Shell Todd Oil Services Limited
Deep Well Injection
Monitoring Programme
Annual Report
2013-2014

Technical Report 2014-92

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Taranaki Regional Council
Private Bag 713
STRATFORD

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Executive summary

The following Annual Report by the Taranaki Regional Council (the Council) outlines Shell Todd Oil Services Limited's (the Company) deep well injection (DWI) activities during the monitoring period 1 July 2013 – 30 June 2014. The report provides details of the DWI consent held by the Company during the period under review and the compliance monitoring programme implemented by the Council with regard to this consent. The report also discusses the results of the monitoring carried out, and provides an assessment of Company performance with regard to consent compliance.

During the period under review, the Company held resource consent 1336-3, authorising the injection of produced water and other approved contaminates by DWI, at the KA1/7/19/20 wellsite, Palmer Road, Kapuni, and the KA9 wellsite, Lower Duthie Road, Kapuni. Injection at the KA1/7/19/20 wellsite is authorised via the KA-1 and KA-7 wells, and via the KW-2 well at the KA9 wellsite. The consent includes a number of special conditions, setting out specific requirements with which the Company must comply.

During the monitoring period, Shell Todd Oil Services Limited demonstrated an overall high level of environmental performance.

During the period under review, injection was carried out exclusively via the KW-2 well, with the KA-1 and KA-7 wells providing contingency disposal options. The monitoring of the Company's DWI activities by the Council included undertaking inspections of injection operations, the review and assessment of injection data submitted by the Company, and groundwater monitoring in the vicinity of the active injection site.

The Council carried out two inspections of the Company's active DWI sites during the period under review. Inspection visits comprised liaison with on-site staff, identification of the active injection well, viewing the injection well monitoring equipment and injection logs, and spot sampling of the injectate.

As required by the special conditions of consent 1336-3, the Company supplied the Council with process monitoring data and injection records at the required intervals. Data supplied by the Company was reviewed by the Council on submission. In total, the Company discharged 62,648 cubic metres (m^3) of fluids by DWI during the 2013-2014 monitoring period. The volumes of fluid discharged, and the pressure at which it was injected into the receiving formations, were within the limits specified in the resource consent.

The information gathered during inspection visits and the data supplied by the Company have been used in compiling this report.

The Council did not receive any complaints or register any unauthorised incidents associated with any of the Company's DWI activities during the 2013-2014 monitoring period.

During the year, the Company demonstrated a high level of environmental and administrative performance with the resource consents. For reference, in the 2013-2014 year, 60% 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 29% demonstrated a good level of environmental performance and compliance with their consents.

This report includes recommendations to be implemented during the 2014–2015 monitoring period.

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1. Introduction

1.1 Compliance monitoring programme reports and the Resource Manage Act 1991

1.1.1 Introduction

The following Annual Report covers the monitoring period 1 July 2013–30 June 2014. During the period under review, Shell Todd Oil Services Limited (the Company) held resource consent 1336-3 for the disposal of wastes by deep well injection (DWI) at their KA1/7/19/20 wellsite, Palmer Road, Kapuni, and the KA9 wellsite, Lower Duthie Road, Kapuni. The resource consent held by the Company permits the discharge of produced water and approved contaminants into the Mangahewa and Matemateaonga Formations. The consent includes a number of special conditions, setting out specific requirements with which the Company must comply.

The following report provides details of the DWI consent held by the Company during the period under review and outlines the Company's DWI activities during this period. The report also outlines the monitoring programme implemented by the Taranaki Regional Council (the Council) with regard to these activities, discusses its results, and provides an assessment of Company performance with regard to consent compliance. The report concludes with recommendations regarding the future monitoring of the Company's DWI activities.

1.1.2 Structure of this report

The following report comprises five sections as follows:

- Section 1 of this report is a background section. It sets out general information about compliance monitoring under the relevant legislation and the Council's obligations and general approach to monitoring sites through dedicated monitoring programmes. Also covered in this section are the details of the individual resource consent held by the Company, the nature of the monitoring programme in place for the period under review, and a description of the activities and operations conducted on the Company's well sites;
- Section 2 presents the results of monitoring during the period under review, including technical data;
- Section 3 outlines any incidents, interventions and incidents that occurred during period under review;
- Section 4 discusses the results, their interpretation, and their significance for the environment; and
- Section 5 presents recommendations to be implemented in the 2014-2015 monitoring period.

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

1.1.3 The *Resource Management Act (1991)* and monitoring

The *Resource Management Act (1991)* (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 a discharger, and may include cultural and socio-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 (e.g., 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 discharge source. 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 performance of resource users against regional plans and consents. Compliance monitoring, (covering both activity and impact), also enables the Council to continuously assess its own performance in resource management as well as that of resource users, particularly consent holders. It also enables the Council to continually re-evaluate its approach to resource management, and ultimately, through the refinement of methods, and considered responsible resource utilisation, to move closer to achieving sustainable development of the regions resources.

1.1.4 Evaluation of environmental performance

Besides discussing the various details of the performance and extent of compliance by the consent holder/s during the period under review, this report also assigns a rating as to each Company's environmental and administrative performance.

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

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

Events that were beyond the control of the consent holder and unforeseeable (i.e. 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 was 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 2013-2014 year, 60% 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 29% demonstrated a good level of environmental performance and compliance with their consents.

1.2 Process description

1.2.1 Background

The Taranaki Basin occupies an area of approximately 100,000 square kilometres and is the most explored and commercially successful hydrocarbon producing area in New Zealand. Oil and gas exploration and development has been on-going in the region for nearly 150 years. Since the first well in 1865, over 600 exploration and production wells have been drilled. While the majority of the basin is offshore, the majority of the producing wells are onshore. The geology of the basin is derived from diverse episodes of tectonic activity. The Cretaceous to Quaternary basin fill is up to 9,000 m thick in places.

The modern era of exploration began in New Zealand in 1955 when a Shell-BP-Todd consortium explored a large part of the Taranaki region. The groups first well (Kapuni-1), discovered gas-condensate in Late Eocene Kapuni Group strata, and marked the beginning of New Zealand's natural gas industry. The Kapuni Field commenced commercial production in 1970. The next major discovery was the off-shore Maui field in 1969, which was in full production by 1979. Maui is New Zealand's largest hydrocarbon field to date. Many smaller fields were discovered between 1979 and 1999, including the McKee, Mangahewa, Ngatoro, Kaimiro and Rimu fields. More recent discoveries include the Pohokura gas field in 2001.

Overall, the Taranaki Basin remains relatively under-explored compared to many comparable rift complex basins of its size and potential.

1.2.2 Deep well injection (DWI)

DWI is often utilised as liquid waste disposal technology and provides an alternative to the surface disposal of such material. The DWI process utilises specially designed

injection wells to pump liquid waste into deep geological formations, hydrocarbon reservoirs or confined saline aquifers. The receiving formations generally contain water that is too saline to be of any potential use. Impermeable geological seals overlying the injection intervals restrict any potential vertical migration of injected wastes into shallow freshwater aquifers.

A typical injection well consists of concentric casing, cemented into the surrounding rock, which extend into permeable saline formations, at depths far below the base of potentially useable freshwater aquifers. Waste is then injected into the receiving formation by pressure generated by surface pumps. International standards (adopted in the Taranaki Region) for the construction of disposal wells emphasise the importance of surface casing extending to depths below the base of the freshwater zones and that it is cemented back to surface. The standards also highlight the requirement for internal casing strings to be cemented back up the hole to seal off and isolate the disposal interval from the overlying freshwater zones, providing a multi-barrier approach to the protection of freshwater resources. As part of the resource consent application procedure for DWI activities, applicants are required to submit information that details both the design and construction specifications of the injection well(s) and illustrates well integrity and the isolation of the well bore from surrounding formations.

In Taranaki, contaminants disposed of by DWI are generally limited to produced water, saline groundwater, contaminated stormwater, waste drilling fluids, hydraulic fracturing (HF) fluids, and production sludges. The Council has approved, on specific occasions, the discharge of small volumes of other specified contaminants by DWI. Any application to discharge waste material not specifically licenced by the relevant resource consent is assessed by the Council on a case by case basis. The Council will assess the composition of the waste for consistency with those specifically approved for disposal. In some cases, a new consent may be required.

Produced water makes up the greatest volume of waste fluids generated by oil and gas exploration and production activities. Produced water is water that is present in a hydrocarbon bearing reservoir, brought to the surface as crude oil or natural gas is extracted from it. The composition of this produced fluid is dependent on whether crude oil or natural gas is being produced and generally includes a mixture of either liquid or gaseous hydrocarbons, formation water, dissolved or suspended solids, produced solids such as sand or silt, and injected fluids and additives that may have been placed in the formation as a result of exploration, hydraulic fracturing, and/or production activities. Produced waters may contain, in addition to salts, hydrocarbon residues and free oil, and traces of process additives including anti-scaling agents, anti-corrosion agents and biocides. Proportionally, higher quantities of water are produced from a hydrocarbon field as more oil or gas is extracted and the productive life of the field diminishes. The volume of produced water requiring disposal is therefore expected to increase as many producing fields approach the end of their lives, and as more fields are discovered and developed.

Produced water and drilling fluid wastes are typically highly saline and contain hydrocarbon residues and system additives. Without treatment to an acceptable standard, the surface disposal of large volumes of produced water is not a suitable disposal option, particularly where the discharge can enter surface or groundwater systems. The salts and other contaminants contained within the discharge can

adversely affect soil or freshwater biological systems and the quality of water resources used for supply purposes. Although there are methods to treat produced waters to a suitable standard for surface disposal, such as gas/steam stripping, biological and chemical adsorption, and activated carbon, they are generally not practical or economically viable. The injection of produced waters into deep geological formations by DWI is presently the most cost-effective option for the disposal of this type of waste, and more importantly, is an environmentally sound disposal option.

Produced waters have been disposed of by DWI in Taranaki since the development of the Kapuni Field in 1970. The collection, handling, treatment and disposal of produced water from a producing field are major undertakings and, if not appropriately managed, can have lasting adverse environmental effects. However, under appropriate geological and operational conditions, the disposal of produced waters by DWI should have no more than negligible environmental effects.

The injection of fluids into hydrocarbon bearing reservoirs is also an established oilfield technique for regulating reservoir pressure and/or as a means of enhancing the rate of oil recovery from a reservoir. This process is often referred to as water flooding. Water flooding is a secondary recovery process that is often implemented when natural reservoir pressures decline due to the removal of reservoir fluids during production. The injection of produced fluids back into the reservoir can increase reservoir pressure and stimulate production by driving reserves toward a production well. In certain cases, injected water is heated and injected through a well annulus to reduce oil viscosity, improving oil deliverability through the wellbore. Typically, either produced waters or freshwater, or a combination of the two, are used for water flooding.

Regional councils are responsible for monitoring environmental effects from hydrocarbon exploration and development activities under the RMA. Sections 15 and 30 of the RMA give regional councils the responsibility for regulating the discharge of contaminants into the environment. The discharge of contaminants onto or into land that may result in water contamination may not take place unless expressly allowed by a rule in a regional plan, resource consent or other relevant regulations. The control of DWI activities through the resource consenting process and subsequent compliance monitoring is an appropriate regulatory regime. In the Taranaki region, the discharge of contaminants by DWI requires resource consent from the Council. The activity falls under Rule 51 of the Regional Freshwater Plan for Taranaki and is classified as a discretionary activity. The application may be non-notified if no parties are deemed to be adversely affected by the proposed activity.

At the time of writing, there were a total of 19 current resource consents for DWI in Taranaki. However, several resource consents have been issued for relatively short-term activities during exploration phase drilling, and several others have not been, and may never be exercised.

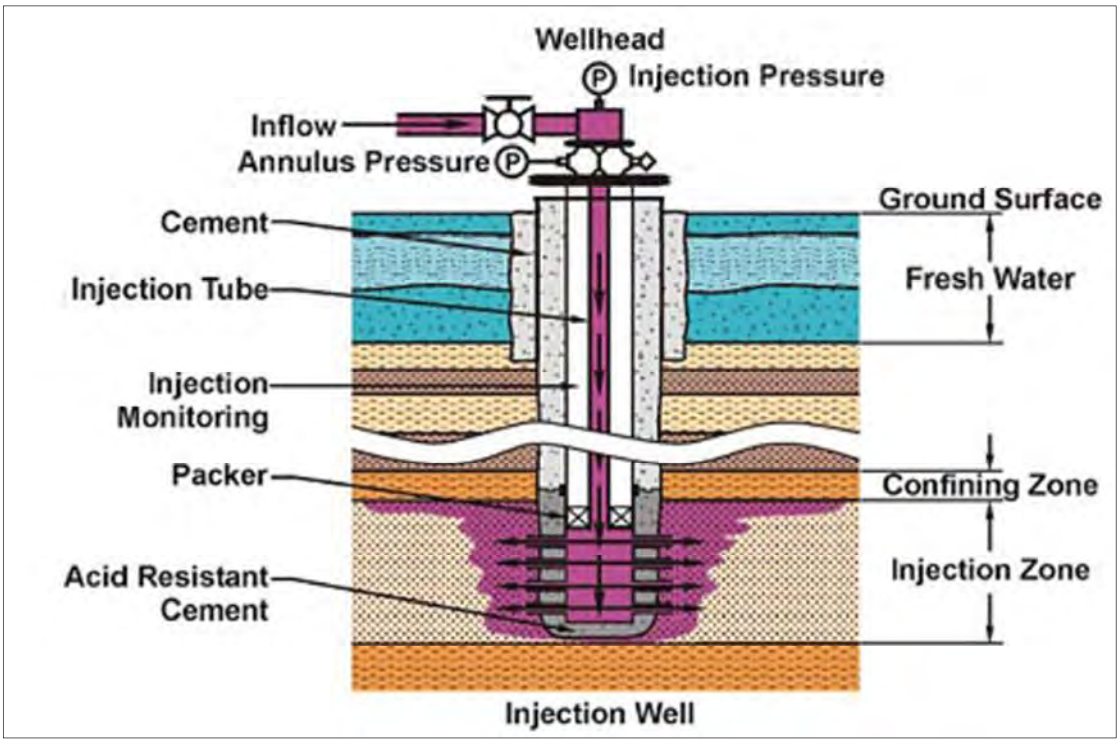

Figure 1 DWI schematic representative of Taranaki sites[1]

1.3 Potential environmental effects of exercising a DWI consent

The most significant potential adverse environmental effect of discharging waste fluids by DWI is the contamination of freshwater aquifers during or following the discharge. Potential pathways for contamination of a freshwater aquifer can be created by the rupture of geological seal confining the injection interval, or failure of the grout seal in either the disposal well or any other well that penetrates the disposal interval. There is also potential for fluids to be forced upward from the injection interval through transmissive faults or fractures in the geological formations overlying the injection interval. Faults or fractures may have formed naturally prior to injection, or may be created by the waste dissolving the rocks of the confining zone. Artificial fractures may also be created by injecting wastewater at excessive pressures or by thermal processes.

There is also the potential for shallow groundwater to be contaminated by surface activities associated with DWI operations, particularly the handling, storage and transport of waste fluids. In all cases, the risk of contamination by spillage or unintended discharge of fluids being managed can be adequately mitigated by ensuring wastes are stored and transported in appropriately constructed and tested storage vessels and pipelines.

In each of the scenarios outlined above, the potential risk can be adequately mitigated by appropriate assessment, design, operation and monitoring of DWI activities. Appropriately engineered technology, regional and local geologic characterisation, and site specific modelling are typically combined at the planning stage of a disposal well to ensure that fluids discharged by DWI will be contained within the intended

[1] https://upstrm.wordpress.com/tag/injection-wells/

disposal interval. The assessment of resource consent applications and setting of appropriate conditions address these issues.

1.4 Resource consents

The protection of groundwater quality is of primary concern to the Council when processing resource consent applications for DWI activities. Section 15(1)(b) of the Act stipulates that no person may discharge any contaminant onto or into land in circumstances which may result in that contaminant (or any other contaminant originated as a result of natural processes from that contaminant) entering water, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or national regulations.

Table 1 details the consent held by the Company for DWI during the period under review, the wellsites to which the consent relates and the injection wells in use at each site. All resource consents are issued by the Council under Section 87(e) of the RMA.

Table 1 Summary of DWI consents held by the Company during the 2013-2014 period

Consent	Wellsite	Injection Well(s)	Formation
1336-3	KA9	KW-2	Matemateaonga
	KA1/7/19/20	KA-1	Mangahewa
	KA1/7/19/20	KA-7	Mangahewa

A summary of the resource consent held by the Company for DWI activities during the 2013-2014 monitoring period is included below.

Resource Consent: 1336-3

"To discharge up to 2,000 cubic metres/day of produced water and approved contaminants by deepwell injection into the Matemateaonga Formation via well KW-2 or into the Mangahewa Formation via contingency back-up wells KA-1 and KA-7."

Background:
The first recorded discharges by DWI in the Kapuni field were carried out under water right 130. Records kept at the Council indicate that from 1973 to 1984, a total of 900,000 cubic metres (m^3) of produced water was discharged at the Kapuni production station, via well KW-1. The discharge was into a freshwater aquifer in the Matemateaonga Formation at a depth of 502 to 538 m true vertical depth (TVD) below ground level. In 1981, when water right 130 was renewed, the Council required the consent holder to nominate a new injection well, and that discharges via the KW-1 well cease. KW-1 was retained for emergency disposal purposes, and periodic discharges of produced water occurred via the well until 1990. Water right 130 expired on 1 June 1991. No adverse environmental effects were reported, and KW-1 was plugged and abandoned in December 2000.

On 10 October 1984, consent TRK931336 was granted to Shell BP & Todd Oil Services Limited, covering DWI activities within the Kapuni field. The consent was subsequently transferred to Shell Todd Oil Services limited (STOS) on 24 January 1991. Consent TRK931336 permitted the discharge of up to 800 m^3/day of produced water into the Matemateaonga Formation, via the KW-2 well, a non-producing gas

well. On 26 September 1990, an application was received from the Company, seeking to increase the authorised discharge volume from 800 m^3/day to 1,200 m^3/day. This application was granted on 17 April 1991. On 7 August 1991, special dispensation was approved for a one-off disposal of up to 132 m^3 of neutralised acids via KW-2.

A consent renewal application was received from the Company on 19 November 1992. The application also sought an increase in the authorised discharge volume to 2,000 m^3/day. A revised consent (1336-2) was granted on 10 February 1993. On 19 December 2003, the consent conditions were varied to allow for discharge by DWI via two contingency wells, KA-1 and KA-7, at the KA1/7/19/20 wellsite.

The consent was reviewed again on 21 April 2005, and currently authorises the discharge of up to 2,000 m^3/day of produced water into the Matemateaonga Formation via the KW-2 well, or into the Mangahewa Formation, via contingency wells KA-1 and KA-7.

On 31 July 2009, the Company applied for a further variation to consent 1336-3 in relation to the range of contaminants authorised for discharge. Due to continual changes in additive technology, and the evolving requirements of a mature field such as Kapuni, there are changes in the nature of additives that may enter the produced water system, and subsequently require disposal by DWI. Rather than requiring the Company to apply for a variation of consent with every change made to the range of additives being used, it was considered preferable that the Company sought prior approval from the Council for any changes to the additives being used on a case-by-case basis. This variation to the consent was approved on 5 October 2009.
On 22 July 2013, the Company again applied for a variation to consent 1336-3. The application was to change the date when information is to be provided to the Council, from May annually, to August annually. This variation to the consent was approved on 9 August 2013.

The Council waived its option to review consent 1336-3 in June 2011, as it was deemed that the consent conditions were adequate to deal with the potential adverse effects of the activity. The next optional review is provided for in June 2017. Consent 1336-3 is due to expire on 1 June 2023.

The current consent has 11 special conditions, as summarised below:

- Special condition 1 requires the best practicable option to be adopted for the discharge;
- Special conditions 2, 3, 5, 6 and 8 refer to information and data submission requirements;
- Special condition 4 prohibits the discharge from endangering or contaminating any freshwater aquifer;
- Special condition 7 limits injection pressures to those which do not fracture the stratigraphic seals of the injection zone;
- Special condition 9 details the consent lapse and expiry dates;
- Special condition 10 contains review provisions; and
- Special condition 11 allows for the introduction of new chemicals to the produced water system, provided they can reasonably be expected to be used in petrochemical well maintenance and development, and they will not have environmental effects that are more adverse than current chemicals in use.

Figure 2 shows the location of the DWI consent held by the Company during the period under review. A copy of the consent certificate is attached in Appendix I of this report.

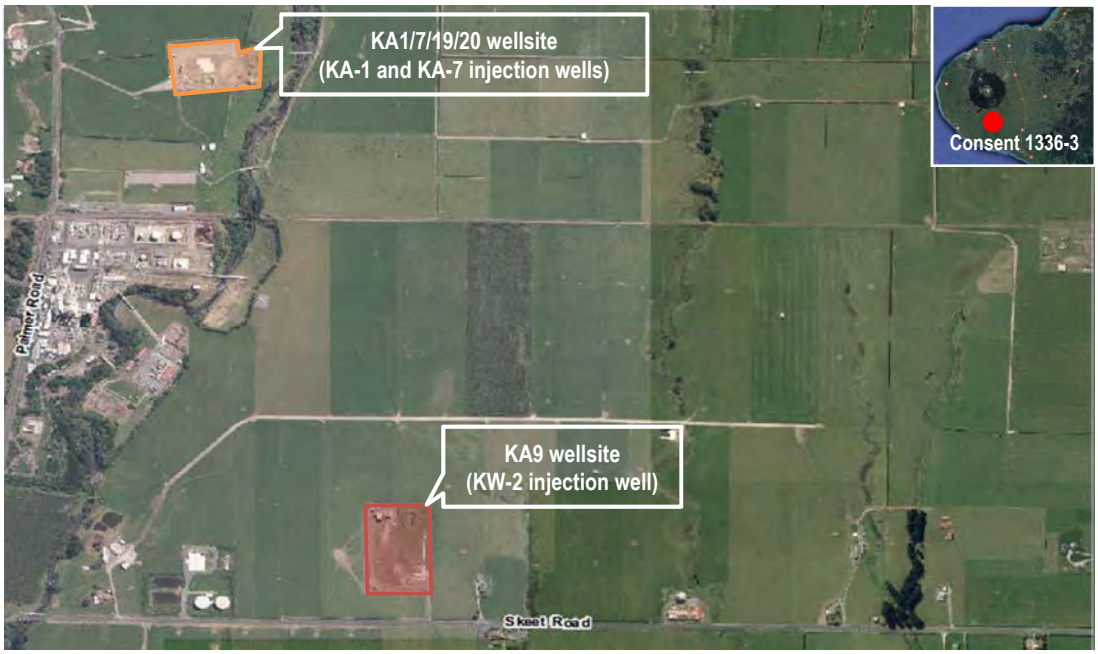

Figure 2 Location of consent 1336-3 and associated injection wells

1.5 Monitoring programme

1.5.1 Introduction

Section 35 of the RMA sets obligations upon the Council to gather information, monitor, and conduct research on the effects arising from consented activities within the Taranaki region and report upon these.

To perform its statutory obligations, the Council may be required to take 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 implemented by the Council in relation to the Company's DWI activities consisted of four main components:

- Programme design, liaison and management;
- Site inspections and injectate sampling;
- Assessment of data submitted by the consent holder; and
- Groundwater quality monitoring.

Each component of the monitoring programme is discussed in further detail below.

1.5.2 Programme liaison and management

There is generally a significant investment of time and resources by the Council during annual reviews of existing monitoring programmes, and the scoping and design of future monitoring requirements. Significant time is spent managing compliance monitoring programmes throughout the monitoring year, and liaising

with resource consent holders over consent conditions, their interpretation and application. The Council also undertakes discussion during preparation for any consent reviews, renewals, or new consent applications, and provides advice on environmental management strategies, the content of regional plans and various other associated matters.

1.5.3 Site inspections and Injectate sampling

The monitoring programme provides for physical inspections to be undertaken at all active DWI sites operated by the Company. The inspections include an examination of the injection wellhead, viewing the monitoring equipment, and the spot sampling of the injectate for laboratory analysis. 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. Samples of injectate were obtained from a holding tank located at the Kapuni Production Station, which stores waste fluid prior to injection. The tank is identified by the Company as tank T604.

The injectate samples collected were submitted to Council's IANZ accredited laboratory to be analysed for the following parameters:

- pH;
- Conductivity;
- Alkalinity;
- Chlorides; and
- Total petroleum hydrocarbons.

Table 2 Location of sample points for active DWI sites

Consent	Wellsite	Injection well(s)	Site code	Sample point
1336-3	KA9	KW-2	GND1412	Tank T604
	KA1/7/19/20	KA-1	GND1683	N/A - contingency well
	KA1/7/19/20	KA-7	GND1684	N/A - contingency well

1.5.4 Consent holder data submission requirements

The resource consent held by the Company for DWI includes conditions which require the Company to submit injection data and supporting information to the Council within specified timeframes. The injection data submitted by the consent holder forms the basis for assessing consent compliance. The major information requirements are as follows:

1. Information on the disposal well and injection interval

The conditions of consent 1336-3 required the Company to submit a management plan for the operation of their injection wells. The plan was required to include details of the injection wells and their operation. The information requested is required to demonstrate that the exercise of the consent will not contaminate or endanger any actual or potentially useable freshwater aquifers.

The Council holds a significant volume of information regarding the Company's injection wells and the underlying geology in the Kapuni field. Data has been gathered

during the resource consenting process, during specific site investigations, and as part of various compliance monitoring programmes.

2. Discharge records

For each well used for DWI during the period under review, the consent holder was required to provide discharge records. Specific data requirements included the following:

- Injection volumes;
- Injection pressures;
- Injection rate; and
- Results of injectate analysis.

The Company provided adequate injection records for the 2013-2014 monitoring year. The data submitted met the requirements stipulated in the DWI consents exercised during this period.

3. Annual reporting

The Company was required to submit an annual report to the Council providing a summary of all injection data gathered over the previous 1 July to 30 June period. The annual report was also required to detail how compliance with the special conditions of consent exercised during the monitoring period has been achieved. The Company provided an annual written report which met the requirements of the consent condition in August 2014.

1.5.5 Groundwater quality monitoring

The Company carried out its own groundwater monitoring in the vicinity of the KA9 wellsite during the 2013-2014 monitoring period. The Company contracted URS New Zealand Limited (URS) to carry out the sampling, as it had done for the previous monitoring period (2012-2013). URS obtained samples of groundwater from four existing groundwater abstractions on two separate occasions. Details of the sites sampled by URS are included in Table 3.

Table 3 Location of groundwater abstraction sampled by the Company (2013-2014)

URS reference	Site code	Type	Distance from wellsite (m)	Casing depth (m)	Total depth (m)	High static water level (m)	Aquifer
Site 1	GND1143	Bore	948	40	65	18	Volcanics
Site 2	GND1701	Bore	2,971	92	337	NR*	Matemateaonga
Site 3	GND2369	Bore	4,643	280	448	NR*	Matemateaonga
Site 4	GND1659	Bore	4,020	123	432	6	Matemateaonga

NR* Not Recorded: Design of the bore prevents static water level from being measured from the ground surface

2. Results

2.1 Site inspections and injectate sampling

During the period under review, the Council carried out two routine inspections in relation to the Company's DWI activities. Inspections were undertaken at the Kapuni Production Station on 30 October 2013 and 23 April 2014. The Kapuni Production Station serves as a central fluid collection and storage facility for waste fluids generated within the Kapuni field. All fluid injection is also controlled and monitored from the production station.

Routine DWI inspections included undertaking a general visual assessment of the operational equipment, storage facilities and associated equipment. No operational issues were identified during the inspections and all equipment appeared in good condition. Company personnel were able to assist by detailing the status of injection equipment, outlining the injection operations being carried out by the Company at that time, and provide real-time monitoring data on request.

As part of the monitoring programme, spot samples of the injectate were obtained during the inspection visits. The injectate samples were submitted to the Council's IANZ accredited laboratory for physicochemical analysis. The results of the analysis are included below in Table 4. The concentrations of each analyte are within the expected range for injectate samples comprised predominantly of produced water.

Table 4 Results of injectate sampling undertaken by the Council (2013-2014)

Parameter	Unit	Site GND1412	
		30/10/13	23/04/14
Time	NZST	11:00	13:20
TRC sample number	-	TRC137449	TRC149832
pH	pH units	7	8
Conductivity @ 20°C	mS/m @ 20^0C	3,190	3,120
Alkalinity	g/m^3 $CaCO_3$	7,700	7,170
Chloride	g/m^3	9,510	9,400
Total petroleum hydrocarbons	g/m^3	130	130

2.2 Assessment of data provided by the consent holder

The Company provided a record of injection data for the 2013-2014 monitoring period, including injection volume, rate and pressure data. The injection data provided by the Company is summarised in Tables 5 and 6. The data provided by the Company is also presented graphically in Figures 3 and 4.

Table 5 Summary of DWI activities during the period under review (2013-2014)

Consent	Wellsite	Injection wells	Total volume discharged (m^3) 01/07/13 – 30/06/14	Discharge period		TRC well ID
				From	To	
1336-3	KA9	KW-2	62,648	01/07/13	30/06/14	GND1412
	KA1/7/19/20	KA-1	0	-	-	GND1683
	KA1/7/19/20	KA-7	0	-	-	GND1684
Total			62,648	01/07/13	30/06/14	-

Table 6 Summary of the Company's 2013-2014 injection data

	1336-3 – KW-2 injection well		
	Volume injected (m^3)	Injection pressure (bar)	Injection Rate (m^3/hr)
Total	62,648	N/A	N/A
Daily Maximum	890	66*	164
Daily Average	172	38	31

*A pressure reading of 113 bar was recorded on 13/08/13. This was explained as calibration of the transmitter, and no pumping was occurring at the time. The inaccurate pressure reading was removed from the dataset to enable the calculation of maximum and mean pressures.

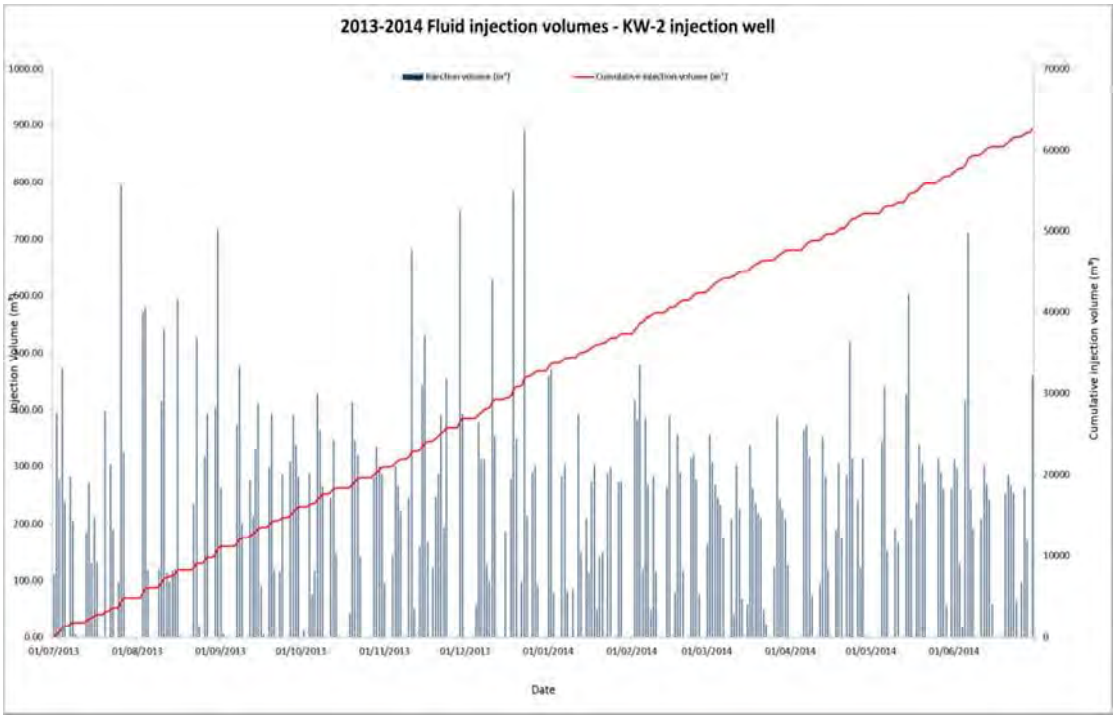

Figure 4 2013-2014 fluid injection volumes – KW-2 injection well (1336-3)

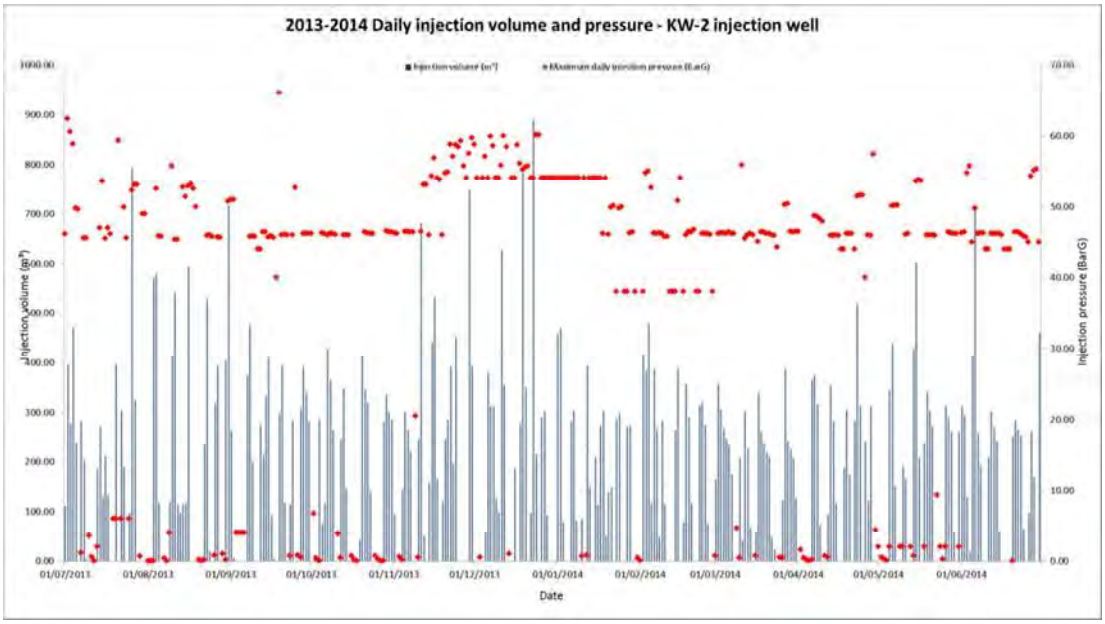

Figure 5 2013-2014 injection volumes and pressure – KW-2 injection well (1336-3)

In addition to the injectate sampling carried out by the Council (Section 2.1), the Company also provided results of their own analysis of KW-2 injectate samples. Injectate at KW-2 throughout the year was composed primarily of produced water. Small volumes of HF and flowback fluids were also discharged during the period under review. Separate physicochemical analysis of each waste stream was carried out. The results of the analyses are presented below in Table 7 and Table 8, respectively.

Table 7 Range of contaminants in produced water samples (2013-2014)

Parameter	Unit	Number of samples	Maximum value	Minimum value	Mean value
pH	pH units	46	7.5	7.0	7.1
Salinity	g/m^3	46	21,900	9,800	20,211
Chloride	ppm	46	19,287	8,140	9,539
Total suspended solids	g/m^3	46	79	28	43
Total dissolved solids	g/m^3	46	38,465	23,603	25,908
Total petroleum hydrocarbons	ppm	46	557	16	137

Table 8 Range of contaminants in hydraulic fracturing flowback fluid (2013-2014)

Parameter	Unit	Number of samples	Maximum value	Minimum value	Mean value
pH	pH units	14	8.9	6.3	7.3
Salinity	g/m^3	14	13,600	1,000	4,593
Chloride	ppm	14	3,307	227	1,079
Total suspended solids	g/m^3	14	515	37	173
Total dissolved solids	g/m^3	14	23,705	4,035	9,629
Total petroleum hydrocarbons	ppm	14	1,079	20	698

The maximum and mean values associated with the results of the analyses carried out illustrate the variability in the composition of injectate across the monitoring

period. The composition of the injectate varies depending on the origin and volume of fluids transferred from each individual waste source at the time of sampling.

2.3 Groundwater quality monitoring

During the period under review, the Company conducted groundwater sampling at four sites in the vicinity of the KA9 wellsite. Sampling was conducted on 13 November 2013 and 10 February 2014. The samples were collected by URS following standard groundwater sampling methodologies. The samples were submitted to Hill Laboratories Limited for analysis. The results of the analyses are included in Appendix II.

The results give no indication of any potential contamination of shallow groundwater as a result of fluid injection via the KW-2 well. The results of the sampling were similar to those from the July 2013, May 2013 and December 2012 monitoring events at the same sites. The results are also generally consistent with the background groundwater quality for Taranaki.

The results of the analysis of groundwater samples for dissolved gases indicate the presence of methane gas within local groundwater. Dissolved methane gas is commonly found in groundwater across the Taranaki region, including in areas where no hydrocarbon exploration or production has occurred. The concentrations of dissolved methane gas are within the typical range for Taranaki groundwater.

As part of their assessment of dissolved gas concentrations, URS submitted samples of groundwater from each sampling site to GNS Science (GNS) for carbon isotope analysis. The analysis of carbon isotopes is used to determine the isotopic signature of methane gas, which can be used as an indicator of its origin. Shallow methane gas, derived from the breakdown of organic material close to the surface (e.g. swamps), is termed biogenic. Alternatively, thermogenic methane is normally produced in deeper formations, at greater heat and pressure.

Compositionally, shallow biogenic gas is easily recognisable from thermogenic gas, as the former is nearly 100% methane, while thermogenic methane usually occurs in the company of the related gases, ethane, propane, butane and pentane, derived from thermal decomposition (King, 2012). They can also be discriminated on the basis of their common stable (non-radioactive) carbon isotopes, ^{12}Carbon (^{12}C has 6 neutrons) and ^{13}Carbon (^{13}C has 7 neutrons). Biogenic methane contains more ^{12}Carbon while thermogenic methane contains more of the ^{13}C carbon isotope. By analysing the relative concentration of ^{13}C carbon isotope (δ^{13}C), it can be determined whether the methane present is biogenic or thermogenic in origin. Generally, a δ^{13}C value that exceeds -50‰ indicates biogenic methane, and a δ^{13}C value less than-50‰ indicates thermogenic methane. The higher or lower the δ^{13}C values, the stronger the isotopic signature. A δ^{13}C value in the vicinity of -50‰ can indicate a mixture of both biogenic and thermogenic methane.

In areas where the injection of fluids under pressure is occurring, i.e. within the vicinity of DWI sites, the presence of thermogenic methane may indicate the fracturing of the stratigraphic seals overlying the injection interval, or the presence of a conduit between the injection interval and the overlying freshwater aquifers.

The results of the $\delta^{13}C$ analysis carried out by the GNS are outlined below in **Error! Reference source not found.**. The results indicate that in all samples, the methane gas present is biogenic in origin and is likely to be present as a result of the biological breakdown of organic matter in shallow subsurface and not related to the Company's injection activities, nor to natural gas seeps.

All results are similar to the July 2013, May 2013 and December 2012 monitoring events.

Table 9 Results of GNS $\delta^{13}C$ analysis (2013-2014)

URS reference	Sample date	$\delta^{13}C$ composition (‰)	Gas origin
Site 1	13 November 2013	-77.5	Biogenic
	10 February 2014	-78.5	
Site 2	13 November 2013	-81.3	Biogenic
	10 February 2014	-78.5	
Site 3	13 November 2013	-82.2	Biogenic
	10 February 2014	-81.7	
Site 4	13 November 2013	-81.4	Biogenic
	10 February 2014	-81.6	

3. Investigations, interventions and incidents

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

The Council operates and maintains a register of all complaints and reported or discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The Incident Register (IR) includes events where the company concerned has itself notified the Council. The register contains details of any investigation and corrective action taken. Complaints may be alleged to be associated with a particular site. If there is potentially an issue of legal liability, the Council must be able to prove by investigation that the identified company is indeed the source of the incident (or that the allegation cannot be proven).

The Council did not record any incidents associated with the Company's DWI activities during the 2013-2014 monitoring period.

4. Discussion

During the period under review, the Company exercised consent 1336-3 for the injection of fluids by DWI. The consent authorises the injection of produced water, and other approved contaminates, into the Mateamateaonga Formation via the KW-2 well, or into the Mangahewa Formation via contingency back-up wells KA-1 and KA-7.

During the period under review, the only well utilised for the injection of waste fluids was the KW-2 well, located at the Company's KA9 wellsite. During this period, a total of 62,648 m^3 of fluid was injected, at an average of 172 m^3/day. The average injection pressure was 38 bar, with a maximum pressure of 66 bar.

Consent 1336-3 specifies a maximum daily injection volume of 2,000 m^3. A review of the injection data provided by the Company indicates the daily maximum volume injected was 890 m^3, on 23 December 2013. The maximum daily injection volume is well below the maximum daily volume authorised by the consent.

Consent 1336-3 does not stipulate a maximum injection pressure, but requires fluids to be injected at pressures below that which would cause fracturing of the stratigraphic seals confining the injection interval. The maximum injection pressure reached during the period under review was 66 bar, which occurred on 19 September 2013. There is no evidence to suggest that the injection of fluids by DWI has resulted in any fracturing of the stratigraphic seals that confine the injection interval.

The consent holder has provided sufficient information for the KW-2 well regarding well construction, and the injection interval, to satisfy the relevant consent conditions and monitoring programme information requirements. However, if deemed necessary, the Council may request further information from the consent holder that illustrates that the wells being used for the injection and the receiving formation remain secure.

During the 2013-2014 period, consent holder performance was assessed on compliance with consent conditions, with a particular emphasis on record keeping requirements and information provision, and the analysis of the information and data provided. Compliance with the conditions of the DWI consent exercised during the 2013-2014 period is summarised below in Section 4.1.

The consent holder is required to ensure that the discharge does not result in any contamination of actual or potential useable freshwater aquifer. Compliance with this condition is based on the assessment of consent holder submitted data, and the sampling and analysis of local groundwater abstractions. During the period under review, groundwater monitoring sites in the vicinity of the KA9 wellsite were sampled by URS on behalf of the Company. The results of the analyses carried out on all samples collected do not indicate any form of contamination as a result of fluid injection via the KW-2 well.

The results of the analyses carried out do indicate the presence of dissolved methane gas within local groundwater. Further analysis of the isotopic signature of the gas indicates that it is biogenic in origin.

Biogenic methane is commonly found in groundwater across the Taranaki region, including areas where no hydrocarbon exploration or production has occurred. The gas is present due to the biological breakdown of organic material within shallow subsurface formations. The concentrations of dissolved methane gas are within the typical range for Taranaki groundwater.

All results are similar to the July 2013, May 2013 and December 2012 monitoring events. No complaints were received from the public with regard to any of the Company's DWI activities during the period under review, and no incidents were recorded by the Council.

4.1 Discussion of site performance

During the period under review, the Company exercised DWI consent 1336-3. A summary of the Company's level of compliance with the special conditions attached to consent 1336-3 is provided in Table 10.

Table 10 Summary of Company performance with regard to consent 1336-3 (2013-2014)

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1336-3: To discharge up to 2,000 cubic metres/day of produced water and approved contaminants by deepwell injection into the Matemateaonga Formation via well KW-2or into the Mangahewa Formation via contingency back-up wells KA-1 and KA-7.		
1. Adopt best practice operations for DWI	Assessment of consent holder records and environmental performance	Yes
2. Exercise consent in accordance with consent application	Assessment of consent holder records	Yes
3. Provision of well and injection zone information	Receipt of satisfactory information	Yes
4. No contamination of freshwater aquifers	Assessment of consent holder records	Yes
5. Provision of records for discharge volumes, rates, and pressures	Receipt of well discharge data	Yes
6. Provision of records of chemical analysis of discharge	Receipt of discharge analytical results	Yes
7. No fracturing of stratigraphic seals of injection formation	Assessment of consent holder records	Yes
8. Provision of annual report on deep well injection activities	Receipt of annual report from consent holder	Yes
9. Lapse clause	Receive notice of exercise of consent	Yes
10. Consent review clause	N/A	N/A
11. Only approved chemicals to be discharged by DWI	Discharge of approved chemicals only	Yes
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**

Overall, in 2013-2014, the Company achieved a '**high**' standard of environmental and administrative compliance with respect to consent 1336-3. The criteria associated with a 'high' level of environmental and administrative compliance are outlined in Section 1.1.4 as follows:

Environmental Compliance

'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.

Administrative compliance

'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.

4.2 Environmental effects of exercise of discharge permit

The most significant potential adverse environmental effect arising as a result of fluid injection is the contamination of freshwater aquifers. The protection of groundwater is also fundamental to the protection of surface water and consequently, groundwater should be protected to the greatest extent practicable from serious or irreversible damage arising from human activity.

Well engineering technology, regional and local geologic characterisation, and site specific modelling are typically combined at the planning stage of an injection well to ensure that injected fluids are contained within the intended disposal interval. This information is typically supplied to the Council when an application for consent to discharge fluids by DWI is lodged, and used to assess the potential for adverse environmental effects resulting from the proposed activity.

The DWI consent exercised by the Company during the period under review authorises the discharge of waste fluids into the Matemateaonga Formation, via the KW-2 well, or into the Mangahewa Formation via contingency back-up wells KA-7 and KA9. All discharges during the 2013-2014 monitoring period were via the KW-2 well, located at the KA9 wellsite.

The KW-2 well is perforated near the base of Matemateaonga Formation, between 1,245 – 1,288 m TVD below ground level. The injection interval is referred to as the MAT-60 unit, and is comprised of sequences of clayey sandstone and siltstones. Electric log data from KA-04 and KA-7 wells indicate that the thickness of MAT-60 ranges between 130 to 157 m. The MAT-60 interval is targeted for injection due to the predominance of permeable sandstone facies. It is expected that the fluids injected via the KW-2 well follow the dip of the MAT-60 unit in a south-westerly direction.

A number of faults are present in the Matemateaonga Formation, running in a north-east to south-west direction. Fault seal analysis has indicated that faults in the

vicinity of the KW-2 well are unlikely to provide a potential conduit between the injection interval and potable shallow aquifers. As such, it is concluded that the injection interval is vertically separated from the deepest water abstraction point in the area (438 m TVD below ground level, 1.9 km south-west of KW-2) by multiple layers of relatively low permeability and continuous stratigraphic seals, within a formation thickness in excess of 500 m.

Figure 5 provides a schematic representation of the relative positions of KW-2, the deepest groundwater abstraction well in the local area, and the major geological layers as interpreted from well logs.

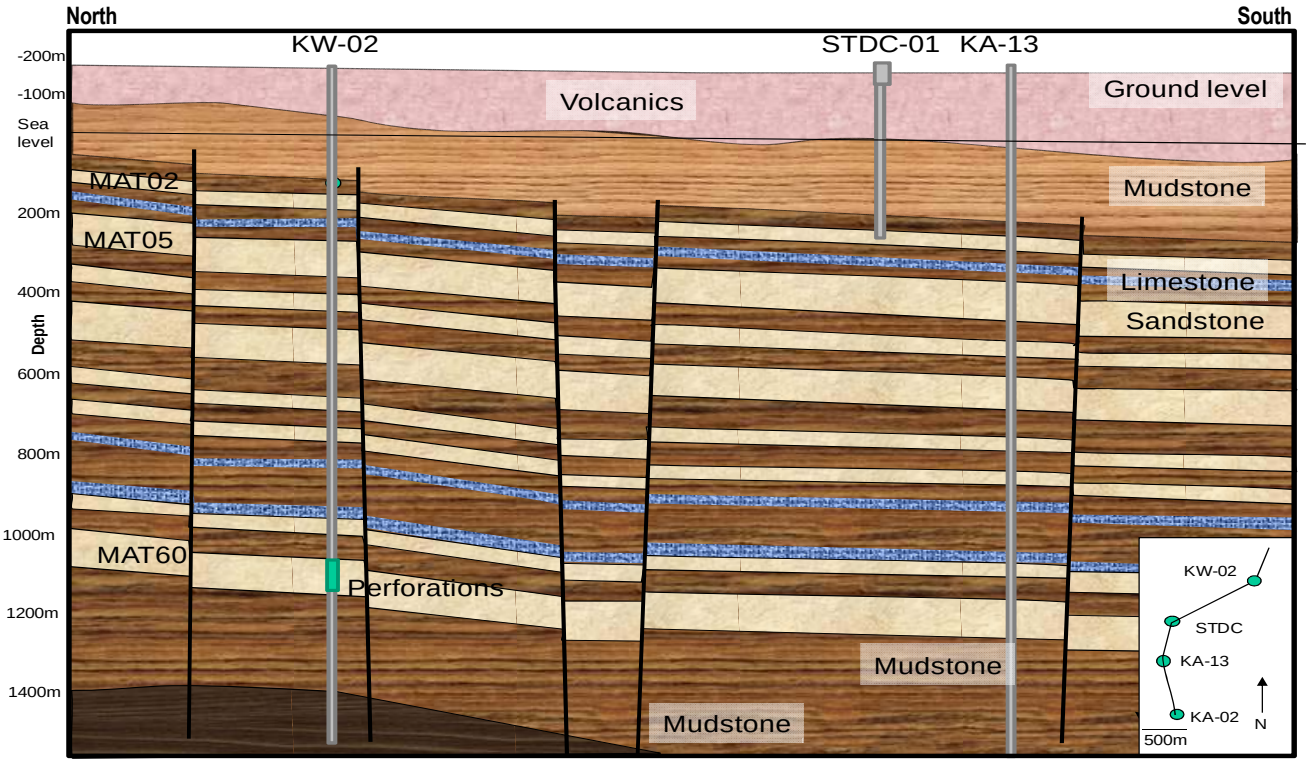

Figure 6 Schematic section through Kapuni wells (location of faults is indicative only)

Well integrity is critical in ensuring that the injection of waste fluids by DWI does not result in the release of contaminants outside of the intended injection interval. The Company carries out regular routine monitoring of well integrity by running time-lapse temperature surveys in the KW-2 well. Any loss of integrity and loss of contaminants outside the injection interval is indicated by spikes of increased temperature (in the shallow section of the well which is cooler than injected water) or reduced temperature (in the deeper part of the well). Injected water typically has a temperature of 16 ^{0}C, whilst the undisturbed formation fluid temperature at 1,200 m TVD below ground level is approximately 26 ^{0}C. The results of the most recent temperature survey carried out by the company in May 2013, indicate the well bore remains isolated from the surrounding formation.

An increase in annulus pressure could also indicate a loss of integrity, and potential leakage outside of the well casing. The Company monitors annular pressure daily during injection. The assessment of the pressure data by the Company and the Council does not indicate any significant increases in well annular pressure, supporting the conclusion that the injection well remains secure.

The natural geological characteristics of the strata overlying the injection intervals, the engineering of the injection wells, the monitoring of injection activities, and their regulation, all contribute to minimise the potential for any adverse environmental effect resulting from DWI activities.

There is no evidence to suggest that the Company's DWI activities during the period under review have resulted in the vertical migration of contaminants outside of the intended injection interval.

4.3 Recommendations from the previous monitoring report

In the 2012-2013 Annual Report, it was recommended:

1. THAT the range of monitoring carried out during the 2012-2013 period in relation to the Company's DWI activities be continued during the 2013-2014 monitoring period.

   The recommendation was implemented in the 2013-2014 monitoring period. Groundwater monitoring was carried out by URS on behalf of the Company in the vicinity of the KA9 wellsite, where this had previously been undertaken by the Council.

2. THAT the Company maintain full daily records of all injection data required by the relevant resource consent, including the nature of material injected, injection volumes, pressures and rates.

   The recommendation was implemented in the 2013-2014 period.

3. THAT, during the 2013-2014 monitoring period, the Company carries out sampling of shallow groundwater on a biannual basis, at the same sites sampled during 2012-2013 monitoring period. Groundwater samples should also be analysed for the same range of parameters as those samples taken during the 2012-2013 baseline sampling round.

   The recommendation was implemented in the 2013-2014 period.

4. THAT, if the Company feels they cannot meet the annual reporting timeframes currently attached to consent 1336-3, a revised submission date should be discussed and agreed with the Council, and a consent variation application lodged.

   On 22 July 2013, the Company applied for a variation to consent 1336-3. The application was to change the date when information is to be provided to the Council, from May annually, to August annually. This variation to the consent was approved on 9 August 2013.

5. 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.

   There was no consent review during the 2013-2014 period as it was deemed that the conditions of each consent were adequate to deal with the potential adverse effects of the activity.

4.4 Exercise of optional review of consent

An optional review of consent 1336-3 is next provided for in June 2017, prior to consent expiry on 1 June 2023.

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.

5. Recommendations

1. THAT the range of monitoring carried out during the 2013-2014 period in relation to the Company's DWI activities be continued during the 2014-2015 monitoring period.

2. THAT the Company maintain full daily records of all injection data required by the relevant resource consent, including the nature of material injected, injection volumes, pressures and rates.

3. THAT, during the 2014-2015 monitoring period, the Company carries out biannual sampling of shallow groundwater, at the same sites sampled during the 2012-2013 baseline and 2013-2014 sampling round. Samples should be analysed for the same range of parameters as during previous sampling events.

4. THAT the Council notes there is no requirement at this time for a consent review to be pursued or grounds to exercise the review options.

Glossary of common terms and abbreviations

The following abbreviations and terms are used within this report:

Aquifer (freshwater)	A formation, or group or part of a formation that contains sufficient saturated permeable media to yield exploitable quantities of fresh water.
Conductivity	A measure of the level of dissolved salts in a sample. Usually measured at 20°C and expressed as millisiemens per metre (mS/m) or as Total Dissolved Solids (g/m^3).
Confining layer	A geological layer or rock unit that is impermeable to fluids.
Deep well injection (DWI)	Injection of fluids at depth for disposal or enhanced recovery.
Freshwater/saline water water interface	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.
m^3	Cubic metre.
pH	Numerical system for measuring acidity in solutions, with 7 as neutral. Values lower than 7 are acidic and higher than 7 are alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Produced water	Water associated with oil and gas reservoirs that is produced along with the oil and gas. Typically highly saline with salt concentrations similar to seawater and containing low levels of hydrocarbons.

Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RMA	Resource Management Act 1991 and subsequent amendments.
TRC	Taranaki Regional Council (the Council).
TVD	True vertical depth.
Water flooding	A method of thermal recovery in which hot water is injected into a reservoir through specially distributed injection wells. Hot water flooding reduces the viscosity of the crude oil, allowing it to move more easily toward production wells.

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Appendix I

DWI consent exercised in 2013-2014 period

Discharge Permit

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

Name of Consent Holder:	Shell Todd Oil Services Ltd Private Bag 2035 NEW PLYMOUTH 4342
Decision Date (Change):	9 August 2013
Commencement Date (Change):	9 August 2013 [Granted: 21 April 2005]

Conditions of Consent

Consent Granted:	To discharge up to 2,000 cubic metres/day of produced water and approved contaminants by deepwell injection into the Matemateaonga Formation via well KW-2 or into the Mangahewa Formation via contingency back-up wells KA-01 and KA-07
Expiry Date:	1 June 2023
Review Date(s):	June 2017
Site Location:	KW-2 wellsite, Lower Duthie Road, Kapuni; KA-01 & KA-07 wellsites, Palmer Road, Kapuni
Legal Description:	Lot 1 DP 11291 Pt Sec 14 Blk XVI Kaupokonui SD [KW-2]; Lots 1 & 2 DP 11138 Blk XVI Kaupokonui SD [KA-01, KA-07]
Grid Reference (NZTM)	1702850E-5629709N, 1701107E-5630144N and 1701159E-5630128N
Catchment:	Kapuni Inaha

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

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. The consent holder shall 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 effects on the environment from the exercise of this consent.

2. The exercise of this consent shall be carried out in general accordance with the information submitted in support of application 3817. In the case of any contradiction between the documentation submitted in support of application 3817 and the conditions of this consent, the conditions of this consent shall prevail.

3. Prior to the exercise of this consent for each individual well to be used for deepwell injection, the consent holder shall submit, to the written satisfaction of the Chief Executive, a log of the injection well, and an injection well operation management plan, to demonstrate that special condition 2 of this consent can be met. The report shall:

a) identify the injection zone, including a validated bore log and geophysical log;
b) detail the results of fluid sampled from the injection zone, and the proposed wastes to be injected for maximum and mean concentrations for pH, suspended solids, total dissolved solids, salinity, chlorides, and total hydrocarbons;
c) demonstrate the integrity of well casing; and
d) outline design and operational procedure to isolate the zone.

4. The resource consent holder shall ensure that injection will not contaminate or endanger any actual or potential useable freshwater aquifer.

5. The consent holder shall keep weekly records of the nature and amounts of all material injected, including injection pressure and rate, and shall make the records available to the Taranaki Regional Council on an annual basis, and when there has been a significant pressure change event.

6. The consent holder shall monitor the injected wastes weekly for maximum and mean concentrations for pH, suspended solids, total dissolved solids, salinity, chlorides, and total hydrocarbons and shall make the records available to the Taranaki Regional Council on an annual basis.

7. The consent holder shall inject fluids at pressures below the pressure that would be required to fracture the stratigraphic seals of the injection formation.

8. The consent holder shall provide to the Taranaki Regional Council during the month of August of each year, for the duration of the consent, a written report on all matters required under special conditions 3, 4, 5, 6 and 7 above.

9. This consent shall lapse on the expiry of five years after the date of commencement of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(b) of the Resource Management Act 1991.

10. 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 2011 and/or June 2017, 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.

11. The chemicals introduced to the produced water system and subsequently discharged by deepwell injection under this consent shall only be those listed in the product table on page 1 of the information submitted in support of application 6314, and other chemicals 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 the product table on page 1 of the information submitted in support of application 6314;
    c) have been certified by the Chief Executive, Taranaki Regional Council as complying with a) and b) above; and
    d) have been the subject of a specific request for certification in accordance with c) above that includes details of the concentration of the contaminant and an assessment of the effects of using the chemical in the manner proposed.

Signed at Stratford on 09 August 2013

For and on behalf of
Taranaki Regional Council

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Director-Resource Management

Appendix II

Results of URS groundwater sampling

Analyte	Units	Site 1		Site 2		Site 3		Site 4	
		(13/11/2013)	10/02/2014	(13/11/2013)	10/02/2014	(13/11/2013)	10/02/2014	(13/11/2013)	10/02/2014
Sum of Anions	meq/L	3.1	3.1	3.6	3.6	3.4	3.4	4.1	4.0
Sum of Cations	meq/L	3.1	3.0	3.9	3.6	3.7	3.4	4.2	4.0
pH	pH Units	7.0	7.1	8.3	8.3	8.7	8.8	8.1	8.2
Total Alkalinity	g/m^3 as $CaCO_3$	107	108	166	166	155	156	186	186
Bicarbonate	g/m^3 at 25°C	130	131	199	198	179	179	220	220
Total Hardness	g/m^3 as $CaCO_3$	59.0	59	51	53	13.3	13.1	111	106
Conductivity (EC)	mS/m	31	32.1	33.4	33.3	31.4	31.7	37.0	36.9
Total disolved solids (TDS)	g/m^3	260	220	220	200	210	200	250	230
Dissolved Barium	g/m^3	0.0280	0.0300	0.0021	0.0020	0.0013	0.0011	0.0065	0.0064
Dissolved Calcium	g/m^3	14.4	14.3	12.9	13.2	3.8	38.0	24.0	24.0
Dissolved Copper	g/m^3	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Iron	g/m^3	1.58	2.50	0.04	0.05	<0.02	0.02	0.13	0.12
Dissolved Magnesium	g/m^3	5.70	5.60	4.70	4.80	0.90	0.89	12.30	11.20
Dissolved Manganese	g/m^3	0.6400	0.6100	0.0130	0.0134	0.0064	0.0063	0.0290	0.0280
Dissolved Mercury	g/m^3	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008
Dissolved Nickel	g/m^3	0.0015	0.0008	0.0013	0.0006	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Potassium	g/m^3	12.90	12.30	1.45	1.41	0.82	0.84	3.00	3.00
Dissolved Sodium	g/m^3	34	32	65	57	78	71	45	41
Dissolved Zinc	g/m^3	0.182	0.157	0.0045	0.0017	0.0014	<0.0010	0.0045	0.0027
Bromide	g/m^3	0	0.06	0.05	<0.05	0.05	<0.05	0.05	<0.05
Chloride	g/m^3	34.0	34.0	10.7	10.4	11.1	10.7	11.6	11.2
Nitrite-N	g/m^3	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Nitrate-N	g/m^3	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Nitrate-N + Nitrite-N	g/m^3	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Sulphate	g/m^3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylene glycol	g/m^3	<4	<4	<4	<4	<4	<4	<4	<4
Propylene glycol	g/m^3	<4	<4	<4	<4	<4	<4	<4	<4
Methanol	g/m^3	<2	<2	<2	<2	<2	<2	<2	<2
Benzene	g/m^3	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Toluene	g/m^3	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	g/m^3	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
m&p-Xylene	g/m^3	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
o-Xylene	g/m^3	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Formaldehyde	g/m^3	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
C7 - C9	g/m^3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
C10 - C14	g/m^3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
C15 - C36	g/m^3	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Total hydrocarbons (C7 - C36)	g/m^3	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
Ethane	g/m^3	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Ethylene	g/m^3	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Methane	g/m^3	8.6	7.5	5.8	6.8	6.7	7.8	9.3	7.9