Greymouth Petroleum Limited
Deep Well Injection
Monitoring Programme
Annual Report
2014-2015

Technical Report 2015-24

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Executive summary

The following Annual Report by the Taranaki Regional Council (the Council) outlines Greymouth Petroleum Limited's (the Company) deep well injection (DWI) activities during the monitoring period 1 July 2014 - 30 June 2015. The report provides details of the DWI consents held by the Company during the period under review, and the compliance monitoring programme implemented by the Council with regard to these consents. The report also discusses the results of the monitoring carried out, and provides an assessment of the Company's performance with regard to consent compliance.

The Company held eight consents throughout the monitoring period for the discharge of fluids by DWI. The consents held by the Company authorise the discharge of a range of fluids by DWI, including water, produced water, contaminated stormwater, waste drilling fluids, 'off-spec' stormwater from the Company's wellsites and well workover fluids (including hydraulic fracturing fluids). The consents include a number of special conditions, setting out specific requirements with which the Company must comply.

During the 2014-2015 monitoring period, the Company exercised five DWI consents. These consents authorised discharges at the Kaimiro-O, Kowhai-A, Kaimiro-J, Turangi-A and Kaimiro-G wellsites.

During the monitoring period, Greymouth Petroleum Limited demonstrated an overall high level of environmental performance.

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 active injection sites.

The Council carried out six 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 the consents exercised by the Company, 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 91,909 cubic metres (m^3) of fluids by DWI during the 2014-2015 monitoring period.

The Kowhai-2 injection well, at the Kowhai-A wellsite, was the Company's most used injection well (by volume) during this period. In total, 35,918 m^3 of fluid was discharged from the well during this period. A total of 41,245 m^3 of produced water was discharged from the Company's Kaimiro field during the period under review. This was comprised of 13,403 m^3 from the Kai-17 well, 16,960 m^3 from the Kai-11 well and 10,882 m^3 from the Kai-10 well. A total of 14,746 m^3 was injected at the Turangi-A wellsite via the Turangi-5 injection well.

The volumes of fluid discharged, and the pressure at which it was injected into the receiving formations, were within the limits specified in the respective resource consents.

The information gathered during inspection visits and the data supplied by the consent holder for Council audit 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 2014-2015 monitoring period.

During the year under review Greymouth Petroleum Limited demonstrated both a high level of environmental and administrative performance and compliance with their resource consents.

For reference, in the 2014-2015 year, 75% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level o f environmental performance and compliance with their consents, while another 22% demonstrated a good level of environmental performance and compliance with their consents.

This report includes recommendations to be implemented during the 2015–2016 monitoring period.

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1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

The following Annual Report covers the monitoring period 1 July 2014 to 30 June 2015. During the period under review, Greymouth Petroleum Limited (the Company) held eight resource consents for the disposal of wastes by deep well injection (DWI) from seven separate wellsites across the Taranaki region. The resource consents held by the Company permit the discharge of a range of fluids by DWI, including water, produced water, contaminated stormwater, waste drilling fluids, 'off-spec' stormwater from the consent holder's wellsites, and well workover fluids (including hydraulic fracturing [HF] fluids). The consents include a number of special conditions, setting out specific requirements with which the Company must comply.

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

Section 1 of this report is a background section. It sets out general information about compliance monitoring under the *Resource Management Act* 1991 (RMA) and the Council's obligations and general approach to monitoring sites though annual programmes, the resource consents held by the Company, the nature of the monitoring programme in place for the period under review, and a description of the activities and operations conducted in the Company's site/catchment.

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 2015-2016 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);
(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 holder during the period under review, this report also assigns a rating as to the 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 (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 was addressed promptly and co-operatively.

- **Good:** Perhaps some administrative requirements of the resource consents were not met at a particular time, however these were 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 2014-2015 year, 75% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level o f environmental performance and compliance with their consents, while another 22% 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 group's 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 a 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 injection 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, 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 improving the 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 hydrocarbons 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.

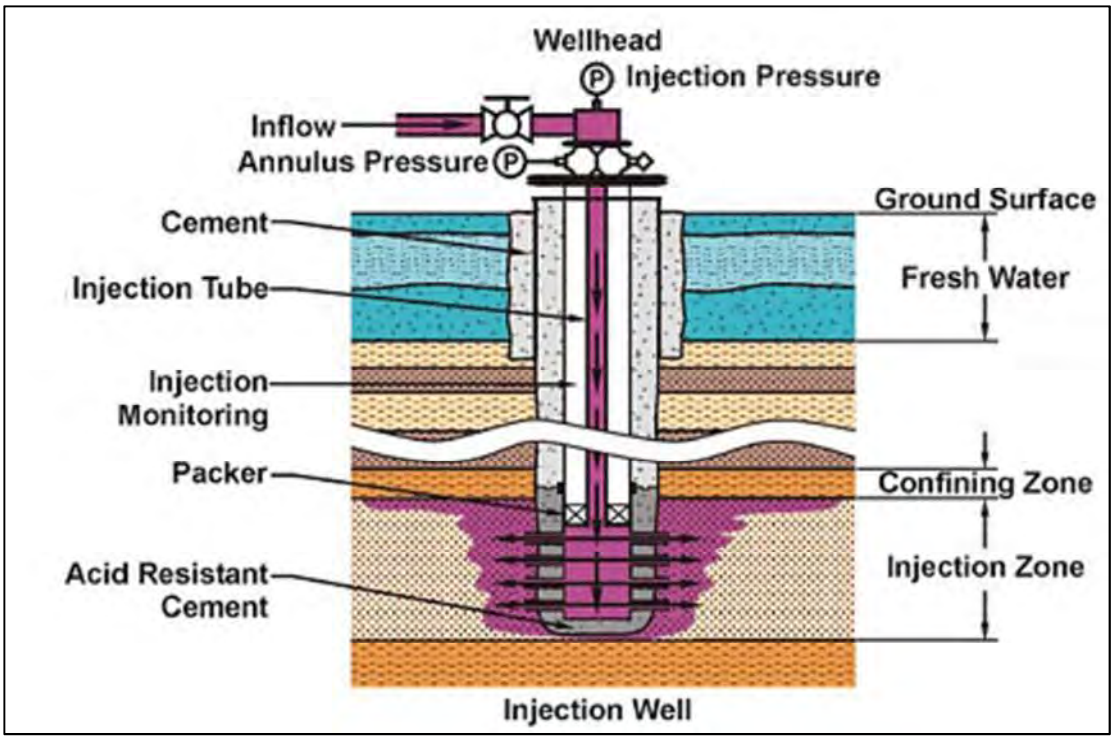

Figure 1 DWI schematic representative of Taranaki sites[1]

1.3 Potential environmental effects of exercising a DWI consent

The most significant potential adverse environmental effect arising as a result of fluid injection 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 injection 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 injection

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

well to ensure that fluids discharged by DWI will be contained within the intended 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 RMA 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 lists the consents held by the Company during the period under review, the wellsites to which the consents relate and the injection wells in use at each site. All of the resource consents were issued by the Council under Section 87(e) of the RMA.

Table 1 Summary of DWI consents held by the Company during the 2014-2015 period

Consent number	Wellsite	Injection well	Formation
5312-2	Kaimiro-O	Kai-17	Mt. Messenger
7390-1	Turangi-A	Turangi-3	Mt. Messenger
7466-1	Kowhai-A	Kowhai-2	Mt. Messenger
7897-1	Kaimiro-J	Kai-11	Mt. Messenger
9206-1	Kowhai-B	N/A*	N/A*
9272-1	Turangi-A	Turangi-5	Mt. Messenger
9470-1	Kaimiro-G	Kai-10	Mt. Messenger
9476-1	Kowhai-C	N/A*	N/A*

* Injection well not yet drilled

A summary of the consents held by the Company for DWI activities during the 2014-2015 monitoring period is included below.

Resource Consent: 5312-2

"To discharge groundwater from the Matemateaonga Formation and produced water into the Mount Messenger Formation for improved hydrocarbon recovery purposes at the Kaimiro-O wellsite"

Background:
Consent 5312-2, which authorises the injection of water for improved petroleum recovery at the Kaimiro-O wellsite, Alfred Road, Egmont Village, was originally granted to Fletcher Challenge Energy Taranaki Limited (FCET), on 17 April 1998. There is no record of the consent being exercised under FCET ownership.

The consent was transferred to the Company on 10 April 2002, and has been regularly exercised under their ownership. The injection authorised by consent 5312-1 is via the Kai-17 injection well. The Kai-17 injection well in perforated within the Mount

Messenger Formation from approximately 1,140 m and 1,165 m true vertical depth (TVDss) sub-sea.

The injection of fluids under this consent is for improved petroleum recovery, otherwise known as water flooding as described in section 1.2.2 of this report.

The Council waived its option to review this consent in June 2002 and June 2008 as it was deemed that the consent conditions were adequate to deal with the potential adverse effects of the activity.

The consent expired on 1 June 2014 and was renewed as 5312-2 on 24 July 2014.

On 6 May 2015 the consent purpose was updated to allow produced water to be discharged into the Mount Messenger Formation, as well as groundwater.

Consent 5312-2, which was used throughout the 2014-2015 monitoring period, has 18 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 sets a maximum injection pressure limit of 85 bar;
- Special condition 4 sets a maximum injection rate limit of 41.6 m^3/hour ;
- Special condition 5 sets a maximum daily injection volume of 1,000 m^3/day;
- Special condition 6 requires that no injection be made after 1 June 2027;
- Special condition 7 refers to the best practicable option (BPO) requirements;
- Special condition 8 requires the discharge to be made into the Mount Messenger Formation, deeper than 1,000 m TVD below ground level;
- Special condition 9 requires that discharge does not result in fracturing of the geological seals confining the injection zone;
- Special condition 10 prohibits the discharge from endangering or contaminating any freshwater aquifer;
- Special conditions 11, 12, 13 , 14 ,15 and 16 refer to process monitoring and data submission requirements;
- Special condition 17 is an annual reporting requirement;
- Special condition 18 is a review provision.

Resource Consent: 7390-1

"To discharge produced water from hydrocarbon exploration and production operations by deep well injection at the Turangi-A wellsite (via Turangi-3 well)"

Background:
Consent 7390-1, which authorises the discharge of produced water by DWI at the Turangi-A wellsite, Upper Turangi Road, Waitara, was granted to the Company on 10 October 2008.

The Turangi-3 well is perforated within the Mount Messenger Formation, between 1,138 m and 2,355 m TVD below ground level. The Turangi-3 well was the Company's primary waste injection well until March 2013, at which time the newly drilled Turangi-5 injection well was brought into operation. Injection via the Turangi-5 well is authorised under consent 9272-1 (see below). Injection via the Turangi-3 well did not occur during the 2014-2015 monitoring period.

The Council waived its option to review this consent in June 2009 and 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 reviews are provided for in June 2015 and June 2021.

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

- Special condition 1 sets a maximum injection pressure limit of 55 bar (800 psi);
- Special condition 2 sets a maximum daily injection volume of 300 m^3/day;
- Special conditions 3, 4 & 5 refer to process monitoring and data submission requirements;
- Special condition 6 required the consent holder to submit an Injection Operation Management Plan prior to exercising the consent;
- Special condition 7 prohibits the discharge from endangering or contaminating any freshwater aquifer;
- Special condition 8 is a lapse clause; and
- Special condition 9 is a review provision.

The consent is due to expire on 1 June 2027.

Photo 1 The Turangi-A wellsite (L) and the Turangi-3 injection well (R)

Resource Consent: 7466-1.1

"To discharge produced water from hydrocarbon exploration and production operations by deepwell injection at the Kowhai wellsite (via Kowhai-2 well)"

Background:
Consent 7466-1, which authorises the discharge of waste fluids by DWI at the Kowhai-A wellsite, Ngatimaru Road, Tikorangi, was granted to Petrochem Limited (Petrochem) on 1 May 2009. Petrochem is a wholly owned subsidiary of the Company. Since being granted, the Company has exercised the consent on a continuous basis.

On 3 February 2014, the consent was varied to 7466-1.1. The new consent has two extra consent conditions. Consent 7466-1.1 was active during the 2014-2015 monitoring period.

Injection under consent 7466-1.1 is via the Kowhai-2 well, which is perforated within the Mount Messenger Formation, between 978 m and 1,263 m TVD below ground level.

The Council has the option to review the conditions of the consent in June 2021.

Consent 7466-1 has 13 special conditions, as summarised below:

- Special condition 1 requires the consent holder to submit well completion information following drilling;
- Special condition 2 sets a maximum injection pressure limit of 92 bar (1,352 psi);
- Special condition 3 sets a maximum daily injection volume of 916 m^3/day;
- Special condition 4 sets a maximum hourly injection rate of 38 m^3/day (4 bpm);
- Special condition 5 requires the discharge to be made into the Mount Messenger Formation, deeper than 970 m TVD below ground level;

- Special conditions 6, 7 & 8 refer to process monitoring and data submission requirements;
- Special condition 9 requires the consent holder to notify the Council at least five working days prior to exercising the consent;
- Special condition 10 required the consent holder to submit an Injection Operation Management Plan prior to exercising the consent;
- Special condition 11 prohibits the discharge from endangering or contaminating any freshwater aquifer;
- Special condition 12 is a lapse clause; and
- Special condition 13 is a review provision.

The consent is due to expire on 1 June 2027.

Resource Consent: 7897-1

"To discharge the following from hydrocarbon exploration operations at the Kaimiro-J wellsite by deepwell injection into the Mount Messenger Formation:

- *produced water;*
- *well drilling fluids;*
- *well workover fluids;*
- *hydraulic fracturing fluids; and*
- *'off-spec' stormwater from the consent holder's wellsites"*

Background:
Consent 7897-1, which authorises the discharge of waste fluids by DWI at the Kaimiro-J wellsite, Junction Road, Inglewood, was granted to the Company on 12 September 2011. The consent replaced the previous DWI consent for the site, 4921-1. Two consent variations were applied for in February and July 2013.

Injection under consent 7897-1 is via the Kai-11st1 injection well, which is perforated within the Mount Messenger Formation, between 1,562 m and 1,571 m TVD below ground level.

The consent provides the Council with an option to review the conditions of the consent at specified intervals. Optional reviews are provided for on an annual basis, with the next review date being 1 June 2016.

The current consent has 18 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 sets a maximum injection pressure limit of 115 bar (1,669 psi);
- Special condition 4 sets a maximum injection rate limit of 29 m^3/hour (3 bpm);
- Special condition 5 sets a maximum daily injection volume of 687 m^3/day;
- Special condition 6 requires the discharge to be made into the Mount Messenger Formation, deeper than 1,320 m TVD below ground level;
- Special condition 7 refers to the BPO requirements;
- Special conditions 8, 9 & 10 refer to process monitoring and data submission requirements;
- Special condition 11 requires the consent holder to notify the Council at least 5 working days prior to exercising the consent;
- Special condition 12 prohibits the discharge from endangering or contaminating any freshwater aquifer;
- Special conditions 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.

The consent is due to expire on 1 June 2026.

Resource Consent: 9206-1

"To discharge produced water, well workover fluids, well drilling fluids and contaminated stormwater from hydrocarbon exploration and production operations into land by deepwell injection below 1,185 m TVD at the Kowhai-B wellsite"

Background:
Consent 9206-1, which authorises the discharge of waste fluids by DWI at the Kowhai-B wellsite, Ngatimaru Road, Tikorangi, was granted to the Company on 11 May 2012.

As of 30 June 2014, the proposed waste injection well had not been drilled and therefore the consent had not been exercised.

The consent conditions provide the Council with an option to review the conditions of the consent at specified intervals. Optional reviews are provided for on an annual basis, with the last review date being 1 June 2015 before the consent expires in June 2016.

The current consent has 17 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 sets a maximum injection pressure limit of 26.1 bar (379 psi);
- Special condition 4 sets a maximum rate of injection of 14.3 m^3/hr (1.5 bpm);
- Special condition 5 sets a maximum daily injection volume of 300 m^3/day;
- Special condition 6 requires the discharge to be made into the Mount Messenger Formation, deeper than 1,185 m TVD below ground level;
- Special condition 7 refers to the BPO requirements;
- Special condition 8 limits the range of fluids that may be injected;
- Special conditions 9 & 10 refer to process monitoring and data submission requirements;
- Special condition 11 prohibits the discharge from endangering or contaminating any freshwater aquifer;
- Special conditions 12, 13 & 14 relate to the requirement for the consent holder to implement a groundwater monitoring programme;
- Special condition 15 is an annual reporting requirement;
- Special condition 16 requires the consent holder to notify the Council at least five working days prior to exercising the consent; and
- Special condition 17 is a review provision.

The consent is due to expire on 1 June 2016.

Resource Consent: 9272-1

"To discharge produced water, well drilling fluids, well workover fluids and contaminated stormwater into the Mount Messenger Formation by deepwell injection via the Turangi-A waste disposal well"

Background:
Consent 9272-1, which authorises the discharge of waste fluids by DWI at the Turangi-A wellsite, Turangi Road, Motunui, was granted to the Company on 4 May 2012.

The injection of waste fluids under consent 9272-1 is via the Turangi-5 well (also referred to as Turangi waste disposal well). Injection via the Turangi-5 well commenced on 1 March 2013. This well is now the primary injection well on the

Turangi-A wellsite, replacing the previously used Turangi-3 well (consent 7390-1), which has been retained for intermittent use as required. The Turangi-5 well is perforated within the Mount Messenger Formation, between 1,352 m and 1,441 m TVD below ground level.

The consent conditions provide the Council with an option to review the conditions of the consent at specified intervals. Optional reviews are provided for on an annual basis, with the last review date being 1 June 2015 prior to expiry of the consent in June 2016.

The current consent has 17 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 sets a maximum injection pressure limit of 115 bar (1,685 psi);
- Special condition 4 sets a maximum rate of injection of 687 m^3/day (3 bpm);
- Special condition 5 sets a maximum daily injection volume of 687 m^3/day;
- Special condition 6 requires the discharge to be made into the Mount Messenger Formation, deeper than 1,350 m TVD below ground level;
- Special condition 7 refers to the BPO requirements;
- Special condition 8 limits the range of fluids that may be injected;
- Special conditions 9 & 10 refer to process monitoring and data submission requirements;
- Special condition 11 prohibits the discharge from endangering or contaminating any freshwater aquifer;
- Special conditions 12, 13 & 14 relate to the requirement for the consent holder to implement a groundwater monitoring programme;
- Special condition 15 is an annual reporting requirement;
- Special condition 16 requires the consent holder to notify the Council at least five working days prior to exercising the consent; and
- Special condition 17 is a review provision.

The consent is due to expire on 1 June 2016.

Resource Consent: 9470-1

"To discharge produced water, well drilling fluids, well workover fluids into the Mount Messenger Formation by deepwell injection via the Kaimiro-G wellsite"

Background:
Consent 9470-1, which authorises the discharge of waste fluids by DWI at the Kaimiro-G wellsite, Upland Road, Kaimiro, was granted to the Company on 4 February 2013.

The injection of waste fluids under consent 9470-1 is via the Kai-10 injection well, which is perforated within the Mount Messenger Formation, between 999 m and 1,002 m TVD sub-sea. Injection via the Kai-10 well commenced on 19 March 2013.

The consent conditions provide the Council with an option to review the conditions of the consent at specified intervals. Optional reviews are provided for on an annual basis, with the next review date being 1 June 2016.

The current consent has 19 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 sets a maximum injection pressure limit of 1,077 psi;
- Special condition 4 sets a maximum rate of injection of 8.6 m^3/hr (0.9 bpm);
- Special condition 5 sets a maximum daily injection volume of 206 m^3/day (1,296 bpd);
- Special condition 6 requires the discharge to be made into the Mount Messenger Formation, deeper than 995 m TVD sub-sea;
- Special condition 7 refers to the BPO requirements;
- Special condition 8 limits the range of fluids that may be injected;
- Special conditions 9, 10 & 11 refer to process monitoring and data submission requirements;
- Special condition 12 prohibits the discharge from endangering or contaminating any freshwater aquifer;
- Special conditions 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 requires the consent holder to notify the Council at least five working days prior to exercising the consent;
- Special condition 18 requires the discharge to cease five years prior to consent expiry date to allow for on-going environmental monitoring after the discharge has ceased; and
- Special condition 19 is a review provision;

The consent is due to expire on 1 June 2032.

Resource Consent: 9476-1

"To discharge produced water, well drilling fluids, well workover fluids including hydraulic fracturing fluids, and contaminated stormwater from hydrocarbon exploration operations into the Mount Messenger Formation by deepwell injection via the Kowhai-C waste disposal well"

Background:
Consent 9476-1, which authorises the discharge of waste fluids by DWI at the Kowhai-C wellsite, Otaraoa Road, Tikorangi, was granted to the Company on 28 February 2013.

The injection of waste fluids under consent 9476-1 is via the Kowhai-C waste disposal well, which as of 30 June 2014, had not yet been drilled. When drilled, the well will be perforated within the Mount Messenger Formation, below 1,350 m TVD below ground level.

The consent conditions provide the Council with an option to review the conditions of the consent at specified intervals. Optional reviews are provided for on an annual basis, with the next review date being 1 June 2016.

The current consent has 19 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 sets a maximum injection pressure limit of 1,685 psi (115 bar);
- Special condition 4 sets a maximum rate of injection of 0.48 m^3/min (3 bpm);
- Special condition 5 sets a maximum daily injection volume of 687 m^3/day (4320 bpd);
- Special condition 6 requires the discharge to be made into the Mount Messenger Formation, deeper than 1,350 m TVD below ground level;
- Special condition 7 refers to the BPO requirements;

- Special condition 8 limits the range of fluids that may be injected;
- Special conditions 9, 10 & 11 refer to process monitoring and data submission requirements;
- Special condition 12 prohibits the discharge from endangering or contaminating any freshwater aquifer;
- Special conditions 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 requires the consent holder to notify the Council at least five working days prior to exercising the consent;
- Special condition 18 requires the discharge to cease five years prior to consent expiry date to allow for on-going environmental monitoring after the discharge has ceased; and
- Special condition 19 is a review provision;

The consent is due to expire on 1 June 2023.

Figure 2 shows the location of the DWI consents held by the Company during the period under review. Copies of the consent certificates are attached in Appendix I.

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.

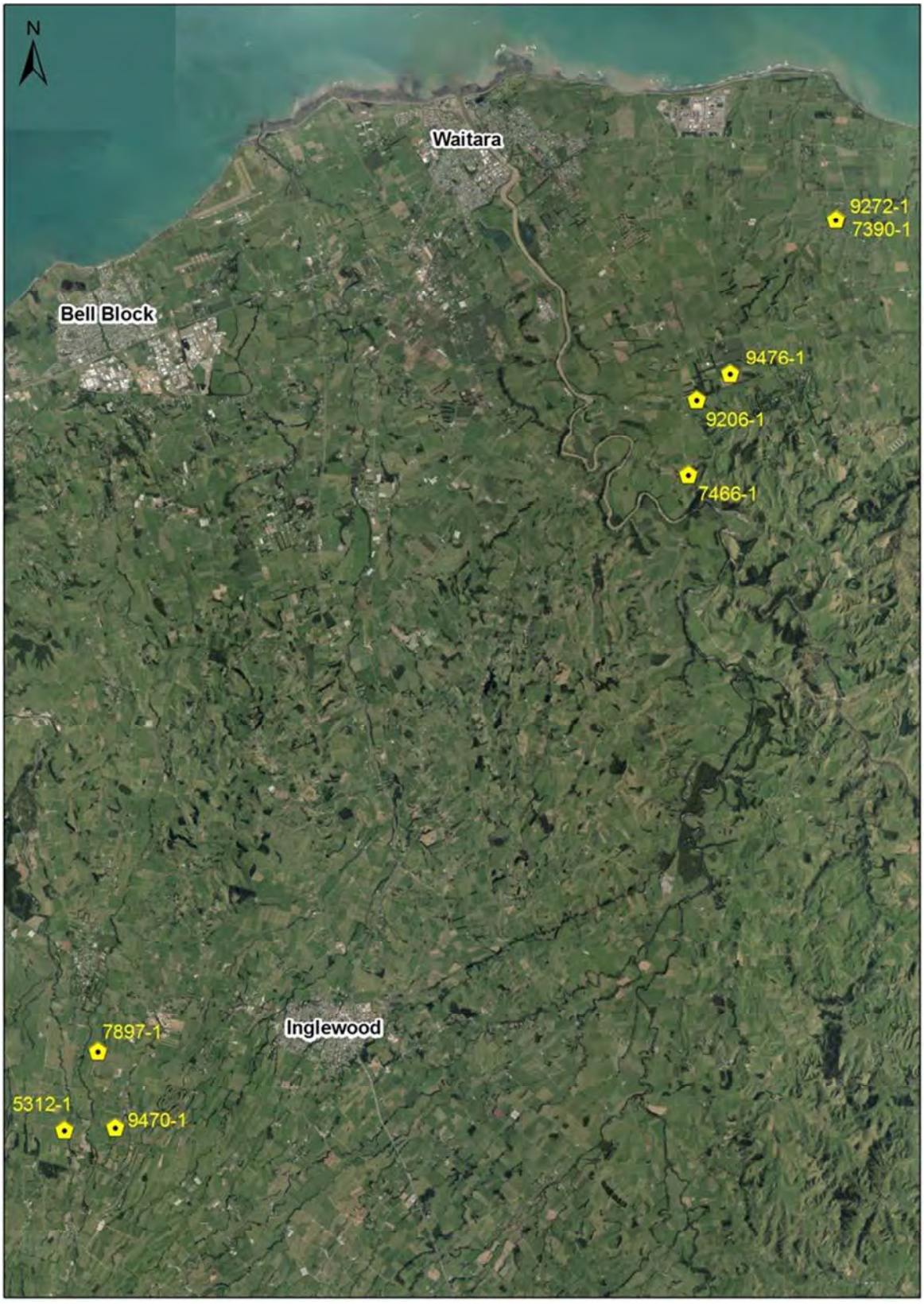

Figure 2 Resource consents for DWI held by the Company during the 2014-2015 monitoring period

1.5.2 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.

1.5.3 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. During the period under review samples of injectate were obtained from fluid storage facilities at the Kaimiro Production Station (KPS), Kaimiro-O, Turangi-A and Kowhai-A wellsites. Details of the sampling sites are outlined below in Table 2.

The injectate samples collected were submitted to Council's IANZ[2] accredited laboratory for the following analyses:

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

Table 2 Location of injectate sampling sites

Consent	Wellsite	Injection well	Sample point	Site code
5312-2	Kaimiro-O	Kai-17	Kaimiro-O well head tank	GND1385
7466-1	Kowhai-A	Kowhai-2	Kowhai-2 well head tank	GND2289
7897-1	Kaimiro-J	Kai-11	KPS – Tank 600 T001	GND1377
9272-1	Turangi-A	Turangi-5	Tank 4	GND2365
9470-1	Kaimiro-G	Kai-10	KPS – Tank 600 T001	GND2351

[2] The tests outlined in this report have been performed in accordance with the laboratory's scope of accreditation.

1.5.4 Consent holder data submission requirements

The resource consents held by the Company for DWI include 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 injection well and injection interval

The conditions of consents exercised by the Company for DWI required them to submit management plans for the operation of each injection well. The plans were 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 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 Kaimiro, Kowhai and Turangi areas. 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 injection records for the 2014-2015 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 annual reports to the Council providing a summary of all injection data gathered over the previous 1 July to 30 June period. The level of detail required in the annual reports varies depending on the conditions of the consents exercised. Additional reporting requirements may also include requirements to provide an assessment of monitoring data and the implications for consent compliance, and/or updated injection modelling reports.

The Company supplied the required annual reports to the Council within the timeframes specified in the relevant consents.

1.5.5 Groundwater quality monitoring

A programme of groundwater monitoring in the vicinity of the Company's active injection sites was initiated during the 2012-2013 monitoring period, and was continued in the 2013-2014 and 2014-2015 monitoring periods, with some sites removed, and some additional sites added. The programme provides for biannual sampling of groundwater from selected groundwater sites.

In order to select suitable sampling sites for inclusion in the monitoring programme, the Council carried out a survey of groundwater abstractions within a 1 kilometre (km) radius of all the Company's active injection wellsites. Initially, a desktop review of data held by the Council was conducted, including a search of the Council 'wells' database. The desktop review indicated that the Council held records of a limited number of groundwater abstractions in the areas of investigation.

Following the desktop review, a field survey was undertaken to confirm the location of known abstraction sites and to assess their suitability for sampling. The field survey was also used as an opportunity to identify any additional groundwater abstraction sites that are not currently registered with the Council.

Following the field survey, two private groundwater abstraction sites located in the vicinity of both the Turangi-A and Kaimiro-G wellsites were selected for inclusion in the programme. One of the monitoring sites (GND2232) had to be discontinued for the 2013-14 monitoring year. For the Kaimiro-O wellsite, it was decided that the abstraction bore used to provide water for the Kai-17 injection well (GND2456) would be used as a groundwater monitoring site. Before the second round of monitoring for the 2013-14 period was carried out, a suitable monitoring location (GND2464) was found in the vicinity of the Kowhai-A wellsite. It is a groundwater spring approximately 100 m to the northwest of the wellsite. A private groundwater abstraction site downstream of the Kaimiro-J wellsite was selected for inclusion in the programme on 21 October 2014. The criteria used in assessing the suitability of a site for inclusion in the programme was the proximity of the site to the injection well in use, the depth to which the bore or well has been drilled or excavated, the construction specification of the bore or well, and its susceptibility to contamination by surface run-off.

Details of the sites selected for inclusion in the monitoring programme are listed below in Table 3.

Table 3 Location of groundwater sampling sites

Site code	Type	Distance from injection wellhead (m)	Casing depth (m)	Total depth (m)	High static water level (m)	Aquifer	Comment
GND1673	Bore	362	26	42	7.5	Volcanics	Downgradient of Turangi-A wellsite
GND0701	Well	56	0.5	4.5	2	Volcanics	Downgradient of Kaimiro-G wellsite
GND2353	Well	685	Unlined	3	0.1	Volcanics	Downgradient of Kaimiro-G wellsite
GND2456	Well	15	330	342	-	Matemateaonga	Located on Kaimiro-O wellsite
GND2464	Spring	144	NA	NA	NA	Volcanics	Downgradient of Kowhai-A wellsite
GND2472	Bore	905	-	30	-	Volcanics	Downgradient of Kaimiro-J wellsite

2. Results

2.1 Site inspections and injectate sampling

During the period under review, the Council carried out six routine inspections in relation to the Company's DWI activities. Inspections were undertaken at the Kowhai-A and Turangi-A wellsites, and KPS. KPS serves as a central fluid collection and storage facility for waste generated within the Company's Kaimiro, Ngatoro, Surrey and Radnor fields, and is also the site from which all injection within these fields is controlled and monitored.

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 inspection visits. The injectate samples were submitted to the Council's IANZ accredited laboratory for physicochemical analysis. The results of the analyses are outlined 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 (2014-2015)

Parameter	Unit	Kowhai-A		Turangi-A		Kaimiro-J		Kaimiro-O		Kaimiro-G	
		28/10/14	22/04/15	23/10/14	22/04/15	6/11/14	23/04/15	8/10/14	23/5/15	6/11/14	23/4/15
Site code	-	GND2289		GND2365		GND1377		GND1385		GND2351	
Sample number	-	1411627	151525	1411624	151524	1411761	151536	1411410	151532	1411764	151533
Time	NZST	11:15	11:20	12:15	9:45	13:00	8:20	8:25	8:40	12:10	9:50
pH	pH Units	6.8	7.0	6.7	7.0	8.0	8	7.3	7.6	7.5	6.7
Conductivity @ 20°C	mS/m @ 20°C	3,150	3,080	2,420	2,430	5,130	4,610	175	144	4,760	3,730
Alkalinity	g/m^3 $CaCO_3$	1,280	1,190	2,160	1,980	1,060	-	321	326	1,590	2,200
Chloride	g/m^3	11,900	11,600	8,730	8,890	20,800	18,600	164	166	22,600	14,400
Total petroleum hydrocarbons	g/m^3	520	72	610	1,400	18,000	14	1.8	<0.5	40	56

2.2 Assessment of data provided by the consent holder

The Company provided a record of injection data for the 2014-2015 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, 4, 5, 6, 7, 8, 9, 10, 11 and 12.

Table 5 Summary of DWI activities during the period under review (2014-2015)

Consent	Wellsite	Injection well	TRC Well ID	Total volume discharged (m^3) 01/07/13 – 30/06/14	Discharge period	
					From	To
5312-2	Kaimiro-O	Kai-17	GND1385	13,403	1/07/2014	27/04/2015
7390-1	Turangi-A	Turangi-3	GND2106	-	-	-
7466-1	Kowhai-A	Kowhai-AWDW	GND2289	35,918	1/07/2014	30/06/2015
7897-1	Kaimiro-J	Kai-11	GND1377	16,960	1/07/2014	30/06/2015
9206-1	Kowhai-B	N/A*	-	-	-	-
9272-1	Turangi-A	Turangi-5	GND2106	14,746	1/07/2014	30/06/2015
9470-1	Kaimiro-G	Kai-10	GND2351	10,882	1/07/2014	30/06/2015
9476-1	Kowhai-C	N/A*	-	-	-	-
		Total	NA	91,909	1/07/2014	30/06/15

* Injection well not yet drilled

Table 6 Summary of the Company's 2014-2015 injection data

Parameter		Unit	Consent (injection well)				
			5312-2 (Kai-17)	7466-1 (Kowhai-AWDW)	7897-1 (Kai-11)	9272-1 (Turangi-5)	9470-1 (Kai-10)
Volume	Total	m^3	13,403	35,918	16,960	14,746	10,882
	Max	m^3/day	58	121	137.2	58.8	121.3
	Average	m^3/day	36.9	98.4	46.8	43.8	53.5
Injection pressure	Max	bar	118.99	26.5	56.0	26.6	73
	Average	bar	74	22.4	48.9	20.1	42.3
Injection rate	Max	m^3/hr	18.27	7.0	14.0	31.1	9.06
	Average	m^3/hr	15.15	4.2	1.6	9.3	0.99

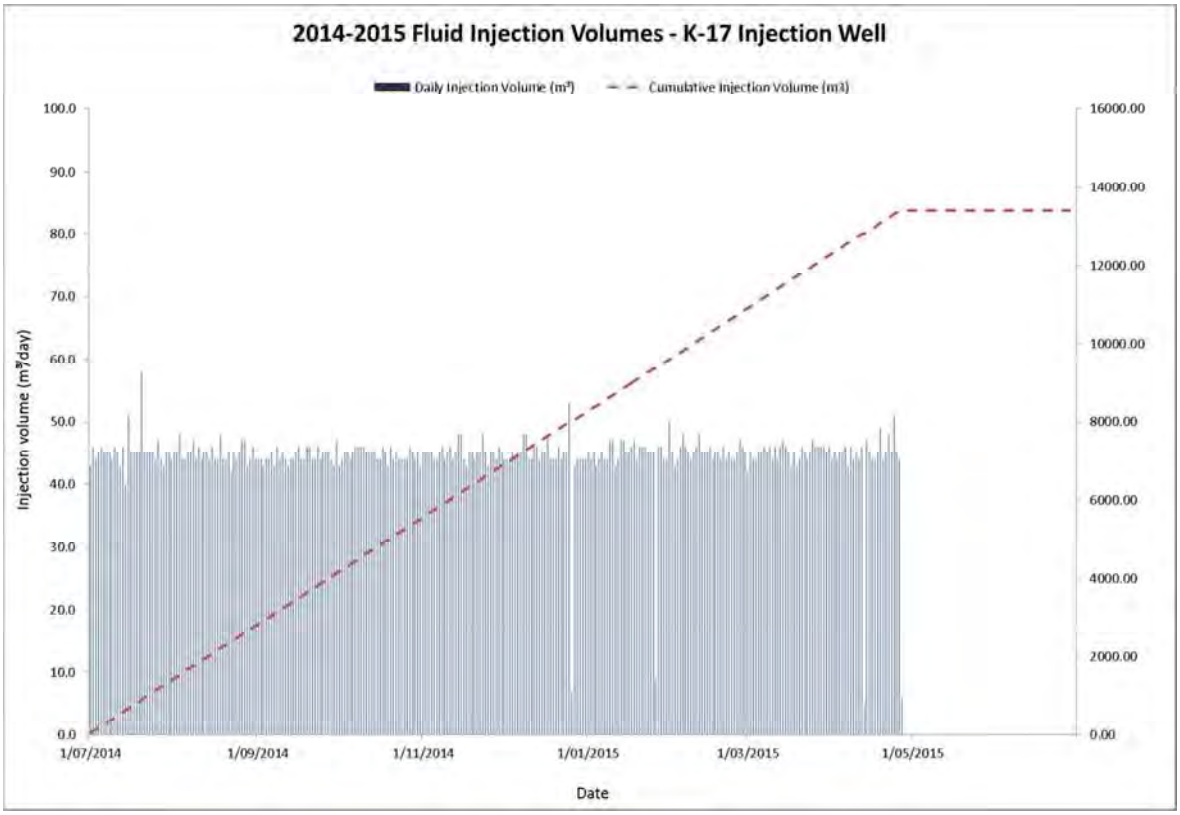

Figure 3 2014-2015 Fluid injection volumes – Kai-17 injection well (5312-2)

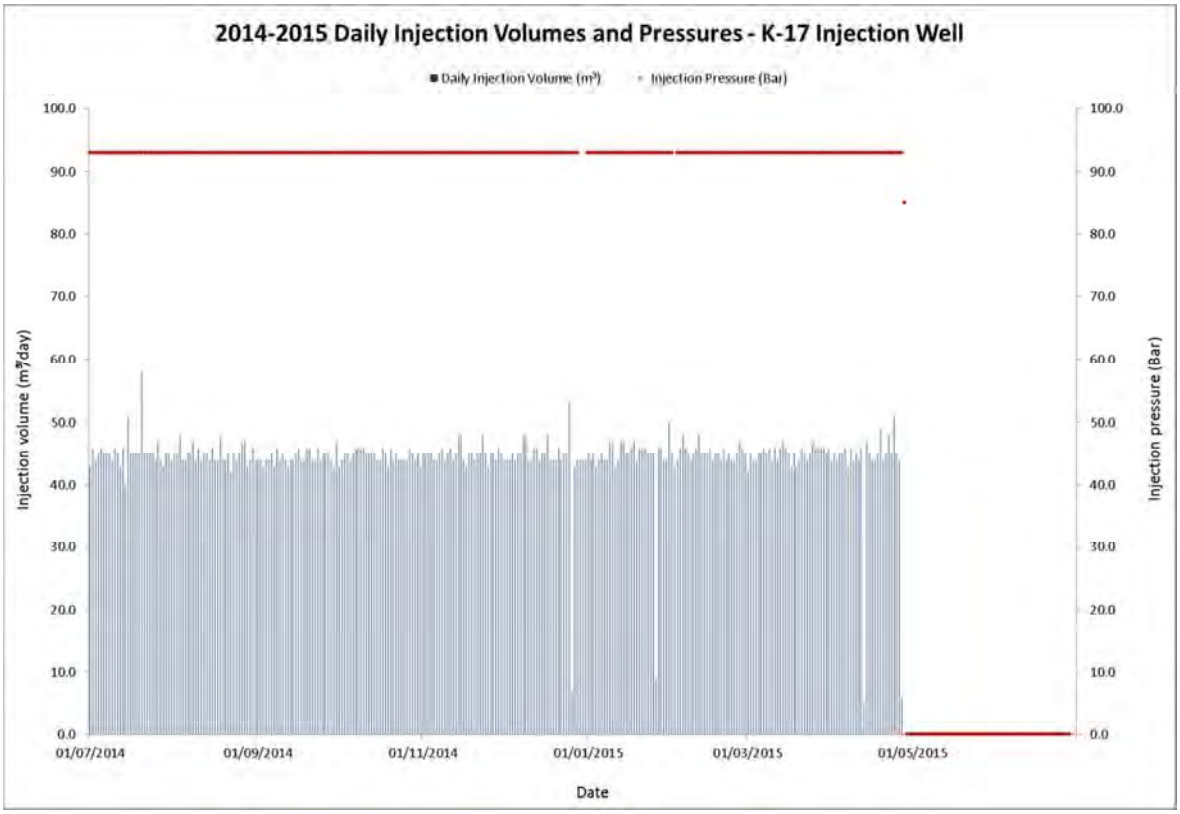

Figure 4 2014-2015 Daily injection volumes and pressures – Kai-17 injection well (5312-2)

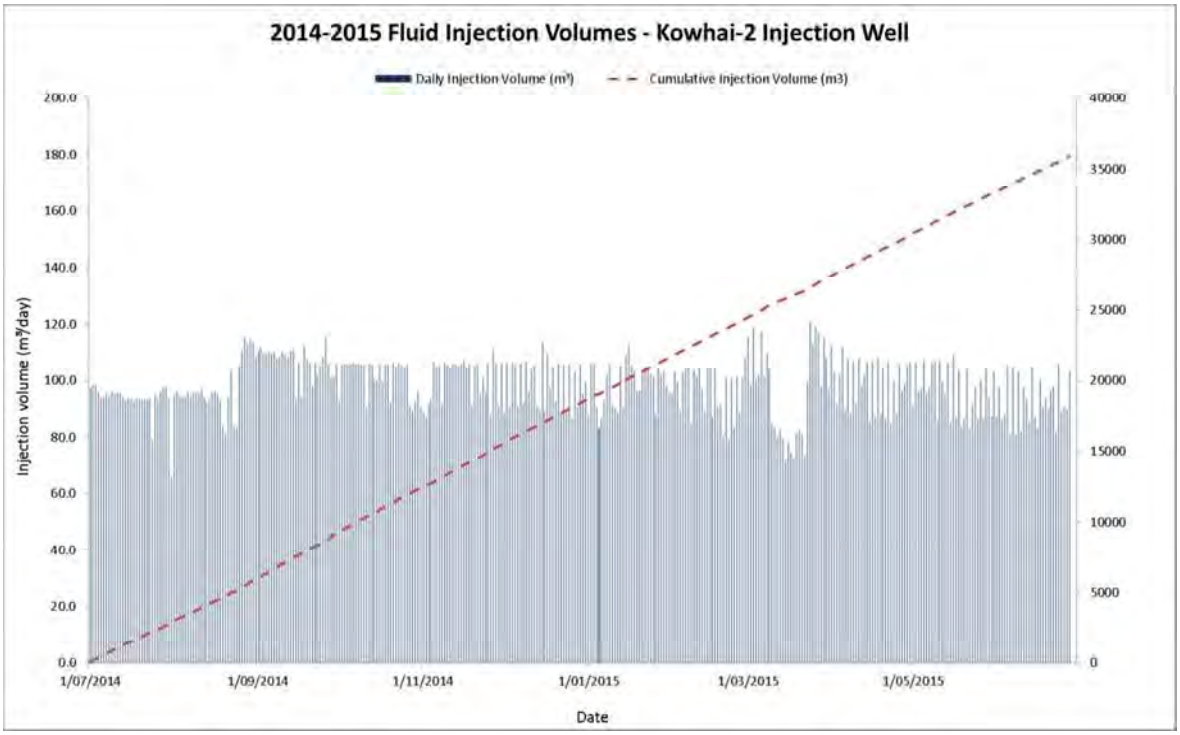

Figure 5 2014-2015 Fluid injection volumes - Kowhai-2 injection well (7466-1)

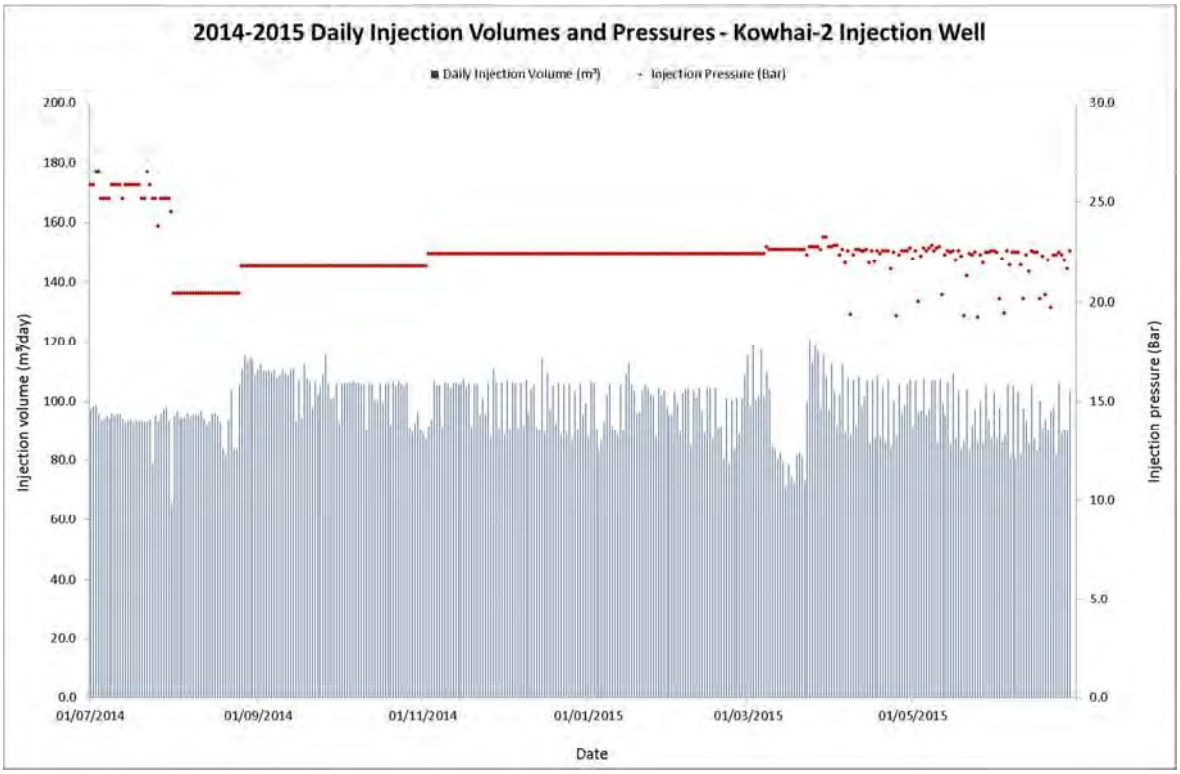

Figure 6 2014-2015 Daily injection volumes and pressures - Kowhai-2 injection well (7466-1)

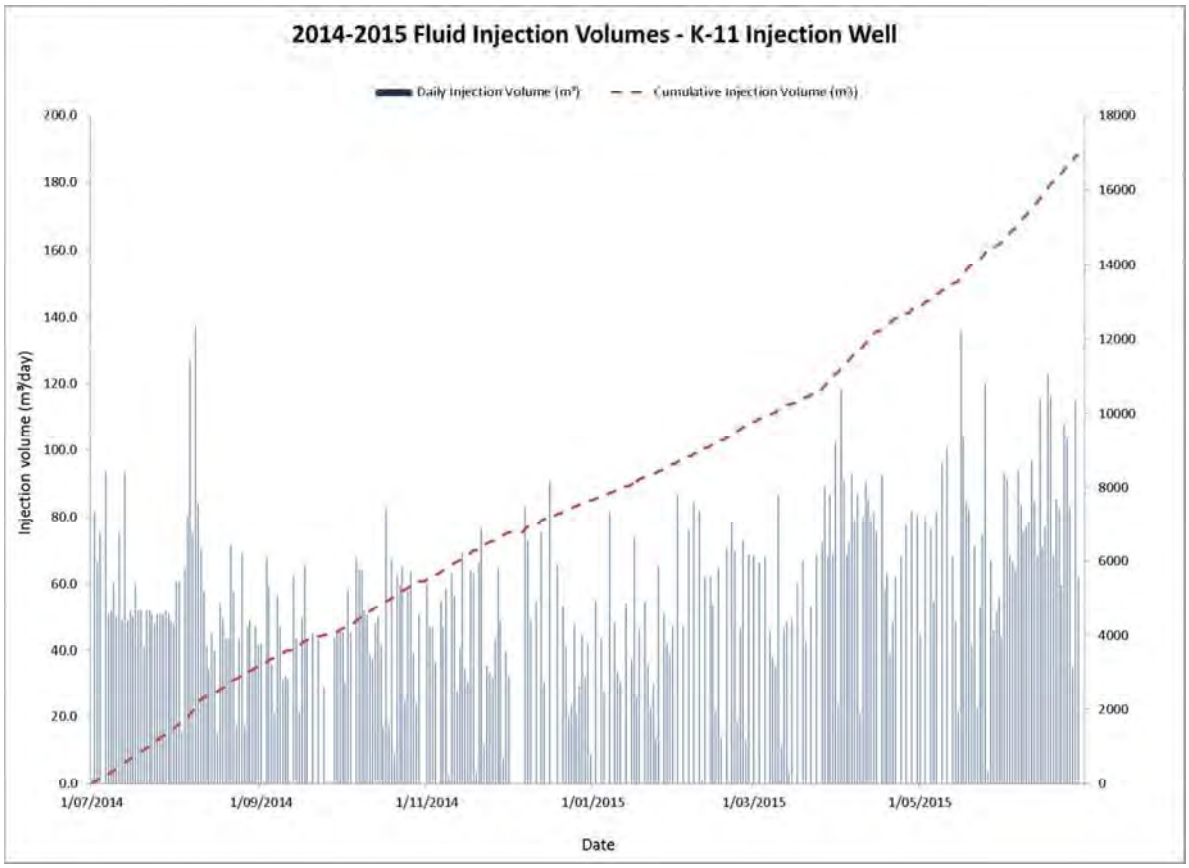

Figure 7 2014-2015 Fluid injection volumes – Kai-11 injection well (7897-1)

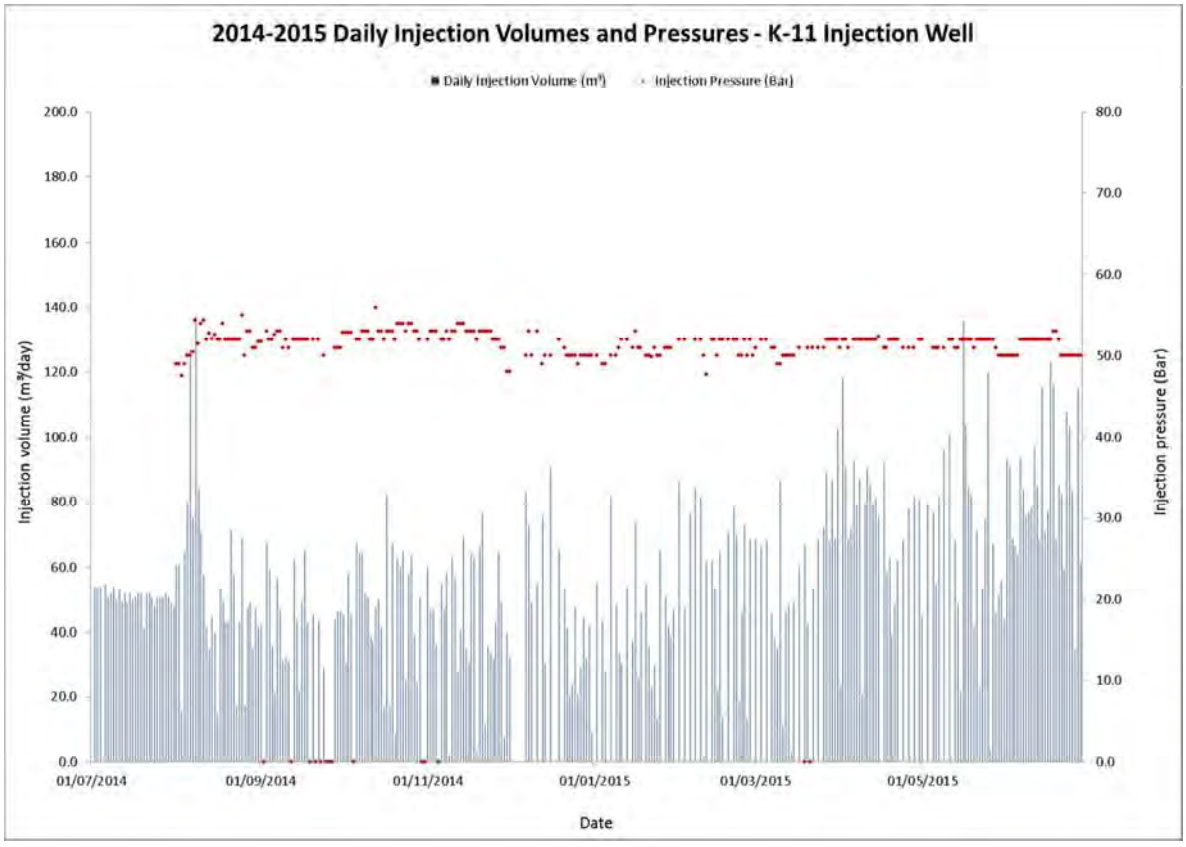

Figure 8 2014-2015 Daily injection volumes and pressures – Kai-11 injection well (7897-1)

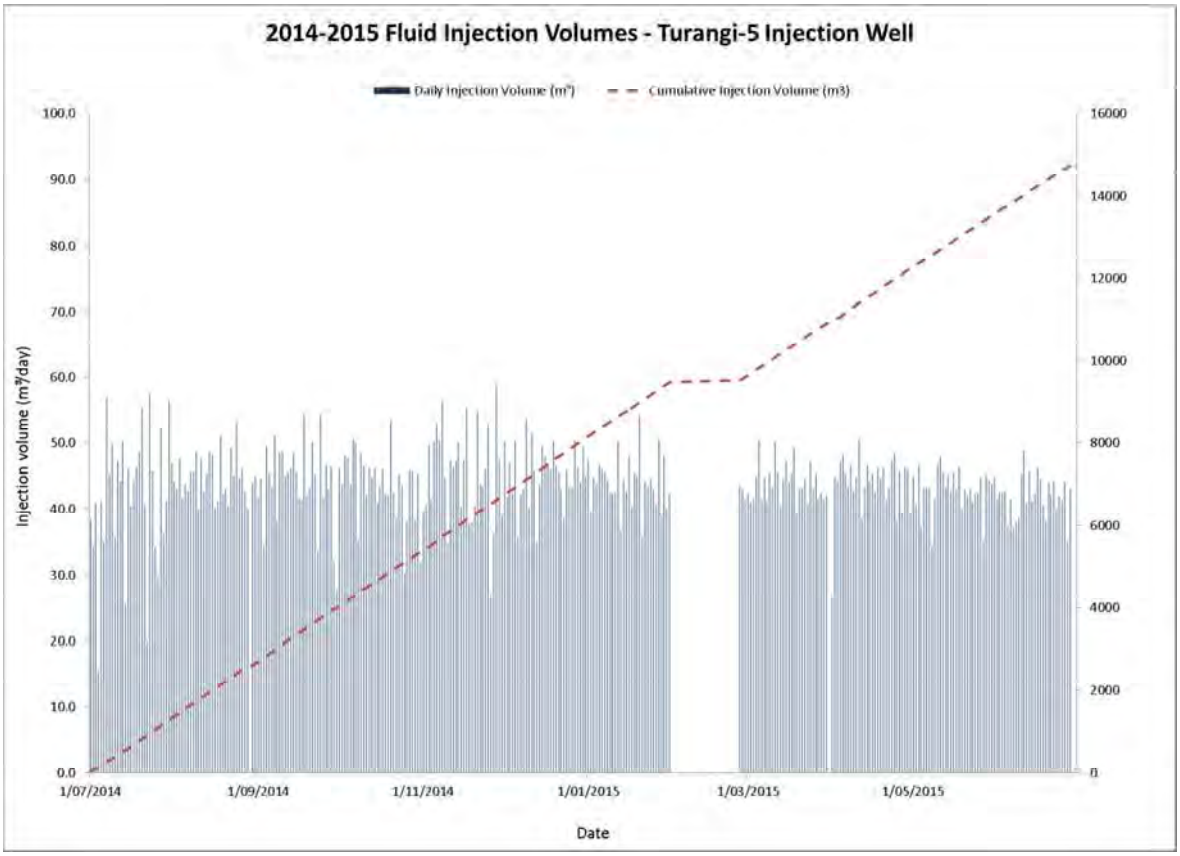

Figure 9 2014-2015 Fluid injection volumes – Turangi-5 injection well (9272-1)

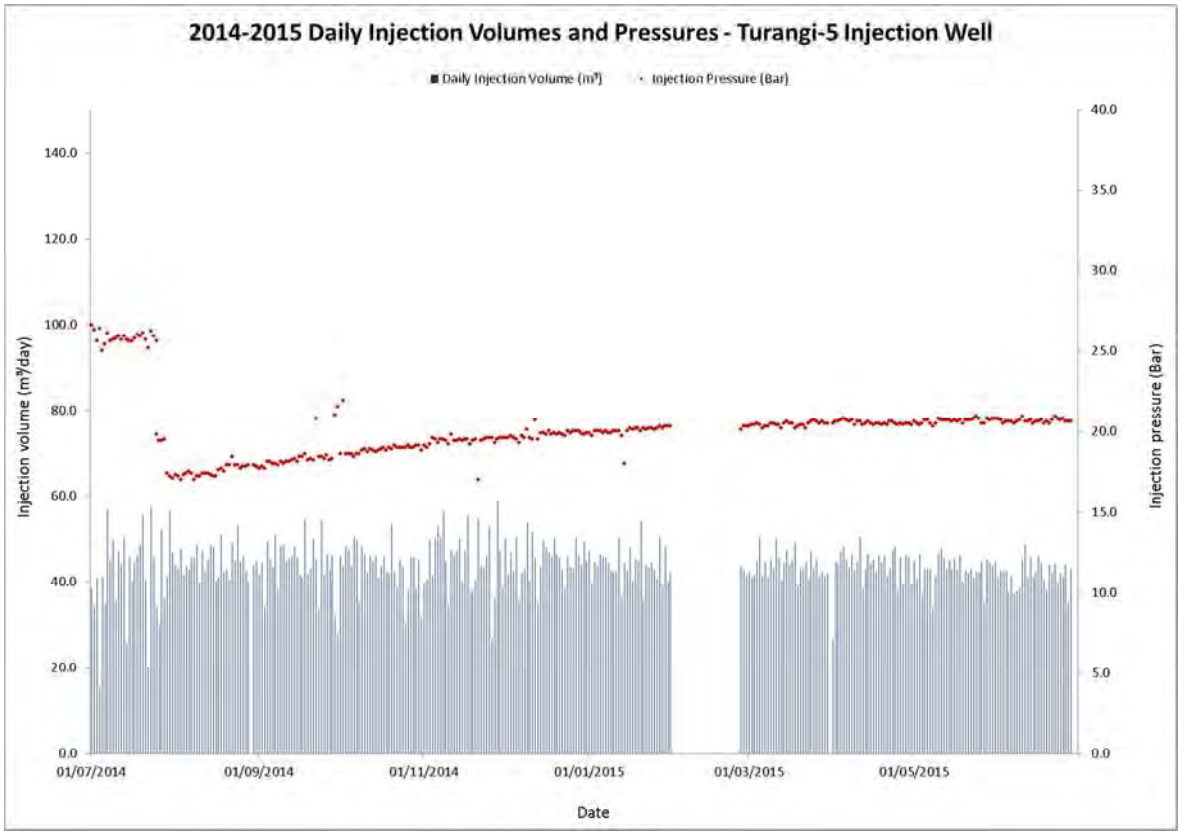

Figure 10 2014-2015 Daily injection volumes and pressures – Turangi-5 injection well (9272-1)

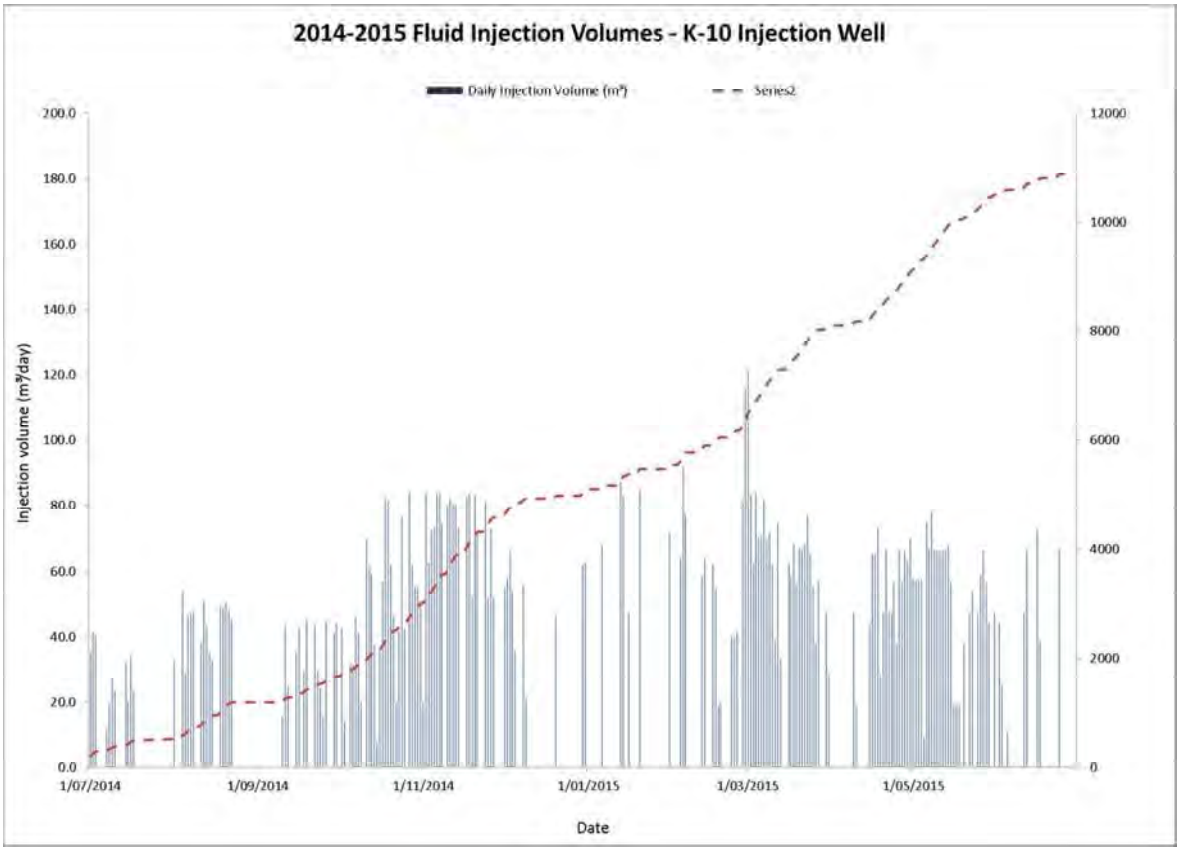

Figure 11 2014-2015 Fluid injection volumes - Kai-10 injection well (9470-1)

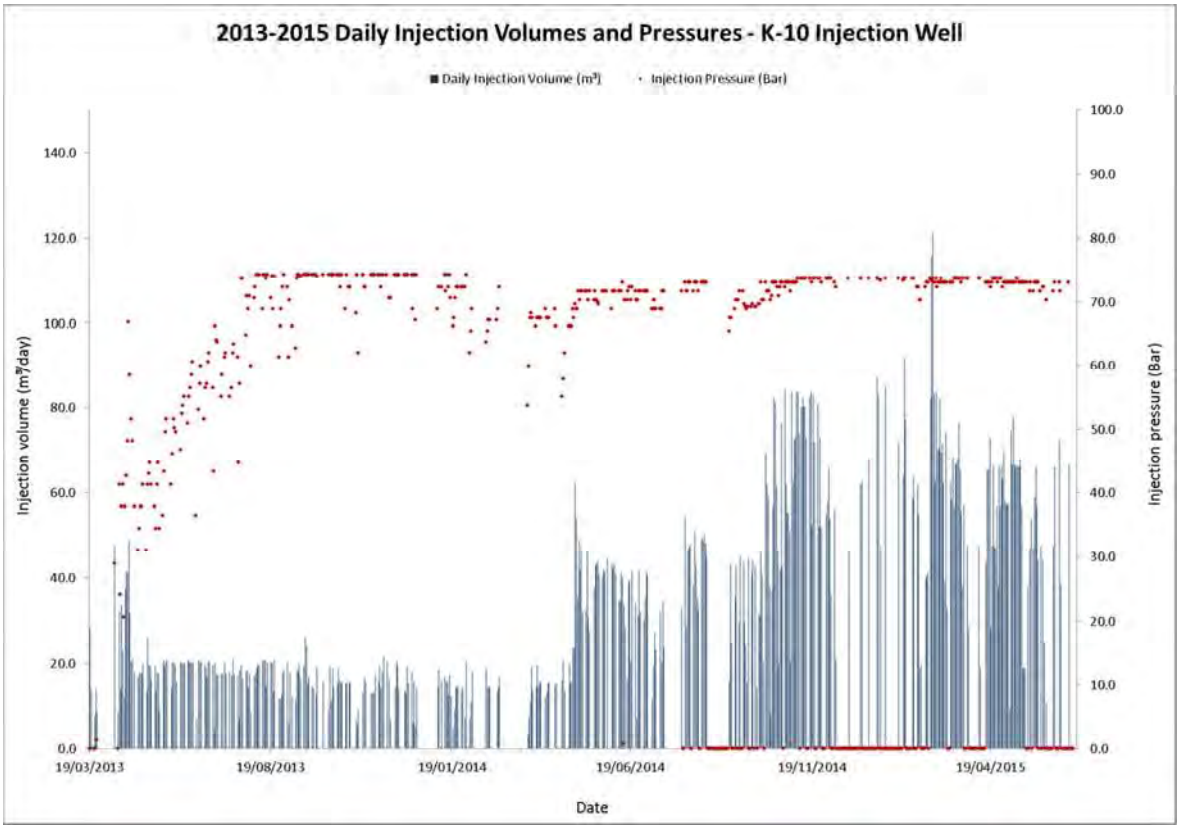

Figure 12 2014-2015 Daily injection volumes and pressures - Kai-10 injection well (9470-1)

The injection volume and pressure data provided by the Company for injection carried out via the KAI-17, Kowhai-2, KAI-11, Turangi-5 and KAI-10 wells between July 2010 and June 2015 is presented graphically in Figure 13, Figure 15, Figure 17, Figure 19 and Figure 21. The total annual injection volumes for the five wells are shown in Figure 14, Figure 16, Figure 18, Figure 20 and Figure 22.

In addition to the injectate sampling carried out by the Council (Section 2.1), the Company also provided results of their own analysis of samples of injectate being discharged via the Kowhai-2, Turangi-5, Kai-10, Kai-11 and Kai-17 wells. The results of the analyses are presented below in Tables 7, 8, 9, 10 and 11. 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.

Table 7 Results of Kowhai-2 injectate analysis (2014-2015)

Parameter	Unit	Number of samples	Maximum value	Minimum value	Average value
pH	pH units	11	7.2	6.3	6.6
Temperature	^{o}C	10	32	20	28
Suspended solids	g/m^3	11	79	6	25
Salinity	g/m^3	11	22	2	20
Chloride	g/m^3	11	13,000	7,800	10,973
Total petroleum hydrocarbons	g/m^3	11	2,900	34	512

Table 8 Results of Turangi-5 injectate analysis (2014-2015)

Parameter	Unit	Number of samples	Maximum value	Minimum value	Average value
pH	pH units	11	6.8	6.5	6.6
Temperature	^{o}C	10	33	20	26
Suspended solids	g/m^3	11	1670	11	221
Salinity	g/m^3	11	22	16	17
Chloride	g/m^3	11	12,300	6,000	8,100
Total petroleum hydrocarbons	g/m^3	11	128,000	83	12,697

Table 9 Results of Kai-11 injectate analysis (2014-2015)

Parameter	Unit	Number of samples	Maximum value	Minimum value	Average value
pH	pH units	11	7.1	4.6	6.5
Temperature	^{o}C	10	23.9	15.7	20.0
Suspended solids	g/m^3	11	196	4	112
Salinity	g/m^3	11	36	31	34
Chloride	g/m^3	11	26,000	17,600	19,945
Total petroleum hydrocarbons	g/m^3	11	76	16	32

Table 10 Results of Kai-10 injectate analysis (2014-2015)

Parameter	Unit	Number of samples	Maximum value	Minimum value	Average value
pH	pH units	7	7.8	5.6	6.8
Temperature	^{0}C	7	31.1	20.0	23.4
Suspended solids	g/m^3	7	2,800	45	887
Salinity	g/m^3	7	133	1.3	32.4
Chloride	g/m^3	7	85,000	800	19,064
Total petroleum hydrocarbons	g/m^3	7	2,200	6	369

Table 11 Results of Kai-17 injectate analysis (2014-2015)

Parameter	Unit	Number of samples	Maximum value	Minimum value	Average value
pH	pH units	2	7.6	7.6	-
Temperature	^{0}C	1	18.5	-	-
Suspended solids	g/m^3	2	< 3	< 3	-
Salinity	g/m^3	2	1	1	--
Chloride	g/m^3	2	163	159	161
Total petroleum hydrocarbons	g/m^3	2	<4	<4	-

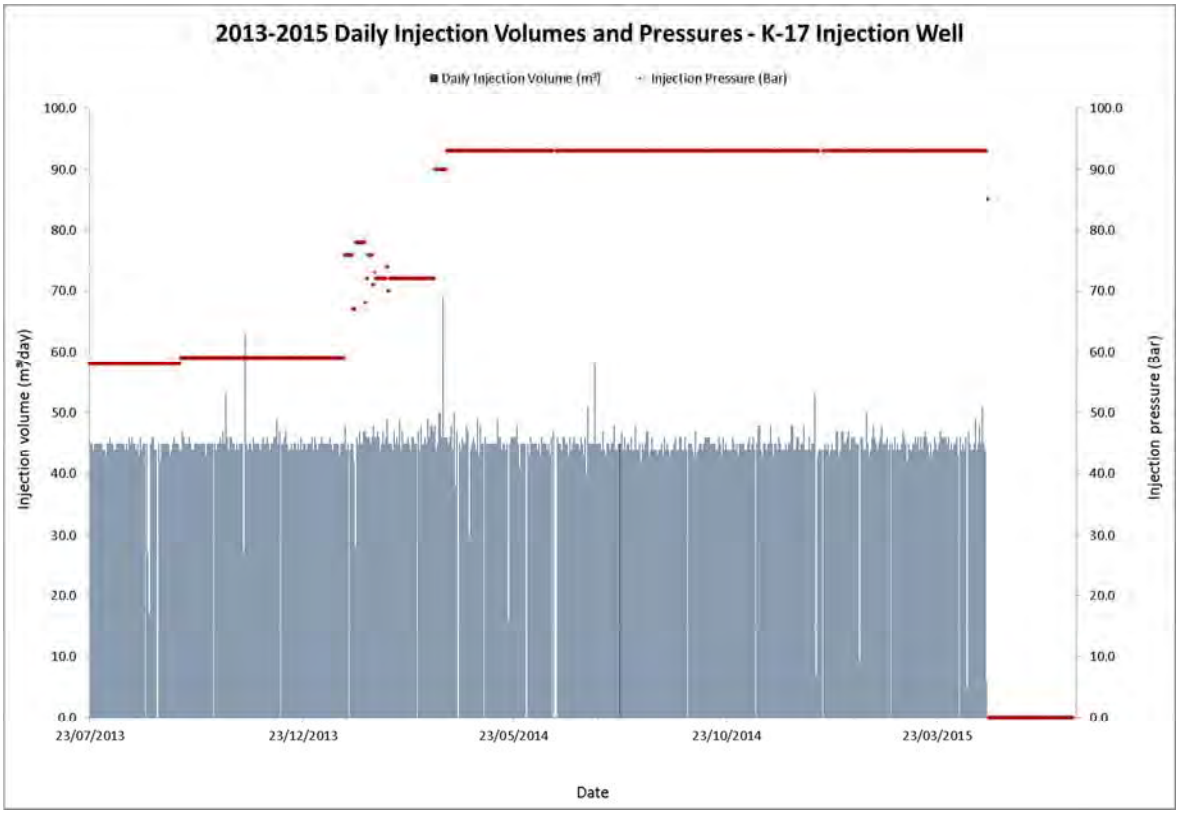

Figure 13 2013-2015 Daily injection volumes - Kai-17 injection well (5312-2)

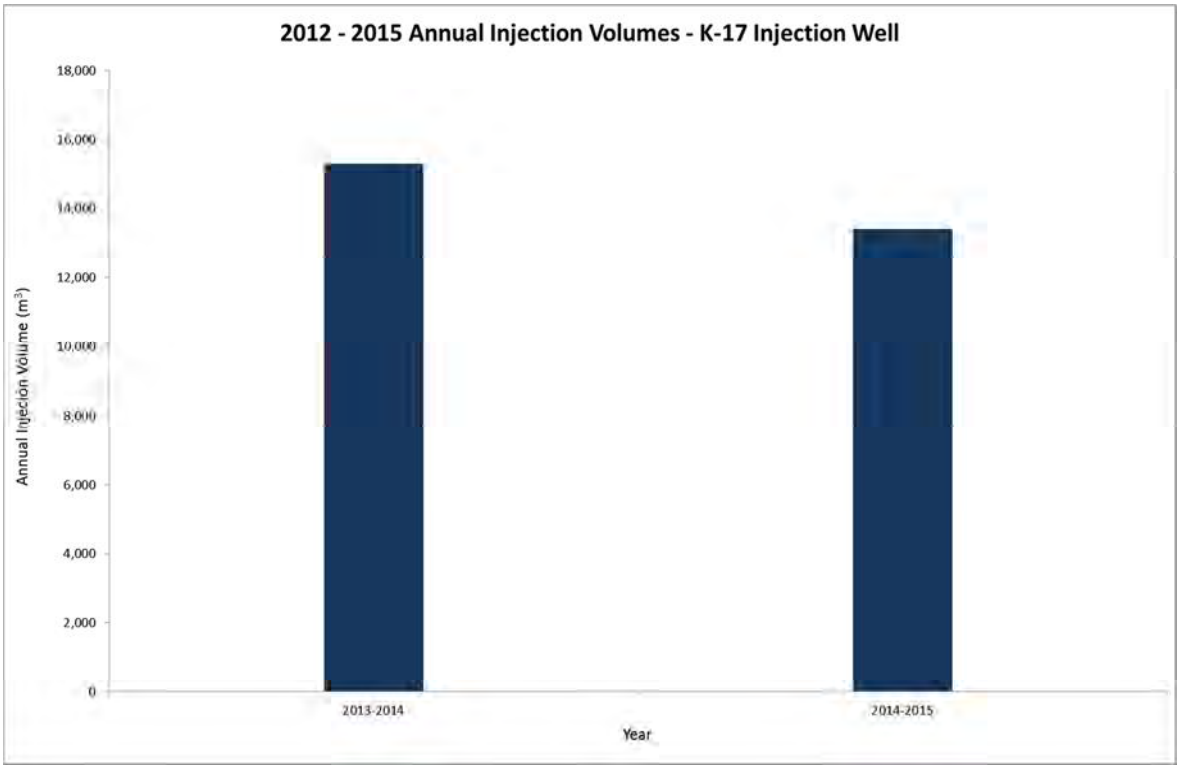

Figure 14 2013-2015 Annual injection volumes - Kai-17 injection well (5312-2)

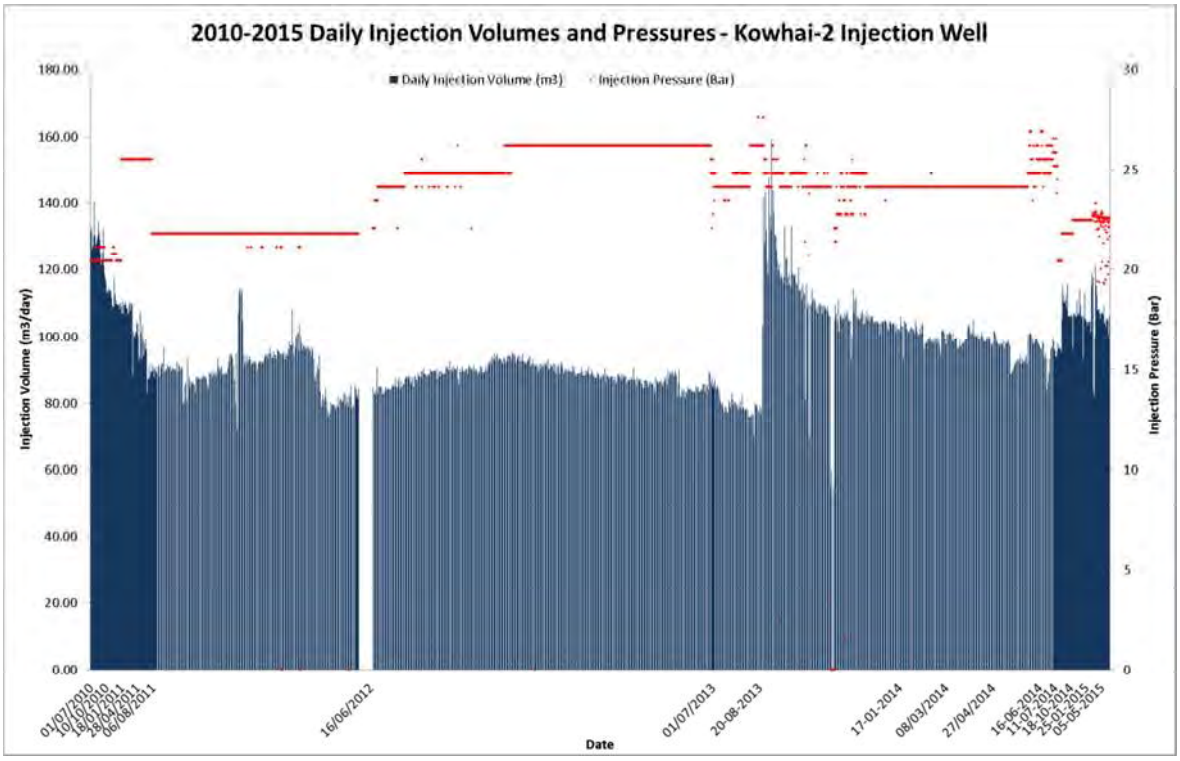

Figure 15 2010-2015 Daily injection volumes – Kowhai-2 injection well (7466-1)

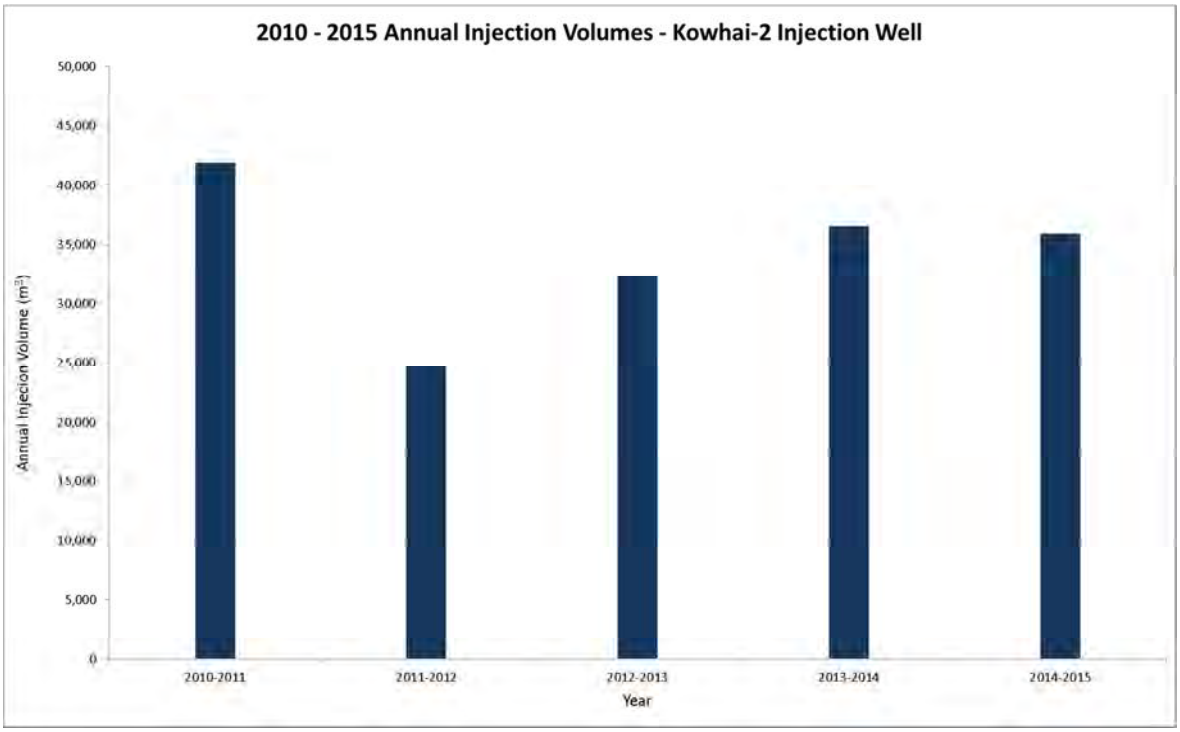

Figure 16 2010-2015 Annual injection volumes – Kowhai-2 injection well (7466-1)

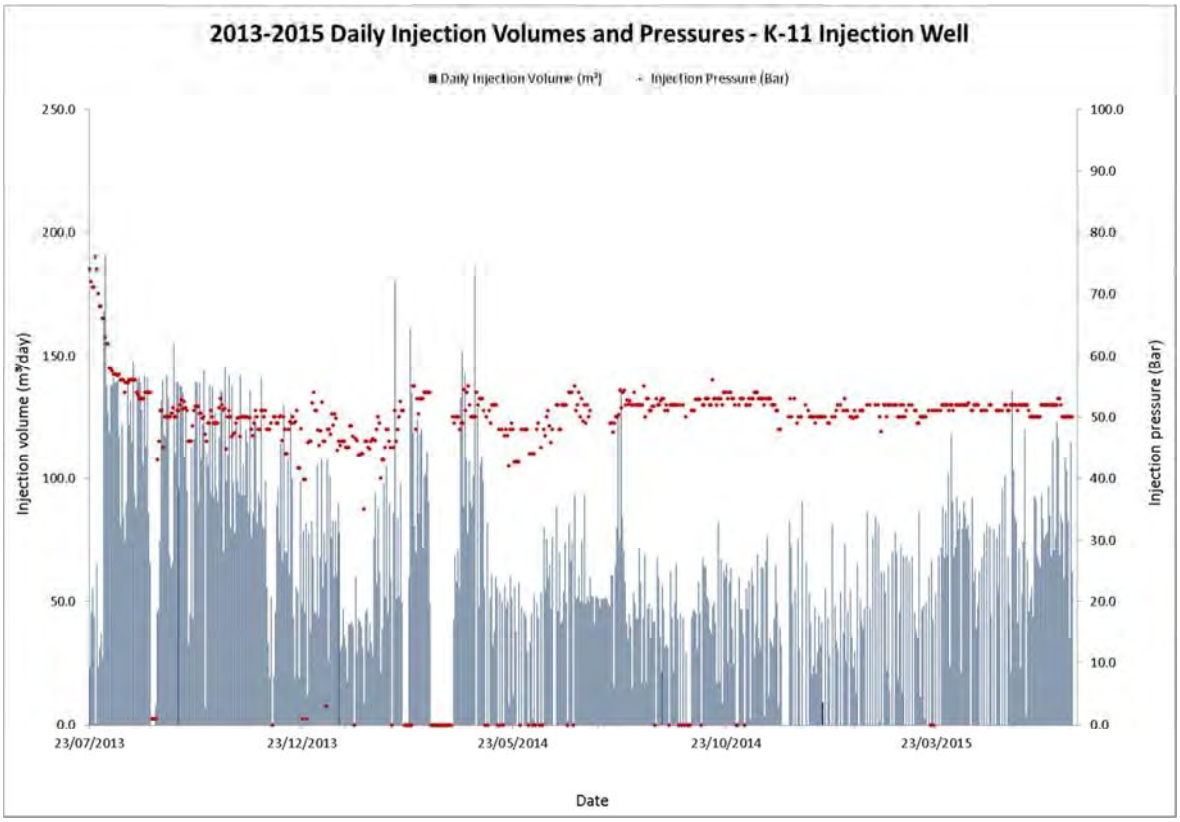

Figure 17 2013-2015 Daily injection volumes and pressures - Kai11 injection well (7897-1)

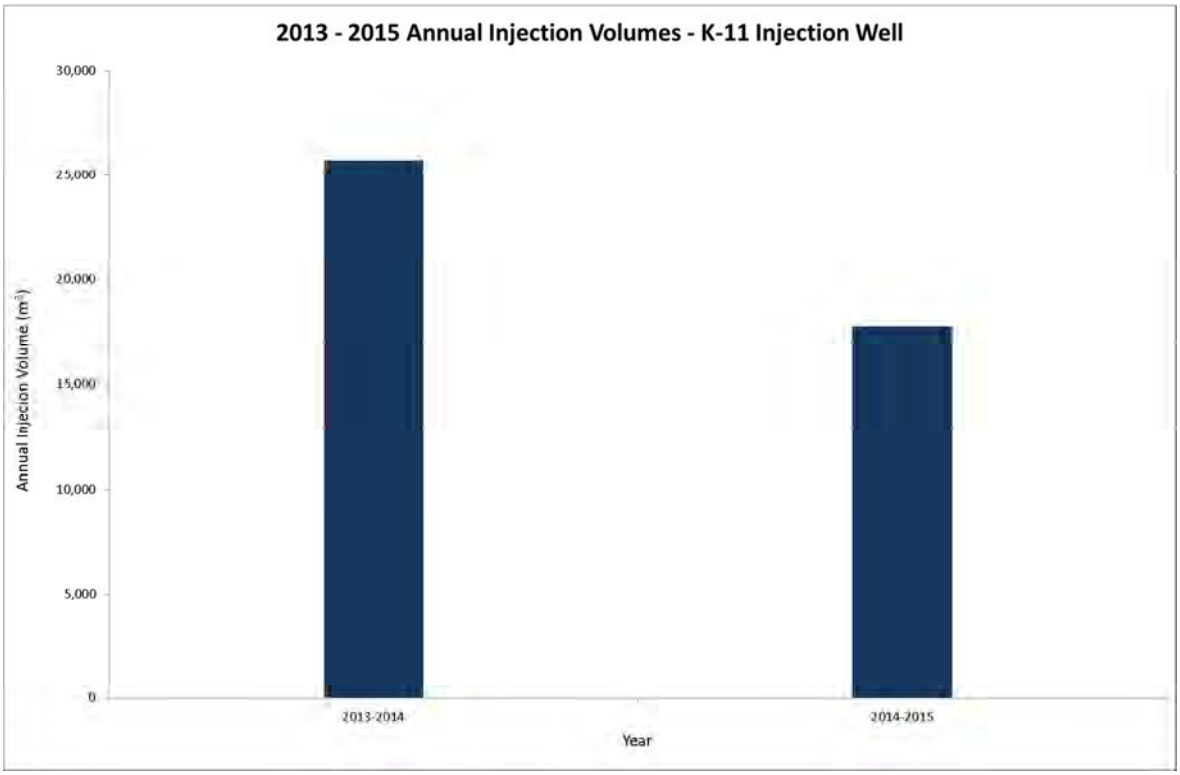

Figure 18 2013-2015 Annual injection volumes - Kai-11 injection well (7897-1)

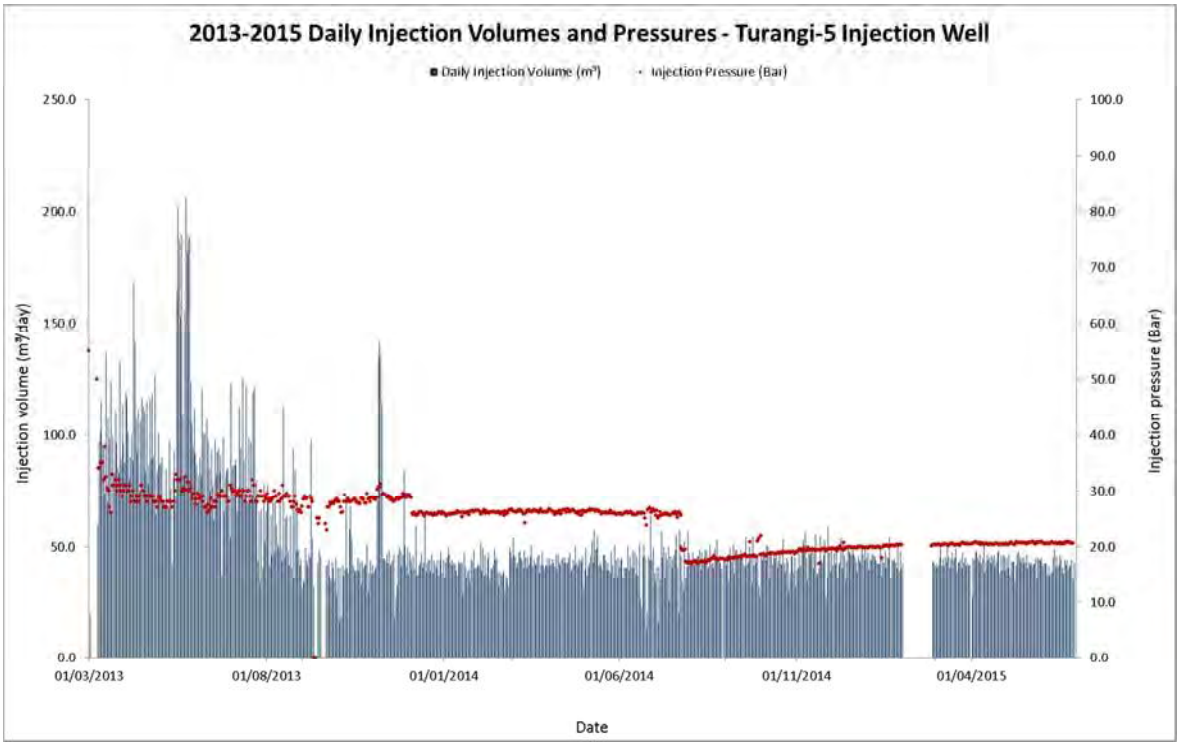

Figure 19 2013-2015 Daily injection volumes and pressures – Turangi-5 injection well (9272-1)

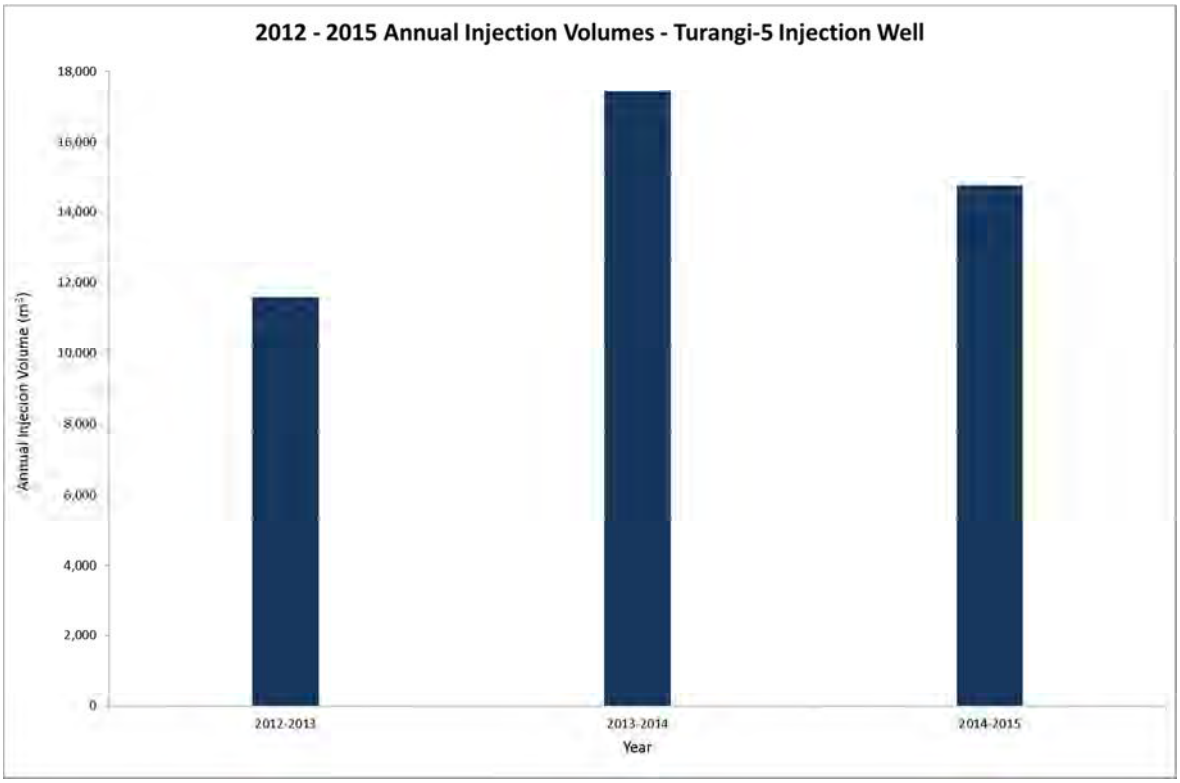

Figure 20 2012-2015 Annual injection volumes – Turangi-5 injection well (9272-1)

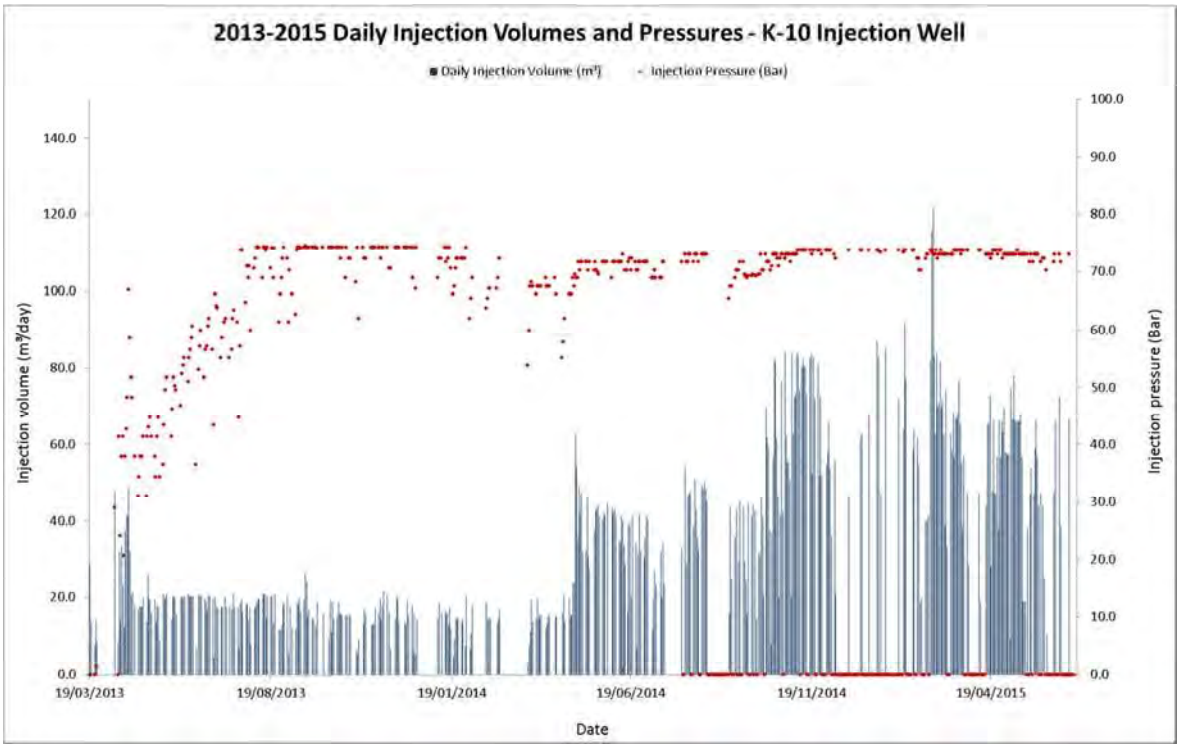

Figure 21 2013-2015 Daily injection volumes and pressures - Kai-10 injection well (9470-1)

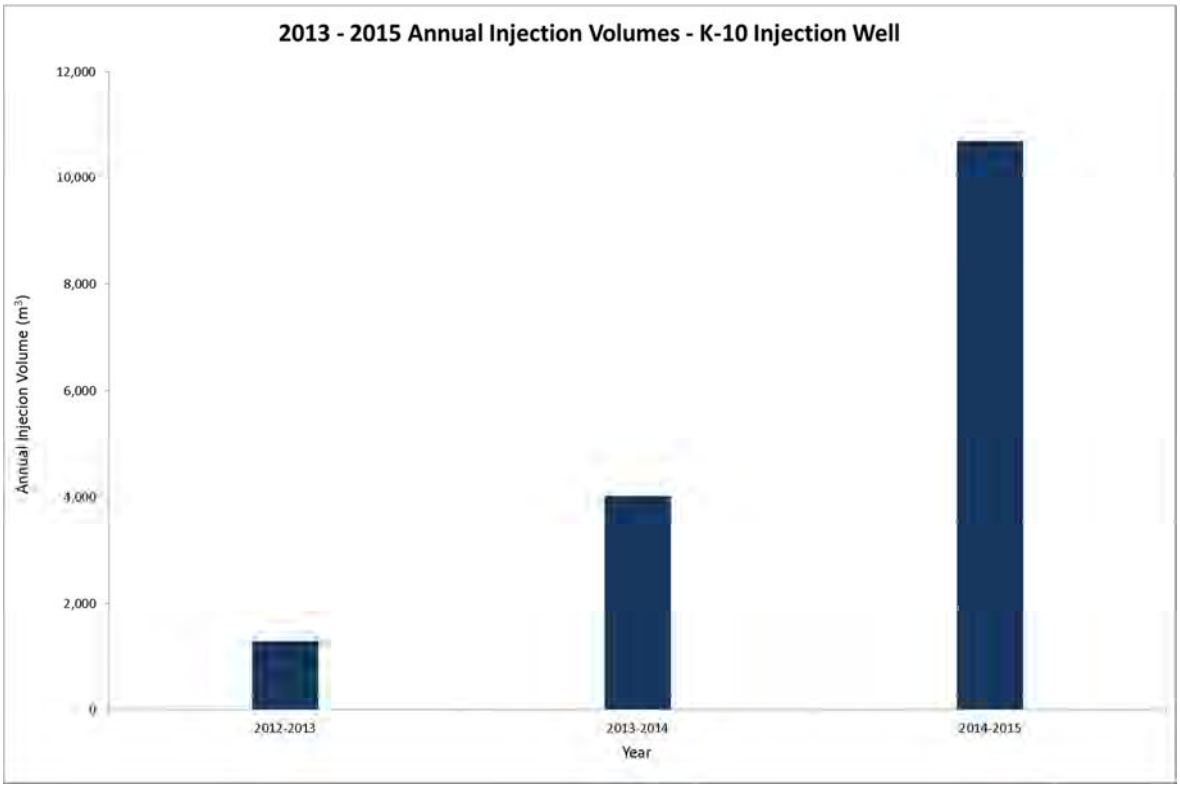

Figure 22 2013-2015 Annual injection volumes - Kai-10 injection well (9470-1)

2.3 Groundwater quality monitoring

Groundwater samples were obtained by the Council from selected sampling locations in the vicinity of the Kowhai-A, Turangi-A, Kaimiro-J, Kaimiro-O, Kaimiro-G wellsites during two sampling rounds between October 2014 and April 2015. Samples were collected following standard groundwater sampling methodologies, and were collected using a combination of low-flow pumping, sampling from springs, sampling from taps and bailing. The samples were analysed in two labs. Groundwater samples from the bore monitoring the Turangi-A wellsite (GND1673) were analysed in the IANZ accredited Hill Laboratories in Hamilton, in accordance with condition 13 in resource consent 9272-1. Groundwater samples taken from sites monitoring the Kowhai-A, Kaimiro-O, Kaimiro-G and Kaimiro-J wellsites were analysed at the Council's IANZ accredited laboratory for a basic range of parameters, sufficient to characterise local groundwater quality, and to assess for potential contamination due to injection activities. A summary of the results of the analyses carried out are outlined in Table 12, with full results shown in Appendix II. Trace levels of hydrocarbons were detected during the October 2014 sampling of GND1385 and the April 2015 sampling of GND2472. The levels of hydrocarbons found at GND2472 are well within the percentage error of the laboratory test for hydrocarbons. The levels of hydrocarbons at GND1385, while slightly higher at 1.8 g/m^3, are still very low and are probably the result of cross-contamination of the sample rather than hydrocarbons migrating to freshwater aquifers. No hydrocarbons were detected at GND1385 during the subsequent April 2015 sampling event. Further sampling will be carried out in the forthcoming monitoring period for comparison with these results.

Table 12 Results of groundwater sampling undertaken by the Council (2014-2015)

		Kowhai-A		Turangi-A		Kaimiro-O		Kaimiro-G				Kaimiro-J	
Well Name		GND2464		GND1673		GND1385		GND0701		GND2353		GND2472	
TRC Sample Number		TRC1411977	TRC151731	TRC1412069	TRC151731	TRC1411410	TRC151532	TRC1411762	TRC151534	TRC1411763	TRC151535	TRC1411912	TRC151508
Sample Date		20/11/2014	30/04/2015	23/10/2014	22/04/2015	08/10/2014	23/04/2015	06/11/2014	23/04/2015	06/11/2014	23/04/2015	13/11/2014	21/04/2015
Sample Time		11:38	10:40	13:41	10:20	8:25	8:40	12:08	09:38	12:45	10:08	10:25	12:14
Analyte	**Units**												
Temperature	**ºC**		14.3	16.1	15.6	23.4	22.2	13.3	14.5	13.2	16.1	14.9	15.3
pH	**pH Units**	6.3	6.6	7.17	7.03	7.3	7.58	6.81	7	6.1	5.9	7.3	7.39
Conductivity (EC)	**mS/m@20ºC**	30.6	26.2	31.7	31.2	143.0	144	23.3	22.98	10.6	10.2	47.85	45.97
Total Alkalinity	**g/m^3 as CaCO3**	30	18	143	146	321	326	-	-	-	-	233	-
Chloride	**g/m^3**	86.8	69.8	14.2	15.5	164	166	19.7	22.3	11.9	11.8	18	18.5
Total Hydrocarbons	**g/m^3**	<0.5	<0.5	<0.7	<0.7	1.8	<0.5	<0.5	<0.5	<0.5	<0.6	<0.5	0.8

2.4 Investigations, interventions, and incidents

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

The Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The Incident Register (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).

In the 2014-2015 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans.

3. Discussion

During the 2014-2015 monitoring period, the Company exercised DWI consents 5312-2, 7466-1, 7897-1, 9272-1 and 9470-1. These consents authorised discharges from injection wells at the Kaimiro-O, Kowhai-A, Kaimiro-J, Turangi-A and Kaimiro-G wellsites, respectively. These consents licensed discharges of various forms of fluid into the Mount Messenger Formation by DWI. During the period under review, produced water, emanating from hydrocarbon producing wells operated by the Company, was the main source of fluid for injection.

During the period under review, the Company exercised Consent 5312-2 between 24 July 2014 and 27 April 2015. The consent permits the injection of groundwater and produced water into the Mount Messenger Formation via the Kaimiro-17 injection well, at the Kaimiro-O wellsite, for improved hydrocarbon recovery purposes. The injection of water into the formation is intended to drive hydrocarbon fluid toward producing wells within the Kaimiro field, improving recovery. During the monitoring period, a total of 13,403 m^3 of fluid was injected, at an average rate of 37 m^3/day. The average injection pressure was 74 bar.

The special conditions of Consent 5312-2 specify a maximum daily injection volume of 1000 m^3/day, a maximum injection rate of 41.6 m^3/hour and a maximum authorised injection pressure of 85 bar. These limits were only brought into place with the updated consent on 6 May 2015. A review of the injection data provided by the Company indicates the maximum daily volume injected was 58 m^3, on 20 July 2014. The maximum injection rate reached during the period under review was 18 m^3/hour. The maximum injection pressure reached during the period under review was 119 bar, which occurred on 31 December 2014. The maximum daily discharge volumes, maximum injection rates and maximum injection pressure were within the limits specified in the consent.

Daily injection volumes and pressures over the 2013-2014 to 2014-2015 monitoring periods show that injection pressures increased at different stages throughout the monitoring period but remained consistent during the last year before injection ceased on 27 April 2015. Annual injection volume data shows that the volumes of fluid injected via the Kai-17 well has decreased over the last two years, from 15,299 m^3 in 2013-2014 to 13,403 m^3 in 2014-2015 monitoring periods.

Consent 7466-1, authorising discharges via the Kowhai-2 injection well, at the Kowhai-A wellsite, was exercised between 1 July 2014 and 30 June 2015. During this period, 35,918 m^3 of fluid was injected, at an average rate of 4 m^3/hour. The average injection pressure was 22 bar.

The special conditions of Consent 7466-1 specify a maximum daily injection volume of 916 m^3/day, and a maximum authorised injection pressure of 92 bar. A review of the injection data provided by the Company indicates the maximum daily volume injected was 121 m^3, on 24 March 2015. The maximum injection pressure reached during the period under review was 27 bar, which occurred on 3 July 2014. Both the maximum daily discharge volumes, and maximum injection pressure, were within the limits specified in the consent.

Daily injection volumes and pressures over the 2010-2011 to 2014-2015 monitoring periods show that injection pressures increased and decreased at different stages throughout the monitoring periods and is currently in a decreasing trend. Annual injection volume data shows that the volumes of fluid injected via the Kowhai-2 well decreased between 2010-2011 and 2011-2012, and then increased between 2011-2012 and 2013-2014. It then decreased slightly between 2013-2014 and 2014-2015.

During the 2014-2015 monitoring period, the Company exercised Consent 7897-1 between 1 July 2014 and 30 June 2015. The consent permits the injection of produced water, well drilling fluids, well workover fluids, hydraulic fracturing fluids and 'off-spec' stormwater from the consent holder's wellsites into the Mount Messenger Formation by deepwell injection via the Kai-11 injection well at the Kaimiro-J wellsite. During this period, a total of 16,960 m^3 of fluid was injected, at an average of 47 m^3/day. The average injection pressure was 49 bar.

The special conditions of Consent 7897-1 specify a maximum daily injection volume of 687 m^3/day, and a maximum authorised injection pressure of 115 bar. A review of the injection data provided by the Company indicates the daily maximum volume injected was 137 m^3, on 8 August 2014. The maximum injection pressure reached during the period under review was 56 bar, which occurred on multiple occasions. Both the maximum daily discharge volumes, and maximum injection pressure, were within the limits specified in the consent.

Daily injection volumes and pressures over the 2013-2014 to 2014-2015 monitoring periods show that injection pressures remained relatively consistent throughout the periods and responds slightly to either an increase or decrease in daily injection volume. Annual injection volume data shows that the volumes of fluid injected via the Kai-11 well has decreased over last two years, from 25,697 m^3 in 2013-2014 to 17,772 m^3 in 2014-2015 monitoring periods.

During the 2014-2015 monitoring period, the Company exercised Consent 9272-1 between 1 July 2014 and 30 June 2015. The consent permits the injection of water, well drilling fluids, well workover fluids and contaminated stormwater into the Mount Messenger Formation by deepwell injection via the Turangi-5 injection well at the Turangi-A wellsite. During this period, a total of 14,746 m^3 of fluid was injected, at an average of 44 m^3/day. The average injection pressure was 20 bar.

The special conditions of Consent 9272-1 specify a maximum daily injection volume of 687 m^3/day, and a maximum authorised injection pressure of 115 bar. A review of the injection data provided by the Company indicates the daily maximum volume injected was 59 m^3, on 28 November 2014. The maximum injection pressure reached during the period under review was 27 bar, which occurred on multiple occasions. Both the maximum daily discharge volumes, and maximum injection pressure, were within the limits specified in the consent.

Daily injection volumes and pressures over the 2013-2014 to 2014-2015 monitoring periods show that injection pressures correspond to the daily injection volumes, with peaks in injection pressure coinciding with daily injection volume peaks. Annual injection volume data shows that the volumes of fluid injected via the Turangi-5 well has increased between the 2012-2013 and 2013-2014 monitoring periods and

decreased between the 2013-2014 and 2014-2015 monitoring periods, with an overall increase between 2013 and 2015.

Consent 9470-1, authorising discharges via the Kai-10 injection well, at the Kaimiro-G wellsite, was exercised between 1 July 2014 and 30 June 2015. During this period, a total of 10,882 m^3 of fluid was injected under the consent, at an average of 53 m3/day. The average injection pressure was 42 bar.

The special conditions of Consent 9470-1 specify a maximum daily injection volume of 206 m^3/day, and a maximum authorised injection pressure of 73 bar. A review of the injection data provided by the Company indicates the maximum daily volume injected was 121 m^3, on 1 March 2015. The maximum injection pressure reached during the period under review was 73 bar. The maximum daily discharge volume and the maximum injection pressure were within the limits specified in the consent.

Daily injection volumes and pressures over the 2013-2014 to 2014-2015 monitoring periods show that injection pressures remained relatively consistent throughout the periods after an initial rise in pressure in 2013, and responds to either an increase or decrease in daily injection volume. Annual injection volume data shows that the volumes of fluid injected via the Kai-10 well has increased over last two three years, from 1,287 m^3 in 2013-2014 to 10,694 m^3.

For each of the wells used for DWI during the monitoring period, the consent holder has provided sufficient information 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 injection wells and the receiving formation remain secure.

During the 2014-2015 monitoring period, consent holder performance was assessed on compliance with consent conditions. There is a particular emphasis on record keeping requirements, data provision, and the analysis data provided. Compliance with the conditions of the DWI consents exercised during the 2014-2015 monitoring period is summarised below in Section 3.1.

The consent holder is required to ensure that the discharge does not result in any contamination of any actual or potentially 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 sampling sites in the vicinity of the Turangi-A, Kowhai-A, Kaimiro-G, Kaimiro-O and Kaimiro-J wellsites were identified and sampled. The results of the analyses carried out do not indicate any form of contamination of local groundwater due to injection activities at either wellsite.

No complaints were received from the public with regard to any of the Company's DWI activities during the period under review.

3.1 Discussion of site performance

A summary of the Company's level of compliance with the special conditions attached to the DWI consents exercised during this period is provided below in Tables 13, 14, 15, 16 and 17.

Table 13 Summary of Company performance with regard to consent 5312-2 (1 July 2014 – 30 June 2015)

Purpose: *To discharge groundwater from the Matemateaonga Formation and produced water into the Mount Messenger Formation for improved hydrocarbon recovery purposes at the Kaimiro-O 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. The injection pressure at the wellhead shall not exceed 85 bar	Review and analysis of injection data.	Yes
4. The rate of injection shall not exceed 41.6 m^3/hour	Review and analysis of injection data.	Yes
5. The volume of fluid injected shall not exceed 1,000 m^3/day.	Review and analysis of injection data.	Yes
6. No injection permitted after 1 June 2027	Assessment of injection records and site inspection notices	Yes
7. The consent holder shall at all times adopt the best practicable option.	Assessment of consent holder records and site inspection notices.	Yes
8. The injection of fluids shall be confined to the Mount Messenger Formation, deeper than 1,000 metres total vertical depth sub-sea.	Review of "Injection Operation Management Plan," well construction log and injection data.	Yes
9. Discharge must not result in fracturing of geological seals confining the injection zone.	Assessment of injection records and results of groundwater sampling and analysis programme.	Yes
10. 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
11. Maintain full records of injection data.	Receipt and assessment of injection data.	Yes

Purpose: *To discharge groundwater from the Matemateaonga Formation and produced water into the Mount Messenger Formation for improved hydrocarbon recovery purposes at the Kaimiro-O wellsite.*		
12. Maintain records and undertake analysis to characterise injectate at intervals not exceeding six months.	Receipt and assessment of injection data.	Yes
13. If not carried out by an IANZ accredited laboratory, analysis shall be carried out in accordance with QA plan which has been certified by the Chief Executive	Inspection of QA plan.	N/A
14. 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
15. Lists the range of parameters required to be tested for in the analysis of groundwater samples.	Implementation of groundwater monitoring programme and assessment of results.	Yes
16. 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
17. The consent holder shall provide to the Council, before 30 June each year, a summary of all data required by conditions 11 and 12, and a report detailing compliance with consent conditions over the previous 1 July to 30 June period. The report shall also provide an assessment of injection well condition, well integrity and an updated injection modelling report.	Receipt of satisfactory report before 30 June each year.	Yes
18. 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

N/A = not applicable

Table 14 Summary of Company performance with regard to consent 7466-1 (1 July 2014 – 30 June 2015)

Purpose: *To discharge produced water from hydrocarbon exploration and production operations by deep well injection at the Kowhai wellsite.*		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Provision of geological and injection well construction information.	Receipt of satisfactory information.	Yes
2. The maximum injection pressure shall not exceed 92 bar (1,352 psi).	Assessment of consent holder records.	Yes
3. The volume of liquid re-injected shall not exceed 916 m^3/day.	Assessment of consent holder records.	Yes
4. The rate of injection shall not exceed 38 m^3/hour.	Assessment of consent holder records.	Yes
5. The injection of fluids shall be confined to the Mount Messenger Formation, deeper than 970 metres true vertical depth below ground level.	Review of "Injection Operation Management Plan," well construction log and injection data.	Yes
6. Recording requirements for discharge volumes, rates, and pressures.	Receipt of well discharge data.	Yes
7. Chemical analysis of discharge.	Receipt of discharge analysis results.	Yes
8. Provision of annual report detailing all records collected in accordance with conditions 4 & 5.	Receipt of satisfactory information.	Yes
9. Notification provision.	Received five working days prior to consent exercise.	Yes
10. Submission of an Injection Operation Management Plan.	Receipt of satisfactory information.	Yes
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of consent compliance and administrative performance in respect of this consent		High High

Table 15 Summary of Company performance with regard to consent 7897-1 (1 July 2014 - 30 June 2015)

Purpose: *To discharge produced water, well drilling fluids, well workover fluids, hydraulic fracturing fluids and 'off-spec' stormwater from the consent holder's wellsites into the Mount Messenger Formation by deep well injection via the KAI-11 waste disposal well.*		
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. The injection pressure at the wellhead shall not exceed 115 bar (1,685 psi).	Review and analysis of injection data.	Yes
4. The rate of injection shall not exceed 687 m^3/day (3 bpm).	Review and analysis of injection data.	Yes
5. The volume of fluid injected shall not exceed 687 m^3/day.	Review and analysis of injection data.	Yes
6. The injection of fluids shall be confined to the Mount Messenger Formation, deeper than 1,320 metres true vertical depth below ground level.	Review of "Injection Operation Management Plan", well construction log and injection data.	Yes
7. The consent holder shall at all times adopt the best practicable option.	Assessment of consent holder records and site inspection notices.	Yes
8. Maintain full records of injection data.	Receipt and assessment of injection data.	Yes
9. Maintain records and undertake analysis to characterise each type of waste arriving on-site for discharge.	Receipt and assessment of injection data.	Yes
10. The data required by conditions 9 & 10 above, for each calendar month, is required to be submitted by the 15th day of the following month.	Receipt of satisfactory data by the date specified.	Yes
11. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least five days prior to the first exercise of this consent.	Notification received by Council.	Yes

Purpose: *To discharge produced water, well drilling fluids, well workover fluids, hydraulic fracturing fluids and 'off-spec' stormwater from the consent holder's wellsites into the Mount Messenger Formation by deep well injection via the KAI-11 waste disposal well.*		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
12. 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
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. Lists the range of parameters required to be tested for in the analysis of groundwater samples.	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, during the month of May 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. The report shall also provide an assessment of injection well condition, well integrity and an updated injection modelling report.	Receipt of satisfactory report during May each year.	Yes
17. Lapse clause.	Receive notice of exercise of consent.	Yes
18. Consent review provision.	N/A	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of consent compliance and administrative performance in respect of this consent		High High

Table 16 Summary of Company performance with regard to consent 9272-1 (1 July 2014 – 30 June 2015)

Purpose: *To discharge produced water, well drilling fluids, well workover fluids and contaminated stormwater into the Mount Messenger Formation by deep well injection via the Turangi-A waste disposal well.*		
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. The injection pressure at the wellhead shall not exceed 115 bar (1,685 psi).	Review and analysis of injection data.	Yes
4. The rate of injection shall not exceed 687 m^3/day (3 bpm).	Review and analysis of injection data.	Yes
5. The volume of fluid injected shall not exceed 687 m^3/day.	Review and analysis of injection data.	Yes
6. The injection of fluids shall be confined to the Mount Messenger Formation, deeper than 1,350 metres true vertical depth below ground level.	Review of "Injection Operation Management Plan," well construction log and injection data.	Yes
7. The consent holder shall at all times adopt the best practicable option.	Assessment of consent holder records and site inspection notices.	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. 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

Purpose: *To discharge produced water, well drilling fluids, well workover fluids and contaminated stormwater into the Mount Messenger Formation by deep well injection via the Turangi-A waste disposal well.*		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
12. 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
13. Lists the range of parameters required to be tested for in the analysis of groundwater samples.	Implementation of groundwater monitoring programme and assessment of results.	Yes
14. 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
15. The consent holder shall provide to the Council, during the month of May 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. The report shall also provide an assessment of injection well condition, well integrity and an updated injection modelling report.	Receipt of satisfactory report during May each year.	Yes
16. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least five days prior to the first exercise of this consent.	Notification received by Council.	Yes
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 environmental performance in respect of this consent		High

Table 17 Summary of Company performance with regard to consent 9470-1 (1 July 2014 – 30 June 2015)

Purpose: *To discharge produced water, well drilling fluids, well workover fluids into the Mount Messenger Formation by deep well injection via the Kaimiro-G 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

Purpose: *To discharge produced water, well drilling fluids, well workover fluids into the Mount Messenger Formation by deep well injection via the Kaimiro-G wellsite.*		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
2. Injection well, geological and operational data submission requirements. This information can be included in the "Injection Operation Management Plan."	Receipt of satisfactory information.	Yes
3. The injection pressure at the wellhead shall not exceed 1,077 psi (73 bars).	Review and analysis of injection data.	Yes
4. The rate of injection shall not exceed 8.6 m^3/hr (0.9 bpm).	Review and analysis of injection data.	No*
5. The volume of fluid injected shall not exceed 206 m^3/day.	Review and analysis of injection data.	Yes
6. The injection of fluids shall be confined to the Mount Messenger Formation, deeper than - 995 metres true vertical depth Sub-sea.	Review of "Injection Operation Management Plan," well construction log and injection data.	Yes
7. The consent holder shall at all times adopt the best practicable option.	Assessment of consent holder records and site inspection notices.	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. The data required by conditions 9 & 10 above, for each calendar month, is required to be submitted by the 15th day of the following month.	Receipt of satisfactory data by the date specified.	Yes
12. 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
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

Purpose: *To discharge produced water, well drilling fluids, well workover fluids into the Mount Messenger Formation by deep well injection via the Kaimiro-G wellsite.*		
Condition requirement	Means of monitoring during period under review	Compliance achieved?
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 with consent conditions over the previous 1 July to 30 June period.	Receipt of satisfactory report by 31 August each year.	Yes
17. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least five days prior to the first exercise of this consent.	Notification received by Council.	Yes
18. No injection permitted after 1 June 2027.	Assessment of injection records and site inspection notices.	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

* Injection rate was 9.06 m^3/hr on 8 October 2014. The likely effects on the receiving formation is negligible.

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

3.2 Recommendations from the 2013-2014 Annual Report

In the 2013-2014 Annual Report, it was recommended:

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.
   The recommendation was implemented in the 2014-2015 period.

2. THAT the Company ensures all injectate sampling required by the conditions of their consents is undertaken at the required intervals and that samples are analysed for the full range of parameters stipulated in the conditions. Results should also be submitted to the Council at the frequencies specified in the respective consents.
   The recommendation was implemented in the 2014-2015 period.

3. THAT sampling of shallow groundwater in the vicinity of all active injection wells be carried out on a biannual basis.
   The recommendation was implemented in the 2014-2015 period

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.
   Consent 5312-1 was updated to 5312-2 on 6 May 2015.

3.3 Alterations to monitoring programmes for 2015-2016

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 in the 2014-2015 period be continued in the 2015-2016 period.

3.4 Exercise of optional review of consent

An optional review of consent 5312-2 is next provided for in June 2020. An optional review of consents 7390-1 and 7466-1 is next provided for in June 2021. Optional review of consents 7897-1, 9206-1, 9272-1, 9470-1 and 9476-1 are provided for on an annual basis, with the next optional review date being June 2016.

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

4. Recommendations

1. THAT 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.

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.
bpd	Barrels per day.
bpm	Barrels per minute.
BPO	Best practicable option.
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.
IR	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.
KPS	Kaimiro production station
L/s	Litres per second.
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.
mbgl	Metres below ground level.
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. Cheal power fluid is a heated combination of fresh and produced water.
ppt	Parts per thousand.
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).
TVDSS	True vertical depth sub sea. Given as metres below sea level.
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

DWI consents exercised in the 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:	Greymouth Petroleum Acquisition Company Limited PO Box 3394 New Plymouth 4341
Decision Date:	24 July 2014
Commencement Date:	24 July 2014

Conditions of Consent

Consent Granted:	To discharge groundwater from the Matemateaonga Formation into the Mount Messenger Formation for enhanced hydrocarbon recovery purposes at the Kaimiro-O wellsite
Expiry Date:	01 June 2032
Review Date(s):	June 2020, June 2026
Site Location:	Kaimiro-O wellsite, 455 Alfred Road, Egmont Village (Property owner: St Leger Manning Reeves & Robert Baker)
Legal Description:	Pt Sec 115-116 Hua & Waiwhakaiho Hun (Discharge source & site)
Grid Reference (NZTM)	1698671E-5663161N
Catchment:	Waiwhakaiho

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 July 2015, 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 July 2015, 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; and
   (e) 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 2027.

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 1,000 metres total vertical depth sub-sea.

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. 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.

9. The consent holder shall have the injection fluid analysed for the following parameters, at intervals not exceeding six months:

   (i) pH;
   (ii) conductivity;
   (iii) chloride concentration;
   (iv) total dissolved solids; and
   (v) suspended solids concentration.

10. If the analysis required by condition 9 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 9. 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.

11. 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 2015, 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.

12. All groundwater samples taken for monitoring purposes shall be taken in accordance with recognised field procedures and analysed for:

    (a) pH;
    (b) conductivity
    (c) anion and cation profile
    (d) total petroleum hydrocarbons; and
    (e) BTEX.

    Note: The samples required, under conditions 12 and 13 could be taken and analysed by the Taranaki Regional Council or other contracted party on behalf of the consent holder.

13. 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 11.

14. The consent holder shall provide to the Chief Executive, Taranaki Regional Council, before 30 June each year, all data required by conditions 8 and 9, 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; and
    c) an assessment of the on-going integrity and isolation of the receiving formation.

15. 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 2020 and/or June 2026 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 24 July 2014

For and on behalf of
Taranaki Regional Council

_____

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:	Greymouth Petroleum Acquisition Company Limited PO Box 3394 New Plymouth 4341
Decision Date (Change):	6 May 2015
Commencement Date (Change):	6 May 2015 (Granted Date: 24 July 2014)

Conditions of Consent

Consent Granted:	To discharge groundwater from the Matemateaonga Formation and produced water into the Mount Messenger Formation for improved hydrocarbon recovery purposes at the Kaimiro-O wellsite
Expiry Date:	1 June 2032
Review Date(s):	June 2020, June 2026
Site Location:	Kaimiro-O wellsite, 455 Alfred Road, Egmont Village (Property owner: Cradles Trust Nominees Limited)
Legal Description:	Pt Secs 115 & 116 Hua & Waiwhakaiho Hun (Discharge source & site)
Grid Reference (NZTM)	1698671E-5663161N
Catchment:	Waiwhakaiho

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 July 2015, 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 July 2015, 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; and
   (e) 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. The injection pressure at the wellhead shall not exceed a maximum injection pressure of 85 bar.

4. The rate of injection shall not exceed 41.6 cubic metres per hour.

5. The volume of fluid injected shall not exceed 1000 cubic metres per day.

6. There shall be no injection of any fluids after 1 June 2027.

7. 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.

8. The injected fluids shall be confined to the Mount Messenger Formation, deeper than 1,000 metres total vertical depth sub-sea.

9. 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.

10. 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.

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. The consent holder shall have the injection fluid analysed for the following parameters, at intervals not exceeding six months:

    i. pH;
    ii. conductivity;
    iii. chloride concentration;
    iv. total dissolved solids; and
    v. suspended solids concentration.

13. If the analysis required by condition 12 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 12. 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.

14. 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 10 (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 2015, 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.

15. All groundwater samples taken for monitoring purposes shall be taken in accordance with recognised field procedures and analysed for:

    (a) pH;
    (b) conductivity
    (c) anion and cation profile
    (d) total petroleum hydrocarbons; and
    (e) BTEX.

    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.*

16. 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 14.*

17. The consent holder shall provide to the Chief Executive, Taranaki Regional Council, before 30 June each year, all data required by conditions 11 and 12, 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; and
    c) an assessment of the on-going integrity and isolation of the receiving formation.

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 2020 and/or June 2026 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 timeThe 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.

Signed at Stratford on 6 May 2015

For and on behalf of
Taranaki Regional Council

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:	Petrochem Limited P O Box 3394 NEW PLYMOUTH 4341
Decision Date (Change):	3 February 2014
Commencement Date (Change):	3 February 2014 (Granted: 1 May 2009)

Conditions of Consent

Consent Granted:	To discharge produced water from hydrocarbon exploration and production operations by deep well injection at the Kowhai wellsite (via Kowhai-2 well)
Expiry Date:	1 June 2027
Review Date(s):	June 2015, June 2021 and within one month following the receipt of information required under special condition 8
Site Location:	Kowhai-A wellsite, Ngatimaru Road, Tikorangi (Property owners: RN & BJ Jupp)
Legal Description:	Pt Sec 44 Tikorangi Dist Blks IX & X Waitara SD (Discharge source & site)
Grid Reference (NZTM)	1710931E-5676289N
Catchment:	Waiau

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

General conditions

a) On receipt of a re.quirement 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. Upon completion of well the following information shall be provided to the Chief Executive of the Taranaki Regional Council:

   a) Subsurface construction details, including design of the exterior surface casing, the intermediate protective casing, and the innermost casing, tubing, and packer;
   b) Borelog of the well from 0.0 mbgl to 500 metres below ground level;
   c) Annular pressure; and
   d) Cementing details

2. The injection pressure at the wellhead shall not exceed a maximum injection pressure of 1,352 pounds per square inch (92 Bar).

3. The volume of liquid re-injected shall not exceed 916 cubic metres per day.

4. The rate of injection shall not exceed 4 barrels per minute (38 cubic metres per hour).

5. The fluids shall be injected into the Mount Messenger Formation at a minimum depth of 970 metres below ground level (true vertical depth).

6. The consent holder shall keep daily records of:

   a) Maximum and average injection pressure;
   b) Maximum and average rate of injection; and
   c) Volume of fluid injected.

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

   a) pH;
   b) Suspended Solids concentration;
   c) Temperature;
   d) Salinity;
   e) Chloride concentration; and
   f) Total hydrocarbon concentration.

These constituents shall be measured at time intervals sufficiently frequent to yield data representative of the injected fluid in the opinion of the Chief Executive of the Taranaki Regional Council.

8. The consent holder shall report to the Taranaki Regional Council's Chief Executive, during the month of May of every year, a monthly summary of all records collected in accordance with conditions 6 and 7. The report shall cover details on the major changes in characteristics or sources of injected fluid.

9. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least 5 working days prior to the exercise of this consent. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz. Notification by fax or post is acceptable only if the consent holder does not have access to email.

10. Before the well is used for deepwell injection the consent holder shall submit an "Injection Operation Management Plan" which describes the reinjection process and identifies the conditions that would trigger concerns about the integrity of the well, or the injection zone, and the action to be taken by the consent holder if trigger conditions are reached.

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

12. This consent shall lapse on the 30th June 2014, 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.

13. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent, by giving notice of review during the month following receipt of information required under special condition 8 above, and the month of June 2015 and/or June 2021, 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 3 February 2014

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:	Greymouth Petroleum Limited P O Box 3394 NEW PLYMOUTH 4341
Decision Date (Change):	19 July 2013
Commencement Date (Change):	19 July 2013 (Granted: 12 September 2011)

Conditions of Consent

Consent Granted:	To discharge the following from hydrocarbon exploration operations at the Kaimiro-J wellsite by deepwell injection into the Mount Messenger formation: • produced water; • well drilling fluids; • well workovers fluids; • hydraulic fracturing fluids; and • 'off-spec' stormwater from the consent holder's wellsites
Expiry Date:	1 June 2026
Review Date(s):	June annually
Site Location:	Kaimiro-J wellsite, 1140 Junction Road, Inglewood (Property owner: BJ & SM Duynhoven)
Legal Description:	Lot 1 DP 19651 (Discharge source & site)
Grid Reference (NZTM)	1699274E-5664725N
Catchment:	Waiongana
Tributary:	Mangaoraka

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

General condition

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

Special conditions

1. Before this consent is exercised the consent holder shall submit an "Injection Operation Management Plan" which describes the reinjection process and identifies the conditions that would trigger concerns about the integrity of the well, or the injection zone, and the action to be taken by the consent holder if trigger conditions are reached.

2. Before this consent is exercised the consent holder shall provide to the Chief Executive of the Taranaki Regional Council:

   (a) Subsurface construction details, including design of the exterior surface casing, the intermediate protective casing, and the innermost casing, tubing, and packer;
   (b) A log of the well from 0.0 metres below ground level to 1,000 metres below ground level; clearly showing the freshwater/brine water interface zone;
   (c) Annular pressure; pressure testing which demonstrates well integrity [Mechanical Integrity Test];
   (d) Receiving Formation fracture pressure and geological seal fracture pressure;
   (e) A chemical analysis of the formation-water;
   (f) Cementing details.

3. The injection pressure at the wellhead shall not exceed a maximum injection pressure of 1669 psi (115 bar).

4. The rate of injection shall not exceed 29 cubic metres per hour (3 bpm).

5. The volume of fluid injected shall not exceed 687 cubic metres per day (4,320 bpd).

6. The injection of fluids shall be confined to the Mt. Messenger Formation, deeper than 1,320 metres true vertical depth.

7. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or likely adverse effect on the environment; in particular, ensuring that the injection material is contained within the injection zone.

8. The consent holder shall keep daily records of the:

   (a) maximum injection pressure;
   (b) maximum and average rate of injection; and
   (c) volume of fluid injected;

   during exercise of this consent.

9. For each waste stream arriving on site for discharge, the consent holder shall record the following information:

   (a) type of fluid;
   (b) source of fluid (site name and location);
   (c) an analysis of the fluid for:
      (i) pH;
      (ii) suspended solids concentration;
      (iii) temperature;
      (iv) salinity;
      (v) chloride concentration; and
      (vi) total hydrocarbon concentration.

   The analysis required by condition 9 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.

10. The information required by conditions 8 and 9 above, for each calendar month, shall be provided to the Chief Executive, Taranaki Regional Council before the 15th day of the following month.

11. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least 5 working days prior to the first exercise of this consent. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz.

12. The consent holder shall ensure that the exercise of this consent does not result in contaminants reaching any useable fresh water (groundwater or surface water). Usable fresh groundwater is defined as any groundwater having a Total Dissolved Solids concentration of less than 1,000 mg/l.

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 to assess compliance with condition 12 (the 'Monitoring Programme'). The Monitoring Programme shall be certified by the Chief Executive, Taranaki Regional Council ('the Chief Executive'), before 30 June 2013, and shall include:

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

14. All water 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 Council or other contracted party on behalf of the consent holder.*

15. All sampling and analysis shall be undertaken in accordance with a *Sampling and Analysis Plan*, which shall be submitted to the Chief Executive for review and certification before the first sampling is undertaken. This plan shall specify the use of standard protocols recognised to constitute good professional practice including quality control and assurance. An International Accreditation New Zealand (IANZ) accredited laboratory shall be used for all sample analysis. Results shall be provided to the Chief Executive within 30 days of sampling and shall include supporting quality control and assurance information. These results will be used to assess compliance with condition 12.

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

16. The consent holder shall provide to Taranaki Regional Council, during the month of July of every year, a summary of all data collected and a report detailing compliance with consent conditions over the previous 1 July to 30 June period. The report shall also provide and assess data which illustrates the on-going integrity and isolation of the wellbore, well performance and condition. The consent holder shall also provide an updated injection modeling report, illustrating the ability of the receiving formation to continue to accept additional waste fluids and estimating its remaining storage capacity.

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

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 annually during the month of June, 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 19 July 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:	Greymouth Petroleum Limited P O Box 3394 NEW PLYMOUTH 4341
Decision Date (Change):	2 November 2012
Commencement Date (Change):	2 November 2012 (Granted: 4 May 2012)

Conditions of Consent

Consent Granted:	To discharge produced water, well drilling fluids, well workover fluids and contaminated stormwater into the Mount Messenger Formation by deepwell injection via the Turangi-A waste disposal well at or about (NZTM) 1713843E-5681399N
Expiry Date:	1 June 2016
Review Date(s):	June 2013, June 2014, June 2015
Site Location:	Turangi-A wellsite, 126 Turangi Road, Motonui (Property owner: B & J McKenzie)
Legal Description:	Sec 21 Blk VI Waitara SD (Discharge source & site)
Catchment:	Parahaki

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

General condition

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

Special conditions

1. Before this consent is exercised, the consent holder shall submit an "Injection Operation Management Plan" which shall include the operational details of the injection activities and identify the conditions that would trigger concerns about the integrity of the injection well, injection zone or overlying geological formations. The plan will also detail the action(s) to be taken by the consent holder if trigger conditions are reached.

2. Before this consent is exercised the consent holder shall provide to the Chief Executive of the Taranaki Regional Council:

   (a) A final well completion log for the injection well including subsurface construction details, design of the exterior surface casing, the intermediate protective casing, and the innermost casing, tubing, and/or packer(s);
   (b) Well cementing details, cement bond log and results of annular pressure testing which demonstrates well integrity;
   (c) Details of on-going well integrity monitoring, well maintenance procedures and safe operating limits for the well;
   (d) A detailed geological log of the well;
   (e) Details and results of the Formation Integrity Testing carried out on the receiving formation and confining layers and an assessment of the results against the estimated modelled values submitted in the consent application;
   (f) Results of an electrical resistivity survey, clearly showing the confirmed depth of freshwater as defined in condition 11; and
   (g) A full chemical analysis of the receiving formation-water.

   (Note: These details can be included within the "Injection Operation Management Plan.")

3. The injection pressure at the wellhead shall not exceed 115 bar (1,685 psi). If exceeded, the injection operation shall be ceased immediately and the Chief Executive of the Taranaki Regional Council informed immediately.

4. The rate of injection shall not exceed 687 m^3/day (3 bpm).

5. The volume of fluid injected shall not exceed 687 m^3/day.

6. The injection of fluids shall be confined to the Mt. Messenger Formation, deeper than 1,350 metres Total Vertical Depth.

7. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or likely adverse effect on the environment; in particular, ensuring that the injection material is contained within the injection zone.

8. Only the fluids listed below and originating from the consent holder's operations may be discharged:

   (a) Produced water;
   (b) Well drilling fluids;
   (c) Well workover fluids, including hydraulic fracturing return fluids; and
   (d) Contaminated stormwater.

9. Once the consent is exercised, the consent holder shall keep daily records of the:

   (a) Injection pressure (regular logged measurements over each injection period);
   (b) Maximum and average rate of injection; and
   (c) Volume of fluid injected.

   During the operation of the well, these records shall be provided to the Taranaki Regional Council at the end of each month.

10. For each discharge, the consent holder shall record the following information, and provide this to the Chief Executive, Taranaki Regional Council upon request:

    (a) Type of fluid;
    (b) Source of fluid (site name and location);
    (c) Subject to condition 10(d) below, an analysis of the fluid for:
        (i) pH;
        (ii) suspended solids concentration;
        (iii) temperature;
        (iv) salinity;
        (v) chloride concentration;
        (vi) total hydrocarbon concentration; and
    (d) 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 and analysed within the previous 6 months.

11. The consent holder shall ensure that the exercise of this consent does not result in contaminants reaching any useable fresh water (groundwater or surface water). Usable fresh groundwater is defined as any groundwater having a Total Dissolved Solids concentration of less than 1000 mg/l.

12. 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 to assess compliance with condition 11 (the 'Monitoring Programme'). The Monitoring Programme shall be certified by the Chief Executive, Taranaki Regional Council ('the Chief Executive'), before this consent is exercised, and shall include:

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

13. All water samples taken for monitoring purposes shall be taken in accordance with recognised field procedures and analysed for:

    (a) pH;
    (b) conductivity;
    (c) total dissolved solids;
    (d) major ions (Ca, Mg, K, Na, total alkalinity, bromide, chloride, nitrate-nitrogen, and sulphate);
    (e) trace metals (barium, copper, iron, manganese, nickel, and zinc);
    (f) total petroleum hydrocarbons;
    (g) formaldehyde;
    (h) dissolved methane and ethane gas;
    (i) methanol;
    (j) glycols;
    (k) benzene, toluene, ethylbenzene, and xylenes (BTEX); and
    (l) carbon-13 composition of any dissolved methane gas discovered ($^{13}C\text{-}CH_4$).

    Note: *The samples required, under conditions 12 and 13, could be taken and analysed by the Council or other contracted party on behalf of the consent holder.*

14. All sampling and analysis shall be undertaken in accordance with a *Sampling and Analysis Plan*, which shall be submitted to the Chief Executive for review and certification before the first sampling is undertaken. This plan shall specify the use of standard protocols recognised to constitute good professional practice including quality control and assurance. An International Accreditation New Zealand (IANZ) accredited laboratory shall be used for all sample analysis. Results shall be provided to the Chief Executive within 30 days of sampling and shall include supporting quality control and assurance information. These results will be used to assess compliance with condition 11.

    Note: *The Sampling and Analysis Plan may be combined with the Monitoring Programme required by condition 12.*

15. The consent holder shall provide to Taranaki Regional Council, during the month of May of every year, a summary of all data collected and a report detailing compliance with consent conditions. The report shall also provide and assess data which illustrates the on-going integrity and isolation of the wellbore, well performance and condition. The consent holder shall also provide an updated injection modeling report, illustrating the ability of the receiving formation to continue to accept additional waste fluids and estimating its remaining storage capacity.

16. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least 5 days prior to the first exercise of this consent. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz.

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 2 November 2012

For and on behalf of
Taranaki Regional Council

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Director-Resource Management

Appendix II

2013-2014 Groundwater monitoring results

			Kowhai-A		Turangi-A		Kaimiro-O		Kaimiro-G				Kaimiro-J	
		Well Name	GND2464		GND1673		GND1385		GND0701		GND2353		GND2472	
		TRC Sample Number	TRC1411977	TRC151731	TRC1412069	TRC151731	TRC1411410	TRC151532	TRC1411762	TRC151534	TRC1411763	TRC151535	TRC1411912	TRC151508
		Sample Date	20/11/2014	30/04/2015	23/10/2014	22/04/2015	08/10/2014	23/04/2015	06/11/2014	23/04/2015	06/11/2014	23/04/2015	13/11/2014	21/04/2015
Analyte	**Units**	**Sample Time**	11:38	10:40	13:41	10:20	8:25	8:40	12:08		12:45	10:08	10:25	12:14
Static Water Level	**m bgl**		NR*	NR*	NR*	NR*	NR*	NR*	NR*	NR*	NR*	NR*	NR*	NR*
Temperature	**ºC**			14.3	16.1	15.6	23.4	22.2	13.3	14.5	13.2	16.1	14.9	15.3
pH	**pH Units**		6.3	6.6	7.17	7.03	7.3	7.58	6.81	7	6.1	5.9	7.3	7.39
Conductivity (EC)	**mS/m@20ºC**		30.6	26.2	31.7	31.2	143.0	144	23.3	22.98	10.6	10.2	47.85	45.97
Total Alkalinity	**g/m3 as CaCO3**		30	18	143	146	321	326	-	-	-	-	233	-
Chloride	**g/m3**		86.8	69.8	14.2	15.5	164	166	19.7	22.3	11.9	11.8	18	18.5
Total Hydrocarbons	**g/m3**		<0.5	<0.5	<0.7	<0.7	1.8	<0.5	<0.5	<0.5	<0.5	<0.6	<0.5	0.8
DissolvedBarium	**g/m3**				0.023	0.021								
Benzene	**g/m3**				<0.0010	<0.0010								
Dissolved Bromine	**g/m3**				0.070	0.060								
Calcium	**g/m3**				19.6	19.3								
Chloride	**g/m3**				14.2	15.5								
Dissolved Copper	**g/m3**				<0.0005	<0.0005								
Ethylbenzene	**g/m3**				<0.0010	<0.0010								
Ethane	**g/m3**				<0.003	<0.003								
Ethylene	**g/m3**				<0.003	<0.004								
Dissolved Iron	**g/m3**				8.1	8.1								
Formaldehyde	**g/m3**				0.02	<0.02								
Ethylene glycol	**g/m3**				<4	<4								
Hydrocarbons	**g/m3**				<0.7	<0.7								
Bicarbonate	**g/m3 HCO3**				174.5	178								
Total Hardness	**g/m3 CaCO3**				94	93								
Dissolved Mercury	**g/m3**				<0.00008	<0.00008								
Potassium	**g/m3**				5.4	5.0								
Methanol	**g/m3**				<2	<2								
Methane	**g/m3**				2.8	2.3								
Magnesium	**g/m3**				10.8	10.9								
Dissolved Manganese	**g/m3**				0.192	0.195								
Sodium	**g/m3**				30	28								
Nickel	**mg/kg**				0.0006	<0.0005								
Nitrite/nitrate nitrogen	**g/m3 N**				<0.002	<0.002								
Nitrite nitrogen	**g/m3 N**				<0.002	<0.002								
Nitrate nitrogen	**g/m3 N**				<0.002	<0.002								
Propylene glycol	**g/m3**				<4	<4								
Sulphate	**g/m3**				<0.5	<0.5								
Sum of Anions	**meq/l**				3.3	3.4								
Sum of Cations	**meq/l**				3.6	3.5								
Total Dissolved Solids	**g/m3**				220	220								
Toluene	**g/m3**				<0.0010	<0.0010								
Xylene-O	**g/m3**				<0.0010	<0.0010								
Xylene-M	**g/m3**				<0.002	<0.002								
Dissolved Zinc	**g/m3**				0.0150	0.0027								

Parameter	Unit	Consent (injection well) 5312-1					
(K-17)	7466-1						
(Kowhai-2)	7897-1						
(K-11)	9272-1						
(Turangi-5)	9470-1						
(K-10)			K17	Kow2	K11	T5	K10
Volume	Total	m3	15,299	36,552	24,885	17,411	4370
	Max	m3/day	69	159	191	142	62.5
	Average	m3/day	44	100	73	48	20.1
Injection pressure	Max	bar	93	28	76	32	74
	Average	bar	71	24	44	27	69
Injection rate	Max	m3/day	45	159	192	142	62.5
	Average	m3/day	45	100	73	47	20.1