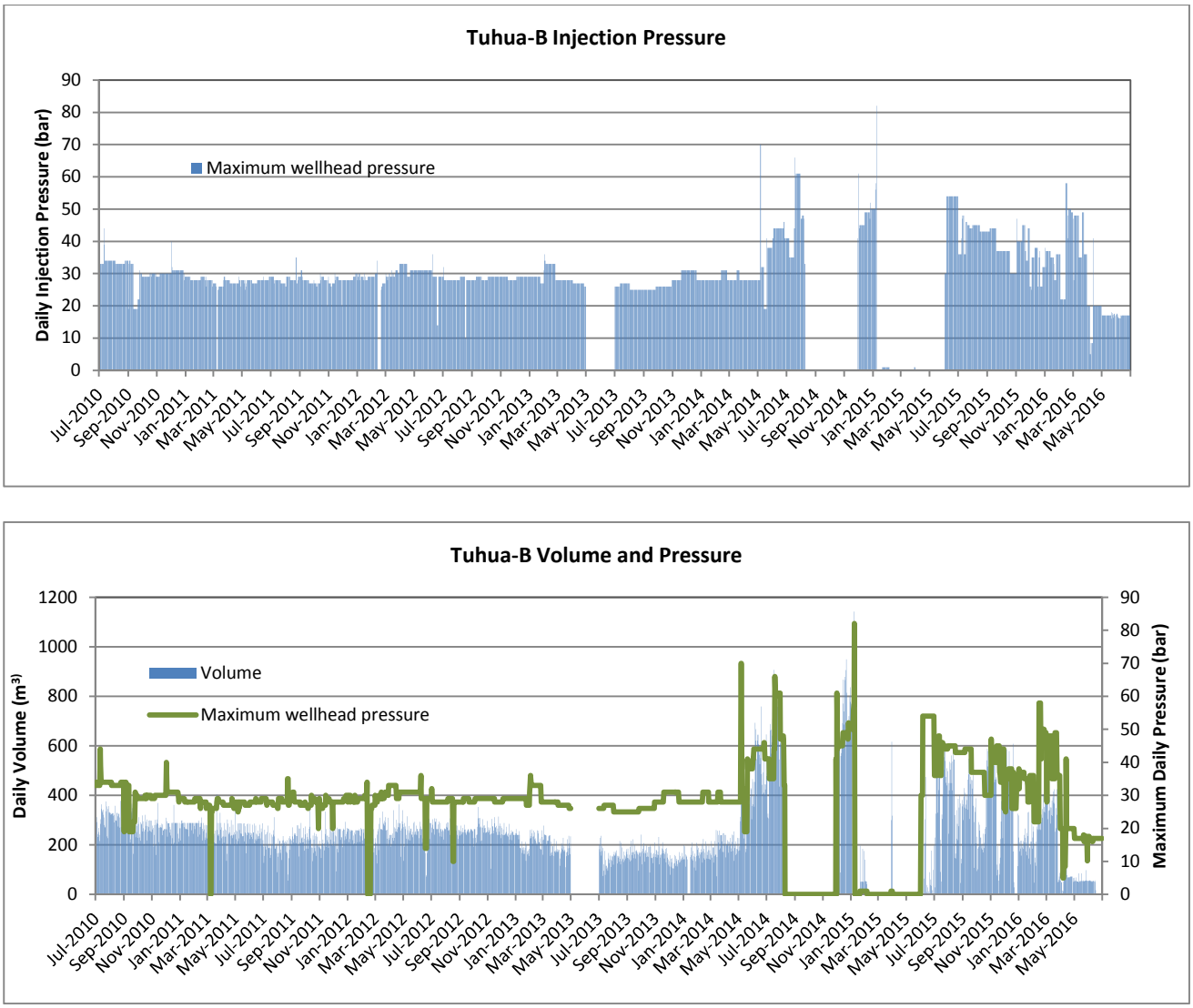


Figure 4 2010-2016 daily injection volumes and pressure - consent 1315-1

The daily volume, maximum daily injection pressure and a comparison pf volume and maximum daily pressure over the entire data record for consent 4182-2 (Mckee-A) is presented in Figure 5. A visual assessment of the data suggests the well was depressurised until August 2014 indicating it's suitability for injection and the pressure required to abstract resources has gradually increased over time. The increase also correlates with increased periods of injection over the same period.

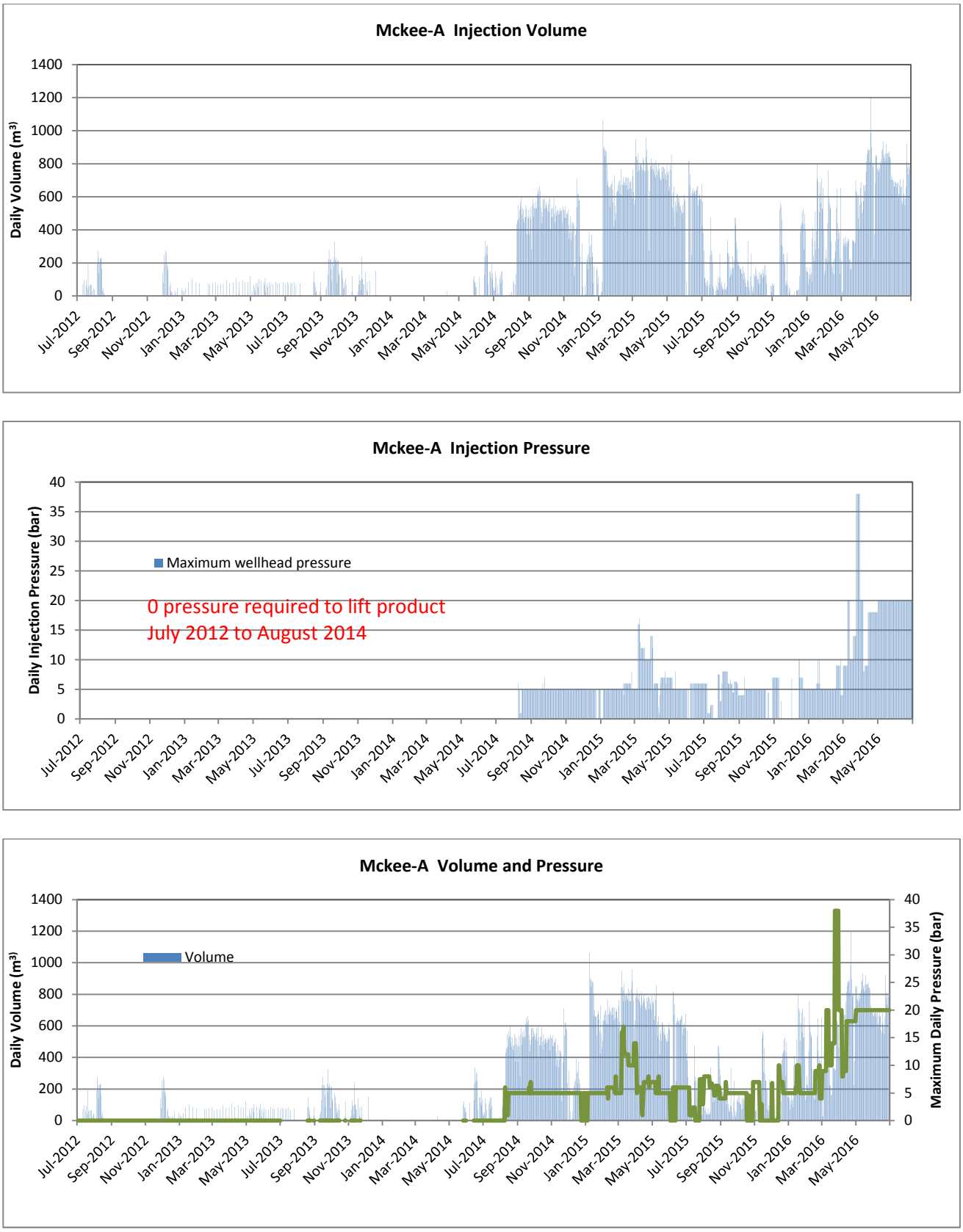
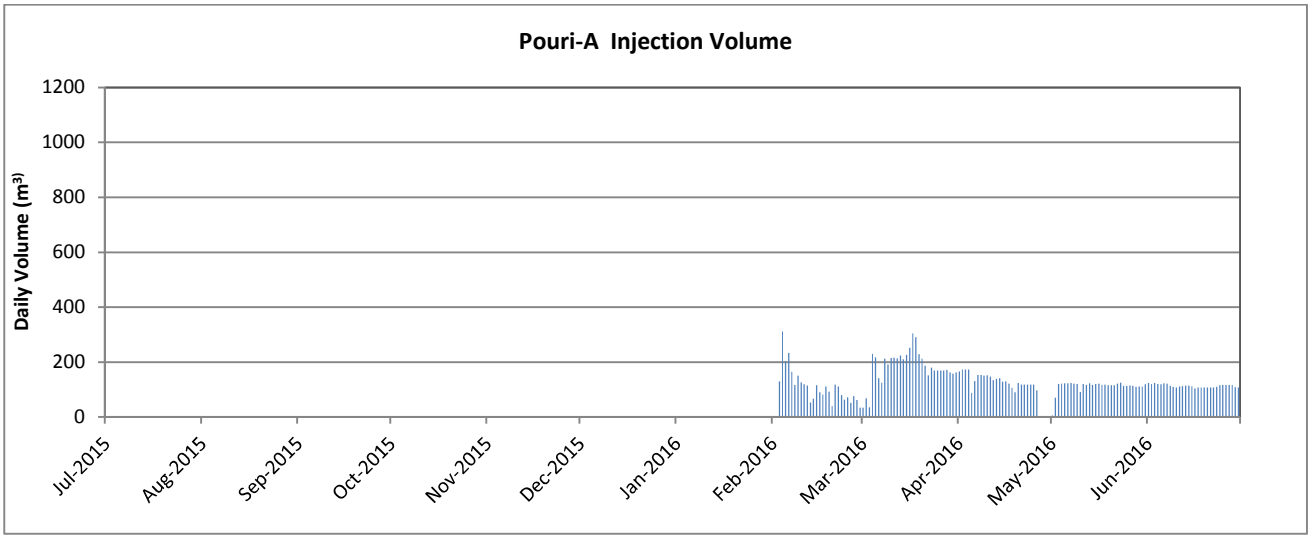
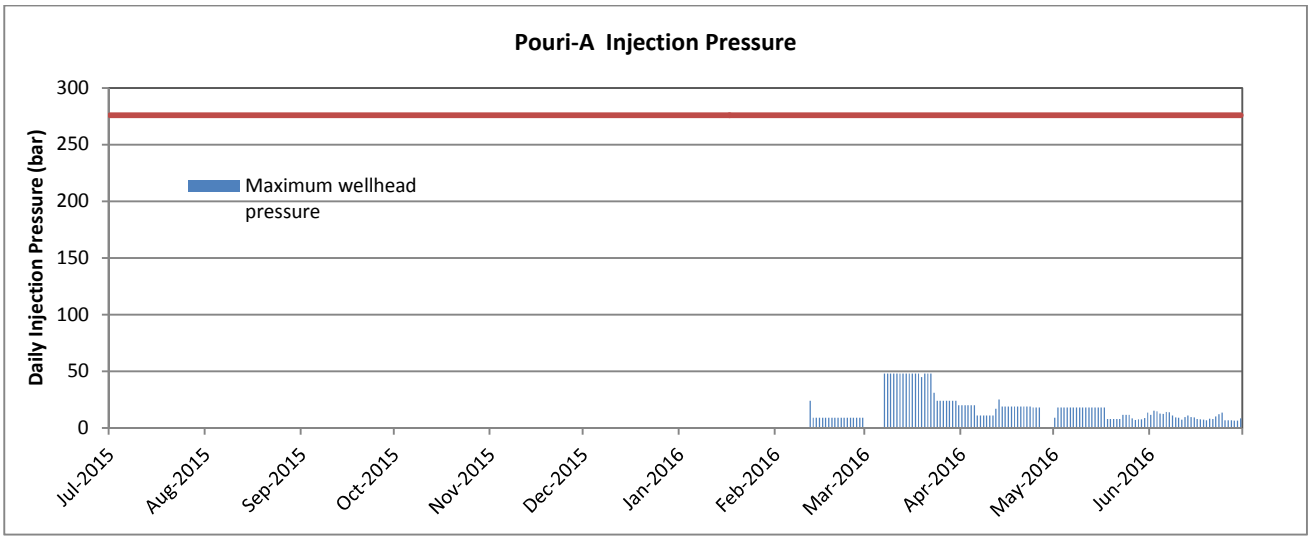


Figure 5 2012-2016 daily injection volumes and pressure - consent 4182-2

The daily volume, maximum daily injection pressure and a comparison pf volume and maximum daily pressure over the entire data record for consent 5037-2.1 (Mckee-A) is

presented in Figure 6. Injection commenced in early February and data suggest a slight decrease in in volume injected over the period.





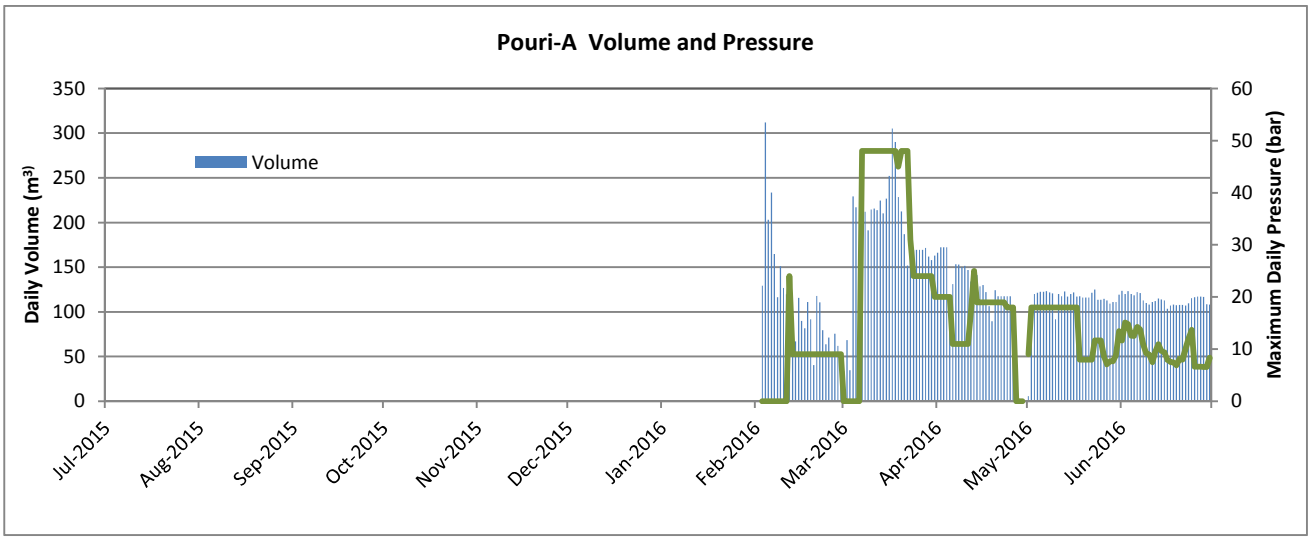


Figure 6 2015 - 2016 daily injection volumes and pressure - consent 5037-2.1

3. Discussion

3.1 Discussion of site performance

During the period under review, the Company exercised three resource consents (1315-1, 4182-2 and 5037-2.1) for the injection of fluids by DWI. These consents licensed discharges of various forms of fluid into the Mount Messenger and McKee Formations, via the McKee Disposal-1, McKee-1 and Pouri-1A injection wells. The main source of fluids for injection was produced water from the Company's Mangahewa and McKee fields. Groundwater quality monitoring was undertaken by the Council on behalf of the Company.

The Tuhua-B, Mckee-A and Pouri-A 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. 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 2015-2016 injection data provided by the Company shows a total of:

- 9406.37 m^3 of fluid was injected under consent 1315-1;
- 125,875.52 m^3 of fluid was injected under 4182-2; and
- 19,016.26 m^3 of fluid was injected under 5037-2.1.

The data also shows that the maximum daily volume injected was 642.40 m^3, on 6 July 2016 under consent 1315-1, 1,203. 3 m^3 on 22 April 2016 under consent 4182-2 and 311.98 m^3 on 4 February 2016 under consent 5037-2.1.

An assessment of the historical injection data suggests that there may have been a slight increase in wellhead pressure over time at the Mckee-A injection well. This increase in pressure is not unexpected as ongoing injection increases pressures within the injection reservoir . Changes in pressure over time will continue to be closely monitored as part of this programme.

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 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 during the 2014-2015 period. 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.

The methane result in GND2455 is within the expected range for shallow groundwater across Taranaki however due to the sample also containing a trace quantity of ethane it is recommended that during the next sampling round analysis is also undertaken for methane, including a carbon isotope analysis if present, to confirm whether the source of the methane is biogenic or thermogenic.

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

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 Company's compliance record in relation to consent 1315-1 is set out in Table 11, 4182-2 in Table 12 and 5037-2.1 in Table 13. Compliance summaries are only provided for consents exercised during the period under review.

Table 11 Summary of performance for consent 1315-1

Purpose: ***To discharge fluid waste generated by oil and gas exploration and production activities to the Mount Messenger Formation by deep well injection at the Tuhua-B wellsite.***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Prior to 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. No injection permitted after 1 June 2027.	Assessment of injection records and site inspection notices.	N/A
4. The consent holder shall at all times adopt the best practicable option.	Assessment of consent holder records and site inspection notices.	Yes
5. The injection of fluids shall be confined to the Mount Messenger Formation, deeper than 1200 m bgl.	Review of "Injection Operation Management Plan," well construction log and injection data.	Yes

Purpose: ***To discharge fluid waste generated by oil and gas exploration and production activities to the Mount Messenger Formation by deep well injection at the Tuhua-B wellsite.***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
6. The injection of fluids does not result in fracturing of geological seals confining the injection zone	Assessment of injection records and results of groundwater sampling and analysis programme.	Yes
7. The consent holder shall ensure that the exercise of this consent does not result in contaminants reaching any useable freshwater (groundwater or surface water).	Assessment of injection records and results of groundwater sampling and analysis programme.	Yes
8. Limits the range of fluids that can be discharged under the consent.	Assessment of consent holder records and injectate sample analysis.	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. Ensure that the analysis required by 10 (c) is carried out in an International Accreditation New Zealand (IANZ) accredited laboratory	Assessment of injection data	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
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 freshwater 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 fist 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	Receipt of satisfactory report by 31 August each year.	Yes

Purpose: *To discharge fluid waste generated by oil and gas exploration and production activities to the Mount Messenger Formation by deep well injection at the Tuhua-B wellsite.*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
with consent conditions over the previous 1 July to 30 June period.		
17. 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**

Table 12 Summary of performance for consent 4182-2

Purpose: *To discharge fluid waste generated by oil and gas exploration and production activities to the McKee Formation by deep well injection at the McKee-A wellsite.*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Prior to 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. No injection permitted after 1 June 2028.	Assessment of injection records and site inspection notices.	N/A
4. The consent holder shall at all times adopt the best practicable option.	Assessment of consent holder records and site inspection notices.	Yes
5. The injection of fluids shall be confined to the McKee Formation, deeper than 2,300 m bgl.	Review of "Injection Operation Management Plan," well construction log and injection data.	Yes
6. The injection of fluids does not result in fracturing of geological seals confining the injection zone	Assessment of injection records and results of groundwater sampling and analysis programme.	Yes
7. The consent holder shall ensure that the exercise of this consent does not result in contaminants reaching any useable freshwater (groundwater or surface water).	Assessment of injection records and results of groundwater sampling and analysis programme.	Yes
8. Limits the range of fluids that can be discharged under the consent.	Assessment of consent holder records and injectate sample analysis.	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. Ensure that the analysis required by 10 (c) is carried out in an International Accreditation New Zealand (IANZ)	Assessment of injection data	Yes

Purpose: ***To discharge fluid waste generated by oil and gas exploration and production activities to the McKee Formation by deep well injection at the McKee-A wellsite.***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
accredited laboratory		
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
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 freshwater resources.	Monitoring Programme submitted to the Chief Executive, Taranaki Regional Council, for certification.	Yes
14. 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	Receipt of Sampling and Analysis Plan prior to fist 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. Consent review provision		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**

Table 13 Summary of performance for consent 5037-2.1

Purpose: ***To discharge fluid waste generated by oil and gas exploration and production activities to the McKee Formation by deep well injection at the McKee-A wellsite.***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Prior to 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

Purpose: ***To discharge fluid waste generated by oil and gas exploration and production activities to the McKee Formation by deep well injection at the McKee-A wellsite.***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
3. No injection permitted after 1 June 2028.	Assessment of injection records and site inspection notices.	N/A
4. The consent holder shall at all times adopt the best practicable option.	Assessment of consent holder records and site inspection notices.	Yes
5. The injection of fluids shall be confined to the Mount Messenger Formation, deeper than 2,338 m bgl.	Review of "Injection Operation Management Plan," well construction log and injection data.	Yes
6. The injection of fluids does not exceed 276 bar	Assessment of injection records	Yes
7. The injection of fluids does not result in fracturing of geological seals confining the injection zone	Assessment of injection records and results of groundwater sampling and analysis programme.	Yes
8. The consent holder shall ensure that the exercise of this consent does not result in contaminants reaching any useable freshwater (groundwater or surface water).	Assessment of injection records and results of groundwater sampling and analysis programme.	Yes
9. Limits the range of fluids that can be discharged under the consent.	Assessment of consent holder records and injectate sample analysis.	Yes
10. Limitations and rules on any additional discharge fluids from 9(f)	Assessment of consent holder records and injectate sample analysis.	
11. Maintain full records of injection data.	Receipt and assessment of injection data.	Yes
12. Maintain records and undertake analysis to characterise each type of waste arriving on-site for discharge.	Receipt and assessment of injection data.	Yes
13. Ensure that the analysis required by 12 (c) is carried out in an International Accreditation New Zealand (IANZ) accredited laboratory	Assessment of injection data	Yes
14. The data required by conditions 11 & 12 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
15. 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 freshwater resources.	Monitoring Programme submitted to the Chief Executive, Taranaki Regional Council, for certification.	Yes

Purpose: ***To discharge fluid waste generated by oil and gas exploration and production activities to the McKee Formation by deep well injection at the McKee-A wellsite.***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
16. 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. ttotal petroleum hydrocarbons	Implementation of Groundwater Monitoring Programme and assessment of results.	Yes
17. 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 fist round of sampling being undertaken.	yes
18. 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
19. Consent review provision		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,

- its obligations to monitor emissions/discharges and effects under the RMA, and
- report 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 emitting to the atmosphere/discharging to the environment.

It is proposed 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, with the addition of further methane sampling to be undertaken at GND2455 for isotopic analysis (as discussed in section 2.3). 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 1315-1, 4182-2 and 5037-2.1 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 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 sampling and analysis of methane to be undertaken at GND2455.

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.
Bcf	Billion cubic feet.
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.
m TVD	Metres true vertical depth.
m^3	Cubic metre.
Packer	A down hole device used to isolate the annulus from the production conduit, enabling controlled production, injection or treatment.
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.
Power fluid	Pressurized fluids used to transmit and control energy into oil/gas wells. Power fluid is a heated combination of fresh and produced water.
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).
TRC	Taranaki Regional Council (the Council).
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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Appendix I

Resource consents held by Todd Energy 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:	Todd Energy Limited P O Box 802 NEW PLYMOUTH 4340
Decision Date (Change):	1 October 2013
Commencement Date (Change):	1 October 2013 (Granted: 8 August 1984)

Conditions of Consent

Consent Granted:	To discharge fluid waste generated by oil and gas exploration and production activities to the Mount Messenger Formation by deep well injection at the Tuhua-B wellsite
Expiry Date:	1 June 2023
Review Date(s):	June Annually
Site Location:	Tuhua-B-wellsite, Otaraoa Road, Tikorangi, Waitara (Property owner: HJ, JK & CJ Megaw)
Legal Description:	Lot 3 DP 15159 Blk XI Waitara SD (Discharge source & site)
Grid Reference (NZTM)	1716911E-5675265N
Catchment:	Onaero
Tributary:	Pukemai

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. By 1 January 2014, 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. By 1 January 2014, 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 7, are encountered below the site; and
   (f) a chemical assessment of the receiving formation water which confirms its Total Dissolved Solids (TDS) 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. There shall be no injection of any fluids after 1 June 2018.

4. 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.

5. The injected fluids shall be confined to the Mount Messenger Formation, deeper than 1,200 metres below ground level.

6. 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.

7. 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 TDS concentration of less than 1,000 mg/l.

8. Only the following fluids may be discharged:

   (a) produced water;
   (b) well workover fluids, including hydraulic fracturing return fluids;
   (c) well drilling fluids;
   (d) production sludges;
   (e) contaminated stormwater; and
   (f) other fluids that if discharged will cause no greater environmental risk than those fluids listed above, and certified as such by the by the Chief Executive, Taranaki Regional Council.

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 (as listed in condition 8);
   (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 (IANZ) accredited laboratory, it shall be undertaken in accordance with a "Quality Assurance (QA) Plan" that has been certified by the Chief Executive, Taranaki Regional Council, as meeting the requirements of condition 10. The Taranaki Regional Council may also, at its discretion, carry out an audit of the consent holder's sampling and analysis regime to assess adherence to the QA 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 (AoR) to assess compliance with condition 7 (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 1 January 2014, and shall include:

    (a) the location of sampling sites;
    (b) well/bore construction details; and
    (c) sampling frequency.

    The AoR shall extend 1,000 m 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 0 and 14, could be taken and analysed by the 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 IANZ 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 0.*

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. 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 15 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:	Todd Energy Limited P O Box 802 NEW PLYMOUTH 4340
Decision Date (Change):	1 October 2013
Commencement Date (Change):	1 October 2013 (Granted: 24 June 2003)

Conditions of Consent

Consent Granted:	To discharge fluid waste generated by oil and gas exploration and production activities to the Mckee Formation by deep well injection at the McKee-A wellsite
Expiry Date:	1 June 2033
Review Date(s):	June Annually
Site Location:	McKee-A wellsite, Otaraoa Road, Tikorangi
Legal Description:	Pt Lot 6 DP 658 Blk XIV Waitara SD (Discharge source & site)
Grid Reference (NZTM)	1715113E-5670963N
Catchment:	Waitara

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

General condition

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

Special conditions

1. By 1 January 2014, 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. By 1 January 2014, 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 7, are encountered below the site; and
   (f) a chemical assessment of the receiving formation water which confirms its Total Dissolved Solids (TDS) 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. There shall be no injection of any fluids after 1 June 2028.

4. 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.

5. The injected fluids shall be confined to the McKee Formation, deeper than 2,300 metres below ground level.

6. 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.

7. 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 TDS concentration of less than 1,000 mg/l.

8. Only the following fluids may be discharged:

   (a) produced water;
   (b) well workover fluids, including hydraulic fracturing return fluids;
   (c) well drilling fluids;
   (d) production sludges;
   (e) contaminated stormwater; and
   (f) other fluids, that if discharged, will cause no greater environmental risk than those fluids listed above, and certified as such by the by the Chief Executive, Taranaki Regional Council.

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 (as listed in condition 8);
   (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 (IANZ) accredited laboratory, it shall be undertaken in accordance with a "Quality Assurance (QA) Plan" that has been certified by the Chief Executive, Taranaki Regional Council, as meeting the requirements of condition 10. The Taranaki Regional Council may also, at its discretion, carry out an audit of the consent holder's sampling and analysis regime to assess adherence to the QA 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 (AoR) to assess compliance with condition 7 (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 1 January 2014, and shall include:

    (a) the location of sampling sites;
    (b) well/bore construction details; and
    (c) sampling frequency.

    The AoR shall extend 1,000 m 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 0 and 14, could be taken and analysed by the 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 IANZ 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 0.*

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. 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 15 November 2013

For and on behalf of
Taranaki Regional Council

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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:	Todd Energy Limited PO Box 802 New Plymouth 4340	
Decision Date (Change):	15 October 2015	
Commencement Date (Change):	15 October 2015	(Granted Date: 20 November 2003)

Conditions of Consent

Consent Granted:	To discharge waste drilling fluids, water, produced water and stormwater form hydrocarbon exploration and production operations by deepwell injection at the Pouri-A wellsite
Expiry Date:	1 June 2033
Review Date(s):	June annually
Site Location:	Pouri-A wellsite, Foreman Road, Tikorangi (Property owner: FD & KS Wyatt)
Legal Description:	Lots 2-3 & 6 DP 384951 Lot 1 DP 4439 (Discharge source & site)
Grid Reference (NZTM)	1715348E-5673407N
Catchment:	Onaero
Tributary:	Mangahewa

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 (TDS) 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. There shall be no injection of any fluids after 1 June 2028.

4. 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.

5. The injection of fluids shall be confined to the Mckee Formation, and be injected at a minimum depth of 2338 true vertical depth below ground level.

6. The injection pressure at the wellhead shall not exceed 4,000 psi (276 bars). If exceeded, the injection operation shall cease immediately and the Chief Executive, Taranaki Regional Council informed immediately.

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.

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 TDS concentration of less than 1,000 mg/l.

9. Only the following types of fluid may be discharged:

   a. produced water;
   b. well workover fluids, including hydraulic fracturing return fluids;
   c. well drilling fluids;
   d. production sludges;
   e. contaminated stormwater; and
   f. other fluids in accordance with condition 10 below.

10. The fluids discharged under this consent shall only be those listed in condition 9(a) to 9(e) above, and other fluids that:

   a) can reasonably be expected to be used in petrochemical well maintenance and development in accordance with industry best practice;

   b) have environmental effects that are no more adverse than those listed in 9(a) to 9(e) above;

   c) have been certified by the Chief Executive, Taranaki Regional Council as complying with 9(a) to 9(e) above; and

   d) have been the subject of a specific request for certification, in accordance with 9(a) to 9(e) above, that includes details of the proposed contaminant.

11. 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.

12. 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 (as listed in condition 9);
   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 12(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.

13. If the analysis required by condition 12(c) above is not carried out in an International Accreditation New Zealand accredited laboratory, it shall be undertaken in accordance with a "Quality Assurance (QA) Plan" that has been certified by the Chief Executive, Taranaki Regional Council, as meeting the requirements of condition 12. 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 QA plan.

14. The information required by conditions 11 and 12 above, for each calendar month, shall be provided to the Chief Executive, Taranaki Regional Council before the 28th day of the following month.

15. 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 (AoR) to assess compliance with condition 9 (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 AoR 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. The bore shall be completed no later than 6 months after granting this consent.

16. 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 15 and 16, could be taken and analysed by the Taranaki Regional Council or other contracted party on behalf of the consent holder.

17. 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 IANZ 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 15.

18. 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 modelling report, demonstrating the ability of the receiving formation to continue to accept additional waste fluids and an estimation of remaining storage capacity.

19. 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 15 October 2015

For and on behalf of
Taranaki Regional Council

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A D McLay
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:	Todd Energy Limited PO Box 802 NEW PLYMOUTH 4340
Decision Date:	27 May 2014
Commencement Date:	27 May 2014

Conditions of Consent

Consent Granted:	To discharge fluid waste generated by oil and gas exploration and production activities to the Mount Messenger Formation by deepwell injection
Expiry Date:	01 June 2033
Review Date(s):	June Annually
Site Location:	McKee-B wellsite, Otaraoa Road, Tikorangi
Legal Description:	Lot 1 DP 14374 Blk X Waitara SD (Discharge source & site)
Grid Reference (NZTM)	1715303E-5671934N
Catchment:	Onaero
Tributary:	Mangahewa

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 7, are encountered below the site; and
   (f) a chemical assessment of the receiving formation water which confirms its Total Dissolved Solids (TDS) 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. There shall be no injection of any fluids after 1 June 2028.

4. 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.

5. The injection of fluids shall be confined to the Mount Messenger Formation, and be injected at a minimum depth of 945 metres true vertical depth below ground level.

6. 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.

7. 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 TDS concentration of less than 1,000 mg/l.

8. Only the following types of fluid may be discharged:

   (a) produced water;
   (b) well workover fluids, including hydraulic fracturing return fluids;
   (c) well drilling fluids;
   (d) production sludges;
   (e) contaminated stormwater; and
   (f) any other fluids approved in writing by the Chief Executive, Taranaki Regional Council.

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 (as listed in condition 8);
   (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 (IANZ) accredited laboratory, it shall be undertaken in accordance with a "Quality Assurance (QA) 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 QA 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 (AoR) to assess compliance with condition 7 (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 AoR 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 IANZ 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 30 June 2019, 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.

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 27 May 2014

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management