

Shell Todd Oil Services Ltd  
KA-19/20 Wellsite  
Monitoring Programme Report  
2013-2014

Technical Report 2014–03

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## Executive summary

Shell Todd Oil Services Ltd previously established a hydrocarbon exploration wellsite located off Palmer Road, Kapuni, within the South Taranaki district, in the Kapuni catchment. This wellsite was initially established for exploration efforts regarding wells KA-1 and KA-7. The wellsite has since had site boundaries extended to accommodate new exploration wells KA-19 and KA-20. This report covers activities concerning only wells KA-19 and KA-20, during the monitoring period February 2013 to December 2013. During this period, KA-19 was drilled, hydraulically fractured and is now in production, whilst KA-20 was drilled and now functions as an observation well.

This report for Shell Todd Oil Services Ltd describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess Shell Todd Oil Services Ltd's environmental performance in relation to drilling operations at the KA-19/20 wellsite during the period under review, and the results and environmental effects of Shell Todd Oil Services Ltd's activities.

Shell Todd Oil Services Ltd holds a total of 4 resource consents for the activities at the KA-19/20 wellsite, which include a total of 52 consent conditions setting out the requirements that Shell Todd Oil Services Ltd must satisfy. Shell Todd Oil Services Ltd holds consent 6646-1 to take groundwater; consent 7995-1 to discharge contaminants associated with hydraulic fracturing activities into land; consent 6822-1 to discharge emissions to air associated with production activities; and consent 6200-1 to discharge treated stormwater and treated site water from hydrocarbon exploration and production operations to land.

The Council's monitoring programme for the period under review included 15 inspections of the site and surrounding environment, at approximately fortnightly intervals. Eight groundwater samples, three hydraulic fracture fluid samples, and 11 stormwater samples were obtained for analysis.

One infringement notice was issued in relation to contaminated water that had discharged from the site. This was due to a discharge pipe from a mud storage tank being relocated with the consequence that the water discharged directly offsite. One sample was obtained, and from the analysis it was concluded that any concentrations of contaminants would have reduced through filtration and dilution upon entering the receiving environment. In addition, as the discharge consisted largely of municipal water (with residual hydrocarbons), was temporary and, was immediately rectified according to on site best practice, the discharge was therefore unlikely to have had any significant or on-going adverse effect on the receiving environment.

Shell Todd Oil Services Ltd notified the Council of its intention to combust gas intermittently between 16 November 2013 and 20 December 2013. No offensive or objectionable odours, smoke or dust associated with activities at the wellsite were observed. The drilling fluids and cuttings were disposed of at a consented off site facility.

Staff on site were cooperative with requests made by officers of the Council, with any required works being completed quickly and to a satisfactory standard. During the monitoring period, Shell Todd Oil Services Ltd demonstrated a good level of environmental performance and compliance with the resource consents. The site was generally neat, tidy, and well maintained.

This report includes recommendations for future drilling or fracturing operations at this site.



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# **1. Introduction**

## **1.1 Compliance monitoring programme reports and the Resource Management Act 1991**

### **1.1.1 Introduction**

This report is for the period February 2013 to December 2013 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by Shell Todd Oil Services Ltd. During this period, two wells were drilled, KA-19 and KA-20. KA-19 was tested, hydraulically fractured and is now in production, whilst KA-20 functions as an observation well.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consents held by Shell Todd Oil Services Ltd that relate to exploration activities at KA-19/20 wellsite located off Palmer Road, Kapuni in the South Taranaki District.

One of the intents of the *Resource Management Act 1991* (RMA) is that environmental management should be integrated across all media, so that a consent holder's use of water, air, and land should be considered from a single comprehensive environmental perspective. Accordingly, the Council generally implements integrated environmental monitoring programmes and reports the results of the programmes jointly. This report discusses the environmental effects of Shell Todd Oil Services Ltd's use of water, land, and air at the site in question.

### **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 RMA and the Council's obligations and general approach to monitoring sites through annual programmes, the resource consent held by Shell Todd Oil Services Ltd in the Kapuni catchment, the nature of the monitoring programme in place for the period under review, and a description of the activities and operations conducted at the KA-19/20 wellsite during exploration activities.

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

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

Section 4 presents recommendations to be implemented during future drilling operations.

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

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

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

- (a) the neighbourhood or the wider community around a discharger, and may include cultural and socio-economic effects;
- (b) physical effects on the locality, including landscape, amenity and visual effects;
- (c) ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;
- (d) natural and physical resources having special significance (eg, 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 Taranaki Regional Council is recognising the comprehensive meaning of 'effects' inasmuch as is appropriate for each discharge source. Monitoring programmes are not only based on existing permit conditions, but also on the obligations of the RMA to assess the effects of the exercise of consents. In accordance with section 35 of the RMA, the Council undertakes compliance monitoring for consents and rules in regional plans, and maintains an overview of 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 consent 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 an overall rating. The categories used by the Council, and their interpretation, are as follows:

- A **high** level of environmental performance and compliance indicates that essentially there were no adverse environmental effects to be concerned about, and no, or inconsequential (such as data supplied after a deadline) non-compliance with conditions.
- A **good** level of environmental performance and compliance indicates that adverse environmental effects of activities during the monitoring period were negligible or minor at most, or, 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, or, there were perhaps some items noted on inspection notices for attention but these items were not urgent nor critical, and follow-up inspections showed they have been dealt with, and any inconsequential non-compliances with conditions were resolved positively, co-operatively, and quickly.

- **Improvement required (environmental) or improvement required (administrative)** (as appropriate) indicates that the Council may have been obliged to record a verified unauthorised incident involving measurable environmental impacts, and/or, there were measurable environmental effects arising from activities and intervention by Council staff was required and there were matters that required urgent intervention, took some time to resolve, or remained unresolved at the end of the period under review, and/or, there were on-going issues around meeting resource consent conditions even in the absence of environmental effects. Abatement notices may have been issued.
- **Poor performance (environmental) or poor performance (compliance)** indicates generally that the Council was obliged to record a verified unauthorised incident involving significant environmental impacts, or there were material failings to comply with resource consent conditions that required significant intervention by the Council even in the absence of environmental effects. Typically there were grounds for either a prosecution or an infringement notice.

For reference, in the 2012-2013 year, 35% of consent holders in Taranaki monitored through tailored compliance monitoring programmes achieved a high level of environmental performance and compliance with their consents, while another 59% demonstrated a good level of environmental performance and compliance with their consents.

## 1.2 Process description

### Site description

Shell Todd Oil Services Ltd holds a 63 year Petroleum Mining Permit No. 38839 to prospect, explore, and mine for condensate, gas, LPG, oil and petroleum within an area of 218.76 Km<sup>2</sup>. The KA-19/20 wellsite is one of many sites within this area that has been established in order to explore, evaluate and produce hydrocarbons.

This wellsite was initially established for exploration efforts regarding wells KA-1 and KA-7. This wellsite has since had site boundaries extended to accommodate new wells KA-19 and KA-20, and site boundaries were also extended temporarily during the campaign. The wellsite is located approximately 3.6 km along Palmer Road (from the south), approximately 6 km from Kaponga.

The initial establishment of the wellsite would have involved the removal of topsoil to create a firm level platform on which to erect a drilling rig and house associated equipment. Site establishment also involved the installation of:

- Wastewater control, treatment and disposal facilities;
- A system to collect and control stormwater and contaminants;
- Gas combustion system; and
- Other on site facilities such as accommodation, parking and storage.

The nearest residence is approximately 200 m away from the wellsite. Bunding, earthworks and good site location helped minimise any potential for off-site effects for the neighbours.

### **Well development**

The process of drilling a well can take a few weeks to several months, depending on the depth of the well, the geology of the area, and whether the well is vertical or horizontal.

Drilling fluids, more commonly known as 'drilling muds', are required in the drilling process for a number of reasons, including:

- As a safety measure to ensure that any pressurized liquids encountered in the rock formation are contained;
- To transport drill cuttings to the surface;
- To cool and lubricate the drilling bit;
- To provide information to the drillers about what is happening down hole and the actual geology being drilled; and
- To maintain well pressure and lubricate the borehole wall to control cave-ins and wash-outs.

The well is drilled progressively using different sized drill bits. The width of the well is widest at the surface as smaller drill bits are used as the well gets deeper. Once each section of the well is drilled, a steel casing is installed. Cement is then pumped down the well to fill the annulus (the space between the steel casing and the surrounding country rock). This process is repeated until the target depth is reached, with each section of steel casing interlocked with the next.

Production tubing is then fitted within the steel casing to the target depth. A packer is fitted between the production tubing and casing to stop oil/gas/produced water from entering the annulus. The packer is pressure tested to ensure it is sealed.

The construction aspects that are most important for a leak-free well include the correct composition and quality of the cement used, the installation method, and the setting time. The aim is to ensure that the cement binds tightly to the steel casing and the rock, and leaves no cavities through which liquids and gases could travel.

Once the well is sealed and tested the casing is perforated at the target depth, allowing fluids and gas to flow freely between the formation and the well.

### **Management of stormwater, wastewater and solid drilling waste**

The KA-19/20 wellsite is located approximately 65 m to the west of the nearest waterbody, known as the Kapuni Stream.

Management systems were put in place to avoid any adverse effects on the surrounding environment from exploration and production activities on the wellsite. There are several sources of potential contamination from water and solid waste material which require appropriate management. These can include:

- Stormwater from 'clean' areas of the site [e.g. parking areas] which run off during rainfall. There is potential that this runoff will pick up small amounts of hydrocarbons and silt due to the nature of the activities on site;
- Stormwater which collects in the area surrounding the drilling platform and ancillary drilling equipment. This stormwater has a higher likelihood of contact with potential contaminants, particularly drilling mud;

- Produced water which flows from the producing formation and is separated from the gas and water phase at the surface; and
- Drill cuttings, mud and residual fluid which are separated from the liquid waste generated during drilling.

An important requirement of site establishment is to ensure that the site is contoured so that all stormwater and any runoff from 'clean' areas of the site flow into perimeter drains. The drains direct stormwater into a skimmer pit system on site consisting of two settling ponds. Any hydrocarbons present in the stormwater float to the surface and can be removed. The ponds also provide an opportunity for suspended sediment to settle. Treated stormwater is then discharged from the wellsite onto and into land, and consequently into the Kapuni Stream, within the Kapuni catchment.

Drilling mud and cuttings brought to the surface during drilling operations are separated out using a shale shaker. The drilling mud and some of the water is then reused for the drilling process. Cuttings were collected in bins located at the base of the shaker and disposed of offsite at a consented facility.

### **Hydraulic fracturing**

In late 2012 the Parliamentary Commissioner for the Environment released an interim report on hydraulic fracturing within New Zealand. The purpose of this report is firstly to assess the environmental risks with hydraulic fracturing, and secondly to assess whether the policies, laws, regulations and institutions in New Zealand are adequate for managing these risks. The following discussion has been based upon this report.

The first known hydraulic fracturing operation was in 1989 at Petrocorp's Kaimiro-2 gas well in Taranaki. Since then, almost all of the hydraulic fracturing that has taken place in New Zealand has been done within the Taranaki region.

By the early 2000's New Zealand started exploring options for more unconventional ways of getting access to natural gas, and especially oil. These are considered to be more expensive than conventional drilling, but as the price of oil has risen and new technologies have been developed, these unconventional methods are growing.

The most common unconventional source of oil and gas in the Taranaki region has been extracting natural gas and oil from 'tight sands'. The boundary between tight sands and conventional reservoirs is ill-defined and generally based on whether the reservoir will have an economic production flow without hydraulic fracturing.

The process of hydraulic fracturing involves using a fracturing fluid, which is primarily water (typically made up of around 95-97% treated water). This fluid also contains various chemicals, including the three main components, which are:

- An inert proppant which keeps the induced fracture open when pumping is stopped, such as medium grained sand, or small ceramic pellets;
- A gelling substance to carry the proppant into the cracks; and
- A de-gelling substance to thin the gel to allow the fracturing fluid to return to the surface while leaving the proppant in the fractures.

The chemicals associated with the fracturing fluid are trucked to the site, stored in concentrated form, and mixed immediately before the hydraulic fracturing commences.

After the casing is perforated at the desired depth, the fracturing fluid is injected under high pressure into the well and is forced through the small holes into the rocks, creating cracks. This high downhole pressure is maintained for a brief period of time (approximately 1 hour) in order to exceed the fracture strength of the reservoir rock and cause artificial fractures.

Once a fracture has been initiated, the fracturing fluid and proppant are carried into the fracture. The placement of proppant in the fractures is assisted by the use of cross-linked gels. These are solutions, which are liquid at the surface but, when mixed, form long-chain polymer bonds and thus become gels that transport the proppant into the formation.

Once in the formation these gels 'break' back with time and temperature to a liquid state and are flowed back to surface as back flow without disturbing the proppant wedge, trapped in the hydraulic fracture. With continued flow, formation hydrocarbon fluids should be drawn into the fracture, through the perforations into the wellbore and to the surface.

#### **Flaring from wellsite activities**

It is possible that flaring may occur during the following activities:

- Well testing and clean-up;
- Emergencies; and
- Maintenance and enhancement activities (well workovers).



**Figure 1** Aerial view depicting the locality of the KA-19/20 wellsite

## 1.3 Resource consents

### 1.3.1 Background

Shell Todd Oil Services Ltd holds 4 resource consents related to exploration activities at the KA-19/20 wellsite site, as follows:

- Water Permit 6646-1; granted 18 July 2005,
- Discharge Permit 6200-1; granted 12 January 2011 (varied 12 January 2011),
- Discharge Permit 6822-1; granted 9 August 2013 (varied 9 August 2013) and
- Discharge Permit 7995-1; granted 28 March 2012,

Each of the consent applications were processed on a non-notified basis as Shell Todd Oil Services Ltd obtained the landowner approvals as an affected party, and the Council were satisfied that the environmental effects of the activity would be minor. The consents are discussed in further detail below.

Copies of the consents and the Council reports describing the associated activities are contained within Appendix I of this report.

### 1.3.2 Water abstraction permit (groundwater)

Section 14 of the *Resource Management Act 1991* (RMA) stipulates that no person may take, use, dam or divert any water, unless the activity is expressly allowed for by resource consent or a rule in a regional plan, or it falls within some particular categories set out in Section 14.

The Council determined that the application to take groundwater fell within Rule 49 of the Regional Freshwater Plan for Taranaki (RFWP) as the rate and daily volume of the groundwater abstraction might exceed that of the permitted activity (Rule 48). Rule 49 provides for groundwater abstraction to be undertaken as a controlled activity, subject to two conditions:

- *The abstraction shall cause not more than a 10% lowering of static water-level by interference with any adjacent bore;*
- *The abstraction shall not cause the intrusion of saltwater into any fresh water aquifer.*

Shell Todd Oil Services Ltd holds water permit 6646-1 to take and use groundwater from a bore as a contingency backup supply for fire fighting, well killing, workover and domestic purposes at the KA-19/20 wellsite.

Shallow groundwater (which does not have any saltwater content) was to be protected by casing within the bore hole. Given these factors, the abstraction would not cause the above effects.

In granting the consent it was considered that the taking of groundwater was unlikely to have any adverse effect on the environment.

The Council was satisfied that the proposed activity would meet all the standards for a controlled activity. It was therefore obliged to grant the consent but imposed

conditions in respect of those matters over which it reserved control. Those matters over which the Council reserved its control were:

- Volume and rate of abstraction;
- Daily timing of abstraction;
- Effects on adjacent bores, the aquifer, river levels, wetlands and sea water intrusion;
- Fitting of equipment to regulate flows and to monitor water volumes, levels, flows and pressures;
- Payment of administrative charges;
- Monitoring and report requirements;
- Duration of consent; and
- Review of the conditions of consent and the timing and purpose of the review.

This permit was issued by the Council on 18 July 2005 under Section 87(d) of the RMA. It is due to expire on 1 June 2023.

Consent conditions were imposed on Shell Todd Oil Services Ltd to ensure that adverse effects were avoided in the first instance. A summary of conditions can be viewed within Table 10, Section 3.3.

A copy of the permit is attached to this report in Appendix 1.

### **1.3.3 Water discharge permit (treated stormwater and treated site water)**

Section 15(1)(a) of the *Resource Management Act 1991* (RMA) stipulates that no person may discharge any contaminant into water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or by national regulations.

The Council determined that the application to discharge treated stormwater and treated site water fell within Rule 44 of the RFWP, which provides for a discharge as a discretionary activity.

The discharge of stormwater may result in contaminants (e.g. sediment, oil) entering surface water. These contaminants have the potential to smother or detrimentally affect in-stream flora and fauna. On site management of stormwater, as discussed in 1.2 above, is necessary to avoid/remedy any adverse effects on water quality.

Shell Todd Oil Services Ltd holds water discharge permit 6200-1 to discharge treated stormwater and treated site water from hydrocarbon exploration and production operations at the KA-19/20 wellsite onto and into land.

This permit was initially issued by the Council on 16 September 2003 under Section 87(e) of the RMA, and varied 12 January 2011. It is due to expire on 1 June 2017.

Consent conditions were imposed on Shell Todd Oil Services Ltd to ensure that adverse effects were avoided in the first instance. A summary of conditions can be viewed in Table 12, Section 3.3.

A copy of the permit is attached to this report in Appendix I.



### 1.3.4 Air discharge permit (production activities)

Section 15(1)(c) of the *Resource Management Act 1991* (RMA) stipulates that no person may discharge any contaminant from any industrial or trade premises into air, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations.

The Council determined that the application to discharge emissions to air associated with the production activities at the KA-19/20 wellsite fell within Rule 11 of the RAQP.

The standard/term/condition of Rule 11 states that the:

- *Flare or incinerator point is a distance equal to or greater than 300 metres from any dwelling house.*

Shell Todd Oil Services Ltd holds air discharge permit 6822-1 to discharge emissions to air associated with production activities at the KA-19/20 wellsite including flaring associated with emergencies and maintenance and minor emissions from other miscellaneous activities.

This permit was initially issued by the Council on 21 March 2006 under Section 87(e) of the RMA, and varied 9 August 2013. It is due to expire 1 June 2023.

Consent conditions were imposed on Shell Todd Oil Services Ltd to ensure that adverse effects are avoided in the first instance. A summary of conditions can be viewed in Table 11, Section 3.3.

A copy of the permit is attached to this report in Appendix I.

### 1.3.5 Discharges to land (hydraulic fracturing)

Sections 15(1)(b) and (d) of the *Resource Management Act 1991* (RMA) stipulate that no person may discharge any contaminant onto land if it may then enter water, or from any industrial or trade premises onto land under any circumstances, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations.

The discharge of contaminants associated with hydraulic fracturing, onto and into land where contaminants may reach water, is a discretionary activity under Rule 44 of the RFWP.

The rule is a “catch all” as there is currently no specific rule for the discharge of hydraulic fracturing contaminants. The rule is set out below:

*Discharge of contaminants onto or into land restricted by s15(1)(b) [where contaminants may reach water] and s15(1)(d) [where the discharge is from industrial or trade premises] of the Act which is not expressly provided for in Rules 21-42 or which is provided for but does not meet the standards, terms or conditions and any other discharge of contaminants to land which is provided for in Rules 21-42 but which does not meet the standards, terms or conditions of*

*those rules [irrespective of whether the discharges are from industrial or trade premises or are likely to reach water].*

Provided the activities were to be conducted in accordance with the application and in compliance with the recommended special conditions, then no significant effects were anticipated.

Shell Todd Oil Services Ltd holds discharge permit 7995-1 to discharge contaminants associated with hydraulic fracturing activities into land at depths greater than 3,000 mTVDss (true vertical depth subsurface), beneath the KA-19/20 wellsite.

This permit was issued by the Council on 28 March 2012 under Section 87(e) of the RMA. It is due to expire on 1 June 2017.

Consent conditions were imposed on Shell Todd Oil Services Ltd to ensure that adverse effects are avoided in the first instance. A summary of conditions can be viewed in Table 13, Section 3.3.

A copy of the permit is attached to this report in Appendix I.

## **1.4 Monitoring programme**

### **1.4.1 Introduction**

Section 35 of the *Resource Management Act 1991* (RMA) sets out obligation/s upon the Council to: gather information, monitor, and conduct research on the exercise of resource consent and the effects arising, within the Taranaki region and report upon these.

The Council may therefore make and record measurements of physical and chemical parameters, take samples for analysis, carry out surveys and inspections, conduct investigations, and seek information from consent holders.

The monitoring programme for exploration well sites consists of seven primary components. They are:

- Programme liaison and management;
- Site inspections;
- Chemical sampling;
- Solid wastes monitoring;
- Air quality monitoring;
- Discharges to land (hydraulic fracturing); and
- Biomonitoring surveys.

The monitoring programme for the KA-19/20 wellsite focused primarily on programme liaison and management, site inspections, and discharges to land. However, all seven components are discussed below.

### 1.4.2 Programme liaison and management

There is generally a significant investment of time and resources by the Council in ongoing liaison with resource consent holders over consent conditions and their interpretation and application, in discussion over monitoring requirements, preparation for any reviews, renewals, or new consents, advice on the Council's environmental management strategies and the content of regional plans, and consultation on associated matters.

### 1.4.3 Site inspections

Inspection and examination of wellsites is a fundamental and effective means of monitoring and are undertaken to ensure that good environmental practices are adhered to and resource consent special conditions complied with.

The inspections are based on internationally recognised and endorsed wellsite monitoring best-practice checklists developed by the Alberta Energy Resources Conservation Board and the USEPA, adapted for local application.

The inspections also provide an opportunity for monitoring officers to liaise with staff about on site operations, monitoring and supervision; discuss matters of concern; and resolve any issues in a quick and informal manner.

Inspections pay special attention to the ring drains, mud sumps, treatment by skimmer pits and the final discharge point from the skimmer pit on to land and then any potential receiving waters.

During each inspection the following are checked:

- Weather;
- Flow rate of surface waters in the general vicinity;
- Flow rate of water take;
- Whether pumping of water was occurring;
- General tidiness of site;
- Site layout;
- Ring drains;
- Hazardous substance bunds;
- Treatment by skimmer pits/sedimentation pits;
- Drilling mud;
- Drill cuttings;
- Mud pit capacity and quantity contained in pit;
- Sewage treatment and disposal;
- Cementing waste disposal;
- Surface works;
- Whether flaring was in progress, and if there was a likelihood of flaring, whether the Council had been advised;
- Discharges;
- Surface waters in the vicinity for effects on colour and clarity, aquatic life and odour;
- Site records;
- General observations; and
- Odour (a marker for any hydrocarbon and hazardous chemical contamination).

#### **1.4.4 Chemical sampling**

The Council may undertake sampling of discharges from site and from sites upstream and downstream of the discharge point to ensure that resource consent special conditions are complied with.

#### **1.4.5 Solid wastes**

The Council monitors any disposal of drill cuttings on site via mix-bury-cover to ensure compliance with resource consent conditions.

In recent times consent holders have opted to remove drilling waste from the site by contractor and dispose of it at licensed disposal areas, which are monitored separately.

#### **1.4.6 Air quality monitoring**

Air quality monitoring is carried out in association with the well testing and clean-up phase, where flaring can occur.

Assessments are made by Inspecting Officers of the Council during site inspections to ensure that operators undertake all practicable steps to mitigate any effects from flaring gas.

Inspecting Officers check that that plant equipment is working effectively, that there is the provision of liquid and solid separation prior to flaring, and that staff on site have regard to wind direction and speed at the time of flaring.

It is also a requirement that the Council and immediate land owners are notified prior to any gas being combusted. This requirement was checked to ensure compliance with the conditions.

#### **1.4.7 Discharges to land (hydraulic fracturing)**

Sampling and analysis of the return flow (also known as 'flowback' fluids) of fracturing fluids and nearby bores were carried out during site inspections. These inspections of the site and surrounding land and water were carried out to ensure that no observable effects have occurred as a result of the discharge to land. Pre and post hydraulic fracturing reports were submitted by the consent holder detailing among other things, the effectiveness of the mitigation measures put in place to protect the environment.

#### **1.4.8 Biomonitoring surveys**

Biomonitoring surveys in any nearby streams may be carried out pre and post occupation of the well site to assess whether the activities carried out on site and associated discharges have had any effect on local ecosystems. However, no biomonitoring surveys have been undertaken during this monitoring period as the KA-19/20 wellsite is still occupied and inspections of the receiving waters did not show any effects from discharges originating from site activities. It should be noted that biomonitoring surveys within the reaches of the Kapuni Stream passing across the Kapuni gas fields are regularly undertaken (including during the period covered by this report), and reported within the Shell Todd Oil Services Ltd Kapuni Production Station annual compliance reports.

## **2. Results**

### **2.1 Water**

#### **2.1.1 Inspections**

The KA-19/20 wellsite, adjacent land and stream were inspected 15 times during this monitoring period.

Below is a copy of the comments that were noted on the day of each inspection.

##### **11 February 2013**

Site was very active with impending drilling and appeared clean and tidy at time of inspection. Site staff were advised to ensure that all water from the site was to be directed towards the skimmer pits including that of the entry/administration area and also the area where the chemicals were stored. Skimmer pits were not discharging at the time of inspection. A sample was obtained from the second skimmer pit to ensure compliance with consent conditions in anticipation of potential discharges.

##### **21 February 2013**

Inspection was conducted following a notification issued on behalf of Shell Todd Oil Services Ltd outlining that contaminated water (namely municipal water contaminated with residual hydrocarbons) had discharged from the site. It was found that the discharge pipe from the mud storage tank was relocated so that the water discharged directly offsite. This discharge contravened Section 15(1)(d) of the Resource Management Act and special conditions 1, 6 and 7 of resource consent 6200-1. A sample was obtained at the time of inspection.

##### **27 February 2013**

Skimmer pits were inspected and found not to be discharging at the time of inspection. A sample was obtained from the second skimmer pit.

##### **5 April 2013**

The site was found to be tidy, clean and dry. Chemicals were stored in a bunded area. Water based drilling mud was being used at the time of inspection. Skimmer pits were inspected and found not to be discharging at the time of inspection. A sample was obtained from the second skimmer pit.

##### **2 May 2013**

The site was found to be tidy with the ring drains clear and dry. The site was being set up in preparation for well stimulation operations. Excellent use of trays for containment of potential spills from chemicals was observed. Tarps were also in use to keep products dry. The skimmer pits were inspected and found to be discoloured and full, yet not discharging at the time of inspection. A sample was obtained from the second skimmer pit.

##### **15 March 2013**

Skimmer pits were inspected and found not to be discharging at the time of inspection. A sample was obtained from the second skimmer pit.

**15 May 2013**

The site appeared tidy at the time of inspection. The chemical storage area was tidy and dry chemicals were covered with tarps. The drilling waste disposal area appeared good with a very small amount of drilling waste observed discharging onto a cement pad. The skimmer pits had been cleaned following a sample with an elevated suspended solid count.

**30 May 2013**

Drilling was occurring at the time of inspection. The site appeared to be in a clean and tidy condition, with no indication of recent spills. The chemical storage area appeared clean and tidy, with chemicals well banded and contained. Skimmer pits were inspected and found not to be discharging at the time of inspection. A sample was obtained from the second skimmer pit.

**26 June 2013**

Drilling was occurring at the time of inspection. No issues were raised by on site HSE staff regarding environmental concerns. The site appeared clean and tidy. Bunding appeared to be cleaned out on a regular basis. Mud tanks and cuttings area appeared very tidy with no sign of any recent spills. The chemical storage area was inspected and some small spills of lime were observed; discussions were held with on site HSE personal to ensure clean up of this area. The cementing area appeared clean and tidy. No flaring had yet occurred at the site. Nearby stream was inspected and found to be running clean and clear. All site runoff was directed to the skimmer pits. The skimmer pits were inspected and found not to be discharging at the time of inspection, with no sign of contamination about the skimmer pit discharge point. A sample was obtained from the second skimmer pit.

**19 July 2013**

The site appeared clean and tidy at the time of inspection. Chemical storage had limited chemicals in stock and all hazardous substances were stored above a steel banded containment reservoir. Final drilling and well completion were anticipated within the next few weeks. Shell Todd Oil Services Ltd discovered a hole in the lining of the first skimmer pit. As a result the pits were being pumped out in order to maintain the level below the hole in the lining. The lining was to be repaired within the week. A sample was obtained from the first skimmer pit.

**13 August 2013**

Rigging at site had been taken down at time of inspection. The chemical storage facility appeared appropriately banded. The first skimmer pit had been re-lined.

**14 August 2013**

Skimmer pits were inspected and found not to be discharging at the time of inspection. A sample was obtained from the second skimmer pit.

**6 September 2013**

The site was engaged in seismic surveying at the time of inspection, with hydraulic fracturing to commence shortly. It was advised to site staff that liquid storage containers were to be moved to the correct banded area and bunding towards the rear of the site needed to be increased to stop any potential water migrating down to the rear facility. Skimmer pits were inspected and found not to be discharging at the time of inspection. A sample was obtained from the second skimmer pit.

### 15 November 2013

At the time of the inspection one hydraulic fracturing operation had taken place the previous evening with seven further operations scheduled over the coming days. Zones were to be stimulated and then flowed back individually. Stimulated zones were located at an approximate depth of between 3300 and 3700 TVD. Flaring on site was planned to be kept to a minimum and a thermal oxidizer was to be utilized for flaring. Inspection found that the site was in a clean and tidy condition. A small spill of proppant was observed on site however this was being cleaned up immediately. Hazardous substances were stored on site within a bunded steel container that was capable of being locked for security and safety purposes. Gradient and ring drains on site were adequate and ensured that all site water was directed to the skimmer pits. Skimmer pits were inspected and found not to be discharging at the time of inspection. A sample was obtained from the second skimmer pit.

### 6 December 2013

Hydraulic fracturing was continuing on site. Six zones had been fractured, with zones seven and eight anticipated to be assessed and fractured. The site was found to be clean and tidy with all non hazardous chemical stores in a well managed and tidy order with no sign of spills. Bunds near the rear of the site were nearing capacity following recent heavy rain. Discussions were held with on site staff regarding this, who agreed to arrange a truck to offload excess liquids to increase storage capacity. A thermal oxidizer was set up on site with the area surrounding the oxidiser clean and tidy with no evidence of hydrocarbon spills observed. Flaring was not occurring at the time of the inspection. No adverse effects were observed of the receiving environment, with grass growth surrounding the point of discharge similar to that of the rest of the paddock. The Kapuni River was found to be flowing swiftly and high. The general water quality was slightly turbid, however no change in water quality was observed along the stretch of river inspected. Skimmer pits were inspected and found to be in good order and not discharging at the time of inspection. A sample was obtained from the second skimmer pit.

## 2.1.2 Results of abstraction and discharge monitoring

During the period under review, stormwater was not observed discharging. There were 11 stormwater samples obtained from the skimmer pits during the period under review. All of the stormwater samples except one were collected from the second skimmer pit at the KA-19/20 wellsite. The exception was collected from the first skimmer pit on 19 July 2013.

Analysis of the samples collected showed all but two of the discharges would have complied with resource consent conditions should a discharge have occurred. Results are detailed in Tables 1 and 2.

**Table 1** Results of stormwater samples obtained from the second skimmer pit at the KA-19/20 wellsite during the monitoring period

Parameter	Unit	Consent limit	27 Feb 2013	15 Mar 2013	05 Apr 2013	02 May 2013	30 May 2013	26 Jun 2013
Hydrocarbons	g/m <sup>3</sup>	15	<0.5	<0.5	<0.5	<0.5	5.2	99
pH	pH	6.5 – 8.5	8.8	8.5	8.5	6.9	7.1	7.1
Suspended Solids	g/m <sup>3</sup>	100	<2	<2	<2	72	45	40

**Table 2** Further results of stormwater samples obtained from the skimmer pits at the KA-19/20 wellsite during the monitoring period

Parameter	Unit	Consent limit	19 Jul 2013	14 Aug 2013	06 Sep 2013	15 Nov 2013	06 Dec 2013
Hydrocarbons	g/m <sup>3</sup>	15	1.0	2.3	0.6	<0.5	<0.5
pH	pH	6.5 – 8.5	7.1	7.3	7.2	7.8	7.2
Suspended Solids	g/m <sup>3</sup>	100	31	47	29	16	14

A sample obtained on 27 February 2013 from the skimmer pit returned a slightly elevated pH level. Upon investigation it was considered that this was due to the consequences of photosynthetic activity of algae growing in the skimmer pit under hot, sunny and dry conditions, rather than any chemical source. It was considered by Council officers that should enough rain fall to cause a discharge, the pH would fall to well within consent limits prior to any discharge occurring. No remedial action was required by the Council.

A sample obtained on 26 June 2013 from the second skimmer pit returned elevated levels of hydrocarbons. After discussion with Shell Todd Oil Services Ltd, it was confirmed that no unusual events or activities were recorded on site in conjunction with this date which may have contributed to a high hydrocarbon reading. In addition, “skimmer pit valves were operated as normally closed” and discharge only manually released once confirmation of compliant results were obtained following routine self-sampling of the skimmer pits. Therefore, no discharges containing elevated levels of hydrocarbons were released from the skimmer pits into the receiving environment.

All sewage was directed for treatment through a septic tank system and removed by contractor to a licensed disposal facility. Inspections of the stormwater discharge found it to be mostly clear. No odours were found to be associated with the discharge.

### 2.1.3 Results of receiving environment monitoring

The receiving surface water body was inspected in conjunction with site inspections. No effects were observed in the receiving environment and the stream appeared clear with no visual change in colour or clarity. There was also no odour, oil, grease films, scum, foam or suspended solids observed in the stream during the monitoring period. As noted in section 1.4.8, no specific biomonitoring of the Kapuni Stream was undertaken in respect of activities on the KA-19/20 wellsite, as an on-going biomonitoring programme is already in place for the stream.

## 2.2 Air

### 2.2.1 Inspections

Air quality monitoring inspections were carried out in conjunction with general compliance monitoring inspections. See Section 2.1.1 for comments concerning site inspections.



## **2.2.2 Results of discharge monitoring**

Shell Todd Oil Services Ltd notified the Council of its intention to combust gas intermittently between 16 November 2013 and 20 December 2013 at the KA-19/20 wellsite. As the flare pit had since been decommissioned, Shell Todd Oil Services Ltd employed the use of a thermal oxidiser at the KA-19/20 wellsite for the combustion of gas.

During routine inspections, no offensive or objectionable odours, smoke or dust associated with activities at KA-19/20 wellsite were observed. The thermal oxidiser was inspected to ensure that solid and liquid hydrocarbons were not combusted through the gas combustion system and there was no evidence to support or suggest this was occurring.

From observations during site inspections, including the inspection of the gas combustion log maintained by Shell Todd Oil Services Ltd, it appeared that special conditions relating to the control of emissions to air from the combustion of hydrocarbons were complied with.

## **2.2.3 Results of receiving environment monitoring**

Monitoring inspections of the site found no offensive or objectionable odours, smoke or dust associated with activities at the Shell Todd Oil Services Ltd wellsite, and inspections of the thermal oxidiser and surrounding area were carried out and no effects were observed.

No chemical monitoring of air quality was undertaken of the KA-19/20 wellsite as the controls implemented by Shell Todd Oil Services Ltd did not give rise to any concerns with regard to air quality.

## **2.2.4 Other ambient monitoring**

No other ambient air sampling was undertaken, as the controls implemented by Shell Todd Oil Services Ltd did not give rise to any concerns with regard to air quality.

## **2.3 Land**

### **2.3.1 Inspections**

Land monitoring inspections were carried out in conjunction with general compliance monitoring inspections. See Section 2.1.1 for comments concerning site inspections.

### **2.3.2 Results of receiving environment monitoring**

One sample was obtained in conjunction with an incident inspection conducted on 21 February 2013. This inspection was conducted following a notification issued on behalf of Shell Todd Oil Services Ltd, outlining that contaminated water (namely municipal water contaminated with residual hydrocarbons) had discharged from the site, as per Photo 1. It was found that the discharge pipe from the mud storage tank was relocated so that the water discharged directly offsite. The one sample was obtained directly from the mud storage tank to determine the probable components of the discharge. The results are presented in Table 3.



**Photo 1** Boundary of wellsite KA-19/20 where the discharge from site occurred

**Table 3** Results of investigative sampling obtained from the discharging mud tank at the KA-19/20 wellsite on 21 February 2013

Parameter	Unit	Sample 1
Calcium	g/m <sup>3</sup>	6.6
Chloride	g/m <sup>3</sup>	102
Conductivity	mS/m@20C	45.7
Hydrocarbons	g/m <sup>3</sup>	24
pH	pH	7.2
Suspended solids	g/m <sup>3</sup>	58
Turbidity	NTU	210

Any concentrations of contaminants would have reduced through filtration and dilution upon entering the receiving environment. In addition, as the discharge consisted largely of municipal water, was temporary and immediately rectified according to on site best practice, the discharge was therefore unlikely to have had any significant or on-going adverse effect on the receiving environment.

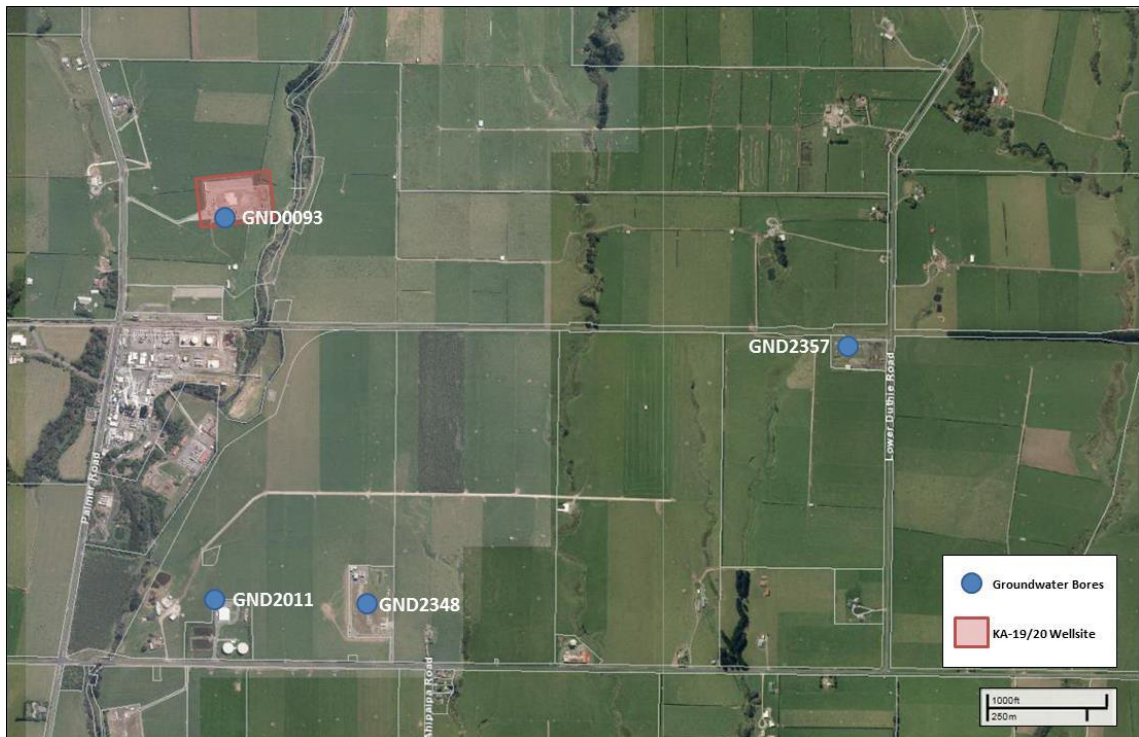
Shell Todd Oil Services Ltd were issued with an infringement notice (number 340) as the discharge contravened Section 15(1)(d) of the Resource Management Act and special conditions 1, 6 and 7 of resource consent 6200-1.

### 2.3.3 Results of receiving environment monitoring (hydraulic fracturing)

Shell Todd Oil Services Ltd notified the Council of the proposed hydraulic fracturing discharge operation for well KA-19. The Council developed the KA-19/20 wellsite groundwater monitoring programme in consultation with Shell Todd Oil Services Ltd. This monitoring programme included four sampling locations which were selected based on their proximity to the KA-19/20 wellsite and their individual construction and usage characteristics. The site selection is designed to provide a sample set representative of groundwater abstractions in the area surrounding the site. Table 4 outlines the details of the sites selected for inclusion in the programme. Figure 2 shows the sampling sites in relation to the wellsite.

**Table 4** KA-19/20 wellsite associated groundwater monitoring bore details

Site No.	Static water level (m) - Summer	Easting (m)	Northing (m)
GND0093	17.438	1701117	5630102
GND2011	(Too deep to obtain)	1701078	5629050
GND2348	10.525	1701489	5629031
GND2357	12.748	1702816	5629763



**Figure 2** Aerial photo depicting the locality of the KA-19/20 wellsite and associated groundwater monitoring bores

The monitoring programme provides an initial 12 months of groundwater monitoring. Groundwater samples were obtained from the sampling sites recorded in Table 4 at the following specified intervals:

- Pre-hydraulic fracturing (baseline sample); and
- Three months after initial hydraulic fracturing event.

Prior to the initial hydraulic fracturing process of the KA-19 well, a sample of the fracture fluids was obtained. Once hydraulic fracturing had commenced, fracture fluids returning to the well head (known as return or 'flowback' fluids) were also sampled and analysed for the same parameters as the groundwater samples. The results are detailed in Table 5.

**Table 5** Hydraulic fracture fluid and return hydraulic fracture fluid results obtained from the KA-19 well

Parameter	Unit	Fracture fluid 14 Nov 2013	Return fluid 24 Nov 2013	Return fluid 07 Dec 2013
Alkalinity	CaCO <sub>3</sub>	-	3000	3400
Barium	mg/kg	-	2.0	0.64
Benzene	g/m <sup>3</sup>	0.0010	2.0	3.7
Bicarbonate	g/m <sup>3</sup> HCO <sub>3</sub>	-	3020	3590
Bromine (dissolved)	g/m <sup>3</sup>	-	5.2	1.5
Calcium	g/m <sup>3</sup>	-	40	39
Chloride	g/m <sup>3</sup>	-	1180	500
Conductivity	mS/m@20C	-	851	734
Copper (dissolved)	g/m <sup>3</sup>	-	0.057	0.057
Ethane	g/m <sup>3</sup>	-	0.30	0.58
Ethylbenzene	g/m <sup>3</sup>	0.0045	0.21	1.28
Ethylene	g/m <sup>3</sup>	-	<0.003	<0.003
Ethylene glycol	g/m <sup>3</sup>	127	111	320
Formaldehyde	g/m <sup>3</sup>	-	<0.02	<0.15
Hardness (total)	g/m <sup>3</sup> CaCO <sub>3</sub>	-	125	124
Hydrocarbons	g/m <sup>3</sup>	1750	420	360
Iron (dissolved)	g/m <sup>3</sup>	-	4.4	8.6
Manganese (dissolved)	g/m <sup>3</sup>	-	2.3	1.69
Magnesium	g/m <sup>3</sup>	-	6	7
Mercury (dissolved)	g/m <sup>3</sup>	-	<0.011	<0.011
Methane	g/m <sup>3</sup>	-	1.38	1.51
Methanol	g/m <sup>3</sup>	3	<2	2
Nickel	mg/kg	-	0.36	0.17
Nitrate nitrogen	g/m <sup>3</sup> N	-	23	<0.02
Nitrite / nitrate nitrogen	g/m <sup>3</sup> N	-	53	<0.02
Nitrite nitrogen	g/m <sup>3</sup> N	-	29	<0.02
pH	pH	-	7.1	7.0
Potassium	g/m <sup>3</sup>	-	40	36
Propylene glycol	g/m <sup>3</sup>	<4	<4	<4
Sodium	g/m <sup>3</sup>	-	2100	1970
Sulphate	g/m <sup>3</sup>	-	90	61
Sulphur (dissolved)	g/m <sup>3</sup>	-	30	20
Temperature	Deg.C	-	22	22
Toluene	g/m <sup>3</sup>	0.0091	3.1	11.5
Total dissolved solids	g/m <sup>3</sup>	-	9300	8900
ortho-Xylene	g/m <sup>3</sup>	0.0129	0.52	3.1
meta-Xylene	g/m <sup>3</sup>	0.025	1.48	10.3
Zinc (dissolved)	g/m <sup>3</sup>	-	0.11	0.12

The original wellsite groundwater monitoring programmes involved the analysis for certain parameters. However, the range of parameters being analysed for has evolved since the first consent for hydraulic fracturing was issued. Therefore, the groundwater monitoring programme was subsequently revised and approved by the Chief Executive of the Council. As such, the Council decided the KA-19/20 wellsite groundwater monitoring programme should follow the latest range. The revised parameters that were analysed are as follows:

- pH;
- Conductivity;
- Total dissolved solids;
- Major ions (Ca, Mg, K, Na, total alkalinity, bromide, chloride, nitrate-nitrogen, and sulphate);
- Trace metals (barium, copper, iron, manganese, nickel and zinc);
- Total petroleum hydrocarbons;
- Formaldehyde;
- Dissolved methane and ethane gas;
- Methanol;
- Glycols;
- Benzene, toluene, ethylbenzene, and xylenes (BTEX); and
- Carbon-13 composition of any dissolved methane gas discovered ( $^{13}\text{C-CH}_4$ ).

A site inspection was undertaken during the first hydraulic fracturing operation, on 15 November 2013. This inspection found that there were no observed effects from the discharge.

In order to assess whether the discharge of fracturing fluids had contaminated or put at risk usable freshwater aquifers above the stated point of discharge, groundwater samples were taken as per the monitoring programme outlined above.

The results of the groundwater monitoring programme are detailed in Tables 6 to 9.

**Table 6** Pre and post hydraulic fracturing results obtained from groundwater monitoring bore GND0093

Parameter	Unit	Pre-frac 06 May 2013	Post-frac 13 Mar 2014
Alkalinity (total)	g/m <sup>3</sup> CaCO <sub>3</sub>	53	67
Barium	mg/kg	0.116	0.107
Benzene	g/m <sup>3</sup>	<0.0010	<0.0010
Bicarbonate	g/m <sup>3</sup> HCO <sub>3</sub>	65	81.7
Bromide	g/m <sup>3</sup>	0.08	-
Bromine (dissolved)	g/m <sup>3</sup>	-	0.181
Calcium	g/m <sup>3</sup>	8.9	9.7
Chloride	g/m <sup>3</sup>	34	30
Conductivity	mS/m@20C	24.7	23.2
Copper (dissolved)	g/m <sup>3</sup>	<0.0005	<0.0005
Ethane	g/m <sup>3</sup>	<0.003	<0.003
Ethylbenzene	g/m <sup>3</sup>	<0.0010	<0.0010
Ethylene	g/m <sup>3</sup>	<0.004	<0.003
Ethylene glycol	g/m <sup>3</sup>	<4	<4

Parameter	Unit	Pre-frac 06 May 2013	Post-frac 13 Mar 2014
Formaldehyde	g/m <sup>3</sup>	<0.02	<0.02
Hardness (total)	g/m <sup>3</sup> CaCO <sub>3</sub>	34	39
Hydrocarbons	g/m <sup>3</sup>	<0.7	<0.7
Iron (dissolved)	g/m <sup>3</sup>	1.34	0.45
Manganese (dissolved)	g/m <sup>3</sup>	0.157	0.146
Magnesium	g/m <sup>3</sup>	3.0	3.6
Mercury (dissolved)	g/m <sup>3</sup>	-	<0.00008
Methane	g/m <sup>3</sup>	3.1	2.1
Methanol	g/m <sup>3</sup>	<2	<2
Nickel	mg/kg	0.0006	<0.0005
Nitrate nitrogen	g/m <sup>3</sup> N	<0.002	0.007
Nitrite/nitrate nitrogen	g/m <sup>3</sup> N	0.003	0.008
Nitrite nitrogen	g/m <sup>3</sup> N	<0.002	<0.002
pH	pH	6.4	7.9
Potassium	g/m <sup>3</sup>	9.5	9.0
Propylene glycol	g/m <sup>3</sup>	-	<4
Sodium	g/m <sup>3</sup>	26	23
Static water level	m	-	17.438
Sulphate	g/m <sup>3</sup>	14.3	0.5
Sum of Anions	meq/l	-	2.2
Sum of Cations	meq/l	-	2.0
Temperature	Deg.C	14.2	16.5
Toluene	g/m <sup>3</sup>	<0.0010	<0.0010
Total dissolved solids	g/m <sup>3</sup>	130	112
ortho-Xylene	g/m <sup>3</sup>	<0.0010	<0.0010
meta-Xylene	g/m <sup>3</sup>	<0.002	<0.002
Zinc (dissolved)	g/m <sup>3</sup>	0.47	0.042

**Table 7** Pre and post hydraulic fracturing results obtained from groundwater monitoring bore GND2011

Parameter	Unit	Pre-frac 23 May 2013	Post-frac 14 Mar 2014
Alkalinity (total)	g/m <sup>3</sup> CaCO <sub>3</sub>	147	146
Barium	mg/kg	0.0036	0.0036
Benzene	g/m <sup>3</sup>	<0.0010	<0.0010
Bicarbonate	g/m <sup>3</sup> HCO <sub>3</sub>	176	178.1
Bromine (dissolved)	g/m <sup>3</sup>	-	0.050
Calcium	g/m <sup>3</sup>	24	22
Chloride	g/m <sup>3</sup>	15.0	14.8
Conductivity	mS/m@20C	31.6	31.3
Copper (dissolved)	g/m <sup>3</sup>	<0.0005	<0.0005
Ethane	g/m <sup>3</sup>	<0.003	<0.003
Ethylbenzene	g/m <sup>3</sup>	<0.0010	<0.0010
Ethylene	g/m <sup>3</sup>	<0.003	<0.003
Ethylene glycol	g/m <sup>3</sup>	<4	<4



Parameter	Unit	Pre-frac 23 May 2013	Post-frac 14 Mar 2014
Formaldehyde	g/m <sup>3</sup>	<0.02	<0.02
Hardness (total)	g/m <sup>3</sup> CaCO <sub>3</sub>	92	87
Hydrocarbons	g/m <sup>3</sup>	<0.7	<0.7
Iron (dissolved)	g/m <sup>3</sup>	0.11	0.06
Manganese (dissolved)	g/m <sup>3</sup>	0.026	0.021
Magnesium	g/m <sup>3</sup>	8.0	7.6
Mercury (dissolved)	g/m <sup>3</sup>	<0.00008	<0.00008
Methane	g/m <sup>3</sup>	1.54	3.6
Methanol	g/m <sup>3</sup>	<2	<2
Nickel	mg/kg	<0.0005	<0.0005
Nitrate nitrogen	g/m <sup>3</sup> N	<0.002	0.010
Nitrite/nitrate nitrogen	g/m <sup>3</sup> N	<0.002	0.011
Nitrite nitrogen	g/m <sup>3</sup> N	<0.002	<0.002
pH	pH	8.2	8.2
Potassium	g/m <sup>3</sup>	4.8	4.8
Propylene glycol	g/m <sup>3</sup>	<4	<4
Sodium	g/m <sup>3</sup>	34	31
Sulphahte	g/m <sup>3</sup>	<0.5	<0.5
Sum of Anions	meq/l	3.4	3.3
Sum of Cations	meq/l	3.5	3.2
Temperature	Deg.C	17.2	19.4
Toluene	g/m <sup>3</sup>	<0.0010	<0.0010
Total dissolved solids	g/m <sup>3</sup>	198	210
ortho-Xylene	g/m <sup>3</sup>	<0.0010	<0.0010
meta-Xylene	g/m <sup>3</sup>	<0.002	<0.002
Zinc	g/m <sup>3</sup>	0.027	0.0032

**Table 8** Pre and post hydraulic fracturing results obtained from groundwater monitoring bore GND2348

Parameter	Unit	Pre-frac 01 May 2013	Post-frac 13 Mar 2014
Alkalinity (total)	g/m <sup>3</sup> CaCO <sub>3</sub>	49	50
Barium	mg/kg	0.066	0.056
Benzene	g/m <sup>3</sup>	0.0019	<0.0010
Bicarbonate	g/m <sup>3</sup> HCO <sub>3</sub>	60	61.0
Bromide	g/m <sup>3</sup>	0.30	-
Bromine (dissolved)	g/m <sup>3</sup>	-	0.30
Calcium	g/m <sup>3</sup>	17.5	16.6
Chloride	g/m <sup>3</sup>	99	83
Conductivity	mS/m@20C	45.2	38.7
Copper (dissolved)	g/m <sup>3</sup>	<0.0005	0.0005
Ethane	g/m <sup>3</sup>	<0.003	<0.003
Ethylbenzene	g/m <sup>3</sup>	<0.0010	<0.0010
Ethylene	g/m <sup>3</sup>	<0.004	<0.003
Ethylene glycol	g/m <sup>3</sup>	<4	<4

Parameter	Unit	Pre-frac 01 May 2013	Post-frac 13 Mar 2014
Formaldehyde	g/m <sup>3</sup>	<0.02	<0.02
Hardness (total)	g/m <sup>3</sup> CaCO <sub>3</sub>	80	76
Hydrocarbons	g/m <sup>3</sup>	<0.7	<0.7
Iron (dissolved)	g/m <sup>3</sup>	32	27
Manganese (dissolved)	g/m <sup>3</sup>	0.57	0.53
Magnesium	g/m <sup>3</sup>	8.8	8.4
Mercury (dissolved)	g/m <sup>3</sup>	-	<0.00008
Methane	g/m <sup>3</sup>	0.65	1.02
Methanol	g/m <sup>3</sup>	<2	2
Nickel	mg/kg	0.0009	0.0020
Nitrate nitrogen	g/m <sup>3</sup> N	<0.02	<0.02
Nitrite/nitrate nitrogen	g/m <sup>3</sup> N	<0.02	<0.02
Nitrite nitrogen	g/m <sup>3</sup> N	<0.02	<0.02
pH	pH	6.6	6.8
Potassium	g/m <sup>3</sup>	8.2	8.7
Propylene glycol	g/m <sup>3</sup>	-	<4
Sodium	g/m <sup>3</sup>	28	27
Static water level	m	-	10.525
Sulphate	g/m <sup>3</sup>	25	<0.5
Sum of Anions	meq/l	-	3.3
Sum of Cations	meq/l	-	3.9
Temperature	Deg.C	15.0	16.1
Toluene	g/m <sup>3</sup>	<0.0010	<0.0010
Total dissolved solids	g/m <sup>3</sup>	330	250
ortho-Xylene	g/m <sup>3</sup>	<0.0010	<0.0010
meta-Xylene	g/m <sup>3</sup>	<0.002	<0.002
Zinc	g/m <sup>3</sup>	0.65	0.47

**Table 9** Pre and post hydraulic fracturing results obtained from groundwater monitoring bore GND2357

Parameter	Unit	Pre-frac 02 May 2013	Post-frac 14 Mar 2014
Alkalinity	g/m <sup>3</sup> CaCO <sub>3</sub>	85	75
Barium	mg/kg	0.0196	0.023
Benzene	g/m <sup>3</sup>	<0.0010	<0.0010
Bicarbonate	g/m <sup>3</sup> HCO <sub>3</sub>	104	87
Bromide	g/m <sup>3</sup>	<0.05	-
Bromine (dissolved)	g/m <sup>3</sup>	-	0.042
Calcium	g/m <sup>3</sup>	5.9	5.6
Chloride	g/m <sup>3</sup>	14.0	13.3
Conductivity	mS/m@20C	19.4	17.0
Copper (dissolved)	g/m <sup>3</sup>	0.0035	0.0149
Ethane	g/m <sup>3</sup>	<0.003	<0.003
Ethylbenzene	g/m <sup>3</sup>	<0.0010	<0.0010
Ethylene	g/m <sup>3</sup>	<0.004	<0.003



Parameter	Unit	Pre-frac 02 May 2013	Post-frac 14 Mar 2014
Ethylene glycol	g/m <sup>3</sup>	<4	<4
Formaldehyde	g/m <sup>3</sup>	<0.02	<0.02
Hardness (total)	g/m <sup>3</sup> CaCO <sub>3</sub>	25	25
Hydrocarbons	g/m <sup>3</sup>	11.8	<0.7
Iron (dissolved)	g/m <sup>3</sup>	0.89	9.1
Manganese (dissolved)	g/m <sup>3</sup>	0.051	0.050
Magnesium	g/m <sup>3</sup>	2.6	2.7
Mercury (dissolved)	g/m <sup>3</sup>	-	<0.00008
Methane	g/m <sup>3</sup>	3.7	8.0
Methanol	g/m <sup>3</sup>	<2	<2
Nickel	mg/kg	0.0010	0.0014
Nitrate nitrogen	g/m <sup>3</sup> N	0.005	<0.002
Nitrite / Nitrate nitrogen	g/m <sup>3</sup> N	0.007	<0.002
Nitrite nitrogen	g/m <sup>3</sup> N	<0.002	<0.002
pH	pH	6.8	8.7
Potassium	g/m <sup>3</sup>	3.9	5.1
Propylene glycol	g/m <sup>3</sup>	-	<4
Sodium	g/m <sup>3</sup>	23	25
Static water level	m	-	12.748
Sulphate	g/m <sup>3</sup>	18.1	2.8
Sum of Anions	meq/l	-	1.93
Sum of Cations	meq/l	-	2.3
Temperature	Deg.C	16.1	14.7
Toluene	g/m <sup>3</sup>	<0.0010	<0.0010
Total dissolved solids	g/m <sup>3</sup>	162	151
ortho-Xylene	g/m <sup>3</sup>	<0.0010	<0.0010
meta-Xylene	g/m <sup>3</sup>	<0.002	<0.002
Zinc	g/m <sup>3</sup>	5.7	7.4

The results in Tables 6 to 9 show parameters that are all within the typical range for background Taranaki shallow groundwater.

It is considered that the slight variations seen between samples are not a result of hydraulic fracturing operations, but are natural variances in groundwater between sites and as seasons change. No levels are of any environmental significance.

### 2.3.4 Land status

The wellsite was constructed on a flat rural dairy farming area. Relatively minor earthworks were required to construct the site. The land had not been reinstated at the time of last inspection (6 December 2013) as the site was still in use.

## 2.4 Biomonitoring surveys

No biomonitoring surveys of receiving surface waters were carried out as the controls implemented by Shell Todd Oil Services Ltd did not give rise to any

concerns with regard to effects on surface water quality during activities, in addition the Council's inspections confirmed any absence of visual effects. Also refer to note in section 1.4.8.

## **2.5 Contingency plan**

Shell Todd Oil Services Ltd have provided a general contingency plan, as required by Condition 3 of resource consent 6200-1 with site specific maps which cover all onshore sites that they operate. The contingency plan has been reviewed and approved by officers of the Council.

## **2.6 Investigations, interventions and incidents**

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 Unauthorised Incident Register (UIR) includes events where the company concerned has itself notified the Council. The register contains details of any investigation and corrective action taken.

Incidents may be alleged to be associated with a particular site. If there is 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 monitoring period under review, the Council was required to undertake additional investigations and interventions, or record incidents, in association with Shell Todd Oil Services Ltd's conditions in resource consents or provisions in regional plans.

In the period under review, there was one incident recorded by the Inspecting Officer. On 21 February 2013 an incident inspection was conducted following a notification issued on behalf of Shell Todd Oil Services Ltd, outlining that contaminated water (namely municipal water contaminated with residual hydrocarbons) had discharged from the site. It was found that the discharge pipe from the mud storage tank was relocated so that the water discharged directly offsite. One sample was obtained and it was concluded that any concentrations of contaminants would have reduced through filtration and dilution upon entering the receiving environment. In addition, as the discharge consisted largely of municipal water, was temporary and immediately rectified according to on site best practice, the discharge was therefore unlikely to have had any significant or on-going adverse effect on the receiving environment. Shell Todd Oil Services Ltd were issued with an infringement notice (number 340) as the discharge contravened Section 15(1)(d) of the Resource Management Act and special conditions 1, 6 and 7 of resource consent 6200-1.

Any other minor actual or potential non-compliance with consent conditions were addressed during site inspections. Shell Todd Oil Services Ltd staff were quick to take steps to ensure that requests made by Council Inspecting Officers were adhered to without delay.

### 3. Discussion

#### 3.1 Discussion of consent exercise

Of the four resource consents relating to the KA-19/20 wellsite, consents 6646-1 (take groundwater), 6200-1 (discharge to land - treated stormwater and treated site water), 6822-1 (discharge to air – production activities) and 7995-1 (discharge to land - hydraulic fracturing) were exercised and actively monitored.

Drilling waste was transported off site to a consented facility. It is considered that all remaining resource consent conditions were complied with during the monitoring period, including the provision of various pieces of information (contingency plan, notifications etc.), other than as noted in section 2.6.

Monitoring has shown that the management on site ensured no significant adverse effects to the environment occurred during the monitoring period.

#### 3.2 Environmental effects of exercise of consents

##### Stormwater

The discharge of stormwater from earthworks has the potential for sediment and other contaminants to enter surface water where it may detrimentally affect in-stream flora and fauna. To mitigate these effects, Shell Todd Oil Services Ltd established perimeter drains during the construction of the wellsite, and care was taken to ensure runoff from disturbed areas was directed into the drains or directed through adequate silt control structures, with the exception of the one reported incident on 21 February 2013.

Adverse effects on surface water quality can occur if contaminated water escapes through the stormwater system. Interceptor pits are designed to trap sediment and hydrocarbons through gravity separation. Any water that is unsuitable for release via the interceptor pits was directed to the drilling sumps, or removed for off-site disposal.

Shell Todd Oil Services Ltd also undertook the following mitigation measures in order to minimize off-site adverse effects:

- All stormwater was directed via perimeter drains to the skimmer pits for treatment prior to discharge;
- Additional bunding was constructed around the bulk fuel tank, chemical storage area, hydraulic fracturing flow-back tanks and other areas where runoff from areas containing contaminants could occur;
- Regular inspections of the interceptor pits occurred; and
- Maintenance and repairs were carried out if required.

Interceptor pits do not discharge directly to surface water, instead they discharge onto and into land where the discharge usually soaks into the soil before reaching any surface water. However, if high rainfall had resulted in the discharge reaching the surface water, significant dilution would have occurred.

There are numerous on site procedures included in drilling and health and safety documentation that are aimed at preventing spills on site, and further procedures that address clean-up to remedy a spill situation before adverse environmental effects have the opportunity to occur (e.g. bunding of chemicals and bulk fuel).

### **Groundwater**

It was anticipated that the abstraction of groundwater would not impact on any groundwater resource and that the groundwater would not be affected as it would be protected by the well casing, as outlined on page 4.

### **Flaring**

The environmental effects from flaring have been evaluated in monitoring reports prepared by the Council in relation to the flaring emissions from specific wells in the region.

The Council has previously undertaken field studies at two wells (one gas, and the other producing oil and heavier condensates); together with dispersion modelling at a third site<sup>1</sup>. More recently two studies have focused on field investigations and modelling of emissions from flares involving fracturing fluids.<sup>2</sup>

In brief, the previous studies found that measurements of carbon monoxide, carbon dioxide, and methane concentrations to be safe at all points downwind, including within 50 m of the flare pit. Measurements of suspended particulate matter found concentrations typical of background levels, and measurements of PM<sub>10</sub> found compliance with national standards even in close proximity to the flare. Beyond 120 m from the flare pit, concentrations of polyaromatic hydrocarbons (PAH) approached background levels, as did levels of dioxins beyond 250 m from the flare.

In summary, the studies established that under combustion conditions of high volume flaring of gases with some light entrained liquids etc., atmospheric concentrations of all contaminants had reduced by a distance of 250 m downwind to become essentially typical of or less than elsewhere in the Taranaki environment (e.g. urban areas). These levels are well below any concentrations at which there is any basis for concern over potential health effects.

Thermal oxidisers provide an alternative system for the combustion of volatile organic compounds and are being increasingly adopted by onshore drilling and production operations in Taranaki. Thermal oxidation is the process of oxidizing combustible materials by raising the temperature of the material above its auto-ignition point in the presence of oxygen, and maintaining it at high temperature for sufficient time to complete combustion to carbon dioxide and water. They are enclosed combustion chamber systems as opposed to direct combustion to atmosphere (flaring) and therefore work to reduce emissions and associated effects (eg light pollution from flaring).

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<sup>1</sup> Taranaki Regional Council, *Fletcher Challenge Energy Taranaki Ltd, Mangahewa 2 Gas Well Air Quality Monitoring Programme Report 1997 – 98*, August 1998.

<sup>2</sup> Taranaki Regional Council: *Atmospheric Dispersion Modelling of Discharges to Air from the Flaring of Fracturing Fluid*, Backshall, March 2013; and *Investigation of air quality arising from flaring of fracturing fluids -emissions and ambient air quality*, Technical Report 2012– 03, Taranaki Regional Council May 2012.

Should flaring have occurred, measures to be undertaken by Shell Todd Oil Services Ltd to avoid or mitigate actual or potential adverse environmental impacts on air quality included:

- The use of a test separator to separate solids and fluids from the gas during all well clean-ups, and workover activities where necessary, thus reducing emissions to air. In particular, this would reduce the potential for heavy smoke incidents associated with elevated PAH and dioxin emissions;
- Records of flaring events are kept by Shell Todd Oil Services Ltd and provided to the Council;
- Shell Todd Oil Services Ltd endeavor to minimise smoke emissions from the combustion of gas on site via thermal oxidiser.

### **Odour and dust**

Suppression of dust with water was to be implemented if it was apparent that dust may be travelling in such a direction to adversely affect off-site parties. Odour may stem from the product, or some of the chemicals used on site. Care was taken to minimize the potential for odour emissions (e.g. by keeping containers sealed).

### **Hazardous substances**

The use and storage of hazardous substances on site has the potential to contaminate surface water and soils in the event of a spill. In the unlikely event of a serious spill or fire, the storage of flammable materials could have resulted in air, soil and water contamination.

Shell Todd Oil Services Ltd was required to implement the following mitigation measures:

- All potentially hazardous material were used and stored in accordance with the relevant Hazardous Substances and New Organisms regulations;
- All areas containing hazardous chemicals were bunded;
- Sufficient separation of chemicals from the thermal oxidiser were maintained for safety reasons;
- In the unlikely event of a spill escaping from bunded areas, the site perimeter drain and interceptor pit system was implemented to provide secondary containment on site; and
- A spill contingency plan was prepared that sets out emergency response procedures to be followed in the event of a spill.

### **Hydraulic fracturing**

The process of hydraulic fracturing results in some chemicals (e.g. clay stabilisers) being absorbed into the rock, where some may be residually trapped near the fracture face. The chemicals used in the fracturing process are classified as hazardous substances. However, these additives used in the process make up less than 5% of the total volume of fluid, the remaining being water and proppant. In a concentrated form some of the chemicals used in the fluid are toxic, but prior to the activity they

are highly diluted as part of the process. The majority of the fluid returns to the surface for controlled disposal at a consented facility.

Hence, there is a discharge of contaminants (energy, chemicals, water and inert sand/ small ceramic pellets) to land at considerable depth that has minor and temporary changes to the physical and chemical condition of the land (reservoir) in a way that does not affect other foreseeable users of the land and water resources.

The interval fractured is generally over 3 km below the surface. It is isolated by a considerable thickness of impermeable rock. The reservoir sands are known to contain hydrocarbons at pressures that exceed hydrostatic pressure, proving that the cap rock is relatively impermeable to the flow of water and hydrocarbons over very long time scales and high pressures.

The potential for the hydraulic fracturing activities to trigger seismic activity, particularly if located near faults within the formation has also been raised as a concern by some individuals. However, hydraulic fracturing is designed to create certain fractures in the rock and on a geological scale these are insignificant. The fissures created by the fracturing discharge are generally less than 400 m long, several mm wide and roughly 20 m thick into reservoir rock. These are very small features on a geological scale, and are not envisaged to create any increased risk of significant seismic activity.

The risk of the reservoir being fractured with a failure of the geological seal causing fracture fluids to migrate upwards and contaminate groundwater resources is considered extremely low. This is a result of numerous geological seals acting as natural barriers that stop any fracture fluids migrating upward.

Concern has also been raised that shallow groundwater may become contaminated from chemicals used in the hydraulic fracturing process. It is alleged that fluids may return to the surface via poorly sealed well casing or via cracks created through the fracturing process, rendering groundwater unsafe for human consumption. These hydro-geological risks of hydraulic fracturing affecting potable groundwater arise from two potential sources. The integrity of the well being used for the hydraulic fracturing, including the well casing and cement programme; and the geologic integrity of the reservoir seal and seals above this.

Throughout the hydraulic fracturing operation, the activity is carefully monitored by Shell Todd Oil Services Ltd to track exact composition, volume and pressure of all fluids being injected into the subsurface environment. As a result of fracture design and modelling, coupled with extensive monitoring, the potential for groundwater to be impacted by hydraulic fracturing of a properly constructed well is extremely low and highly unlikely.

## **Summary**

There were no significant environmental effects observed to water, land or air as a result of wellsite and hydraulic fracturing activities at the KA-19/20 wellsite during the monitoring period. There were no unauthorised direct discharge to water or the air observed from the KA-19/20 wellsite.

### 3.3 Evaluation of performance

A tabular summary of Shell Todd Oil Services Ltd's compliance record for the period under review is set out in Tables 10 to 13.

**Table 10** Summary of performance for Consent **6646-1** to take and use groundwater from a bore as a contingency backup supply for fire fighting, well killing, workover and domestic purposes at the KA-1/7 wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Consent holder shall exercise consent in accordance with information submitted	Inspections and comparing submitted & approved plans	Yes
2. Volume of water abstracted shall not exceed 300 m <sup>3</sup> / day at a rate not exceeding 4 litres / second	Water sampling adjacent bores pre/post drilling	Yes
3. Bore completion log must be submitted to the Council prior to the exercise of consent	Log submitted	Yes
4. Consent shall be subject to monitoring by the Council	Inspections and sampling	Yes
5. Consent shall lapse if not implemented by date specified	Notification received and confirmed by inspection	N/A
6. Notice of Council to review consent	Notice of intention not served	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>High</b>

**Table 11** Summary of performance for Consent **6822-1** to discharge emissions into the air from well workovers and in emergency situations and miscellaneous emissions associated with production activities at the KA-1/7 wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Council must be notified 24hrs prior to flaring activities	Notification	Yes
2. 24hrs notice of flaring to the Council when flaring is longer than 5 minutes in duration	Notification	Yes
3. No alterations made to plant equipment that will alter the nature or quantity of flare emissions	Inspection, plant procedures and processes	Yes
4. Consent holder shall have regard to prevailing and predicted wind speed and direction with commencement of flaring	Inspection	Yes
5. Liquid and solid separation to occur before flaring to minimise smoke emissions	Inspection of thermal oxidiser	Yes
6. If separation could not be implemented / maintained, the consent holder shall notify the Council	Notification	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
7. No liquid or solid hydrocarbons shall be combusted within the flare pit	Flare pit decommissioned. Thermal oxidiser inspected in accordance with this condition	Yes
8. Only substances originating from the well stream shall be combusted in the flare pit	Flare pit decommissioned. Thermal oxidiser inspected in accordance with this condition	Yes
9. Conditions 5, 6, 7 & 8 shall not apply to flaring associated with drilling, workover, and fracing activities	Inspections	Yes
10. Best practicable option to be adopted	Inspections, procedures and processes	Yes
11. Consent holder shall not discharge any contaminant to air authorised by this consent at a rate or a quantity such that the contaminant is or is liable to be hazardous or toxic or noxious at or beyond the boundary of the wellsite	Inspections	Yes
12. No offensive odour or smoke beyond the boundary	Inspection	Yes
13. All hydrocarbon vessels to be fitted with vapour recovery systems	Inspection	Yes
14. Opacity of smoke emissions shall not exceed level 1 on Ringelmann Scale	Inspection	Yes
15. Control of carbon monoxide	Chemical analysis of emissions	Yes
16. Control of nitrogen oxides	Chemical analysis of emissions	Yes
17. Control of other emissions	Chemical analysis of emissions	Yes
18. Upon request a record be made available to the Council of all smoke-emitting incidents	Available on request	Yes
19. Log all flaring including time, duration, zone, volumes flared and smoke events	Inspection of Company records	Yes
20. Consent holder shall submit a report to the Council annually	Report received	Yes
21. Analysis of typical gas and condensate stream from field to be made available to the Council	Available upon request	Yes
22. Consent shall lapse if not implemented by date specified	Consent exercised	N/A
23. Notice of Council to review consent	No provision for review during period	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>High</b>



**Table 12** Summary of performance for Consent **6200-1** to discharge treated stormwater and treated site water from hydrocarbon exploration and production operations onto and into land at the KA-1/7 wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Consent holder to adopt best practicable option at all times	Inspecting site, procedures & processes	No – one recorded incident
2. Max stormwater catchment area shall be no more than 2 hectares	Inspection of site and records	Yes
3. Maintain a contingency plan	Contingency plan received and approved	Yes
4. The stormwater system shall be designed, managed and maintained in accordance with information submitted	Comparing submitted & approved plans with the built site inspection	Yes
5. Any above ground hazardous substance storage areas shall be bunded	Inspections	Yes
6. Constituents in discharges shall meet the following standards: a) pH 6.5 – 8.5 b) Suspended solids <100 g/m <sup>3</sup> c) Hydrocarbon <15 g/m <sup>3</sup>	Physicochemical sampling	No – two samples within the treatment systems indicated potential for exceedence, one recorded incident
7. Discharges shall not lead or be liable to lead to the discharge entering a surface water body by direct surface overland flow	Inspection	No – one recorded incident
8. The Council shall be advised 48hrs prior to reinstatement of the site	Notification	N/A
9. Notice of Council to review consent	No provision for review during period	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>Poor</b>

**Table 13** Summary of performance for the original Consent **7995-1** to discharge contaminants associated with hydraulic fracturing activities into land at depths greater than 3000 mTVSS beneath the KA-1/7/19/20 wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Any discharge shall occur below 3,000 mTVSS	Inspection of Company records	Yes
2. Exercise of consent shall not contaminate or put at risk freshwater aquifers	Sampling fresh water bores pre/post discharge	Yes
3. Consent Holder shall undertake sampling programme	Sampling fresh water bores pre/post discharge	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
4. Sampling programme shall follow recognised field procedures	Visual inspection	Yes
5. All sampling shall be submitted to the Council	Notification received	Yes
6. Consent Holder shall undertake pressure testing pre-fracturing	Notification received	Yes
7. A pre-fracturing discharge report is to be provided to the Council 14 days prior to the second and subsequent discharges	Pre-fracturing discharge report submitted 14 days prior to discharge	Yes
8. Consent holder shall notify the Council of a pre-fracturing discharge	Notification received	Yes
9. A post-fracturing discharge report is to be provided to the Council within 60 days after the discharge has ceased	Post-fracturing discharge report submitted within 60 days	Yes
10. The report must be emailed to consents@trc.govt.nz	The report is emailed to consents@trc.govt.nz	Yes
11. The consent holder shall provide access to a location where samples of hydraulic fracturing fluids and return fluids can be obtained.	Access provided	Yes
12. Best practicable option adopted at all times	Inspection of site, procedures & processes	Yes
13. The fracture fluid shall be comprised of no less than 95% water	Sample of discharge and return fluids analysed	Yes
14. Notice of Council to review consent	No provision for review during period	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		<b>High</b>

During the monitoring period, Shell Todd Oil Services Ltd overall demonstrated a good level of environmental performance and compliance with the resource consents. The incident that occurred in respect of resource consent 6200-1 has been discussed in Section 2.6. The site was generally neat, tidy, and well maintained.

### 3.4 Exercise of optional review of consents

Each resource consent includes a condition which allows the Council to review the consent, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of the resource consent, which were not foreseen at the time the application was considered or which it was not appropriate to deal with at the time. The next provisions for review are in 2014 and 2017.

Based on the results of monitoring during the period under review, it is considered that there are no grounds that require a review to be pursued. A recommendation to this effect is presented in section 4.

### **3.5 Alterations to monitoring programmes for hydraulic fracturing activities**

In designing and implementing the monitoring programmes for air and water discharges and water abstractions at wellsites in the region, the Council takes into account the extent of information made available by previous and other authorities, its relevance under the Act, the obligations of the Act in terms of monitoring emissions/discharges and effects, and of subsequently reporting to the regional community, the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of wellsite processes within Taranaki.

The Council has routinely monitored wellsite activities for more than 20 years in the region. This work has included in the order of hundreds of water samples and biomonitoring surveys in the vicinity of wellsites, and has demonstrated robustly that a monitoring regime based on frequent and comprehensive inspections is rigorous and thorough, in terms of identifying any adverse effects from wellsite and associated activities. In addition, with regard to hydraulic fracturing activities, given that the primary effects of concern (had they occurred) would have involved the vertical migration of sediment, hydraulic fracturing fluids and/or hydrocarbons, all of which are easily detectable through inspection and visual scrutiny, this represented an appropriate and well-grounded approach. The wide-ranging scope of the routine inspections in this particular programme to include adjacent waterways and feedback from local residents should particularly be noted. Accordingly the Council had for a time not routinely required the imposition of additional targeted physicochemical and biological monitoring unless a site-specific precautionary approach indicated this would be warranted for certainty and clarity around site effects.

However, the Council has also noted a desire by some community areas or individuals for a heightened level of information feedback and certainty around the results and outcomes of monitoring at wellsites where hydraulic fracturing is to occur or has occurred. Not with standing the long track record of a demonstrable suitability of an inspection-based monitoring programme, the Council has therefore moved to extend the previous regime, to make the sampling and extensive analysis of groundwater and surface waters in the general vicinity of a wellsite where hydraulic fracturing occurs, and biomonitoring of surface water ecosystems, an integral part of the basic monitoring programme for such activities.

It is proposed that for any further work at the KA-19/20 wellsite, the new standard programme will continue to be repeated with the inclusion of biomonitoring surveys, notwithstanding the lack of any effects or concerns previously found. A recommendation to this effect is attached to this report.

## 4. Recommendations

1. THAT this report be forwarded to the Company, and to any interested parties upon request;
2. THAT the monitoring of future consented activities at the KA-19/20 wellsite will continue to include the sampling and extensive analysis of both groundwater and surface waters in the general vicinity of a wellsite where hydraulic fracturing occurs;
3. THAT the monitoring of future consented activities at KA-19/20 wellsite be extended to include a biomonitoring survey;
4. THAT, subject to the findings of monitoring of any further activities at the KA-19/20 wellsite consents 7995-1, 6646-1 and 6822-1 shall not be reviewed in 2014 and 2017 respectively.

## Glossary of common terms and abbreviations

The following abbreviations and terms may have been used within this report:

Al*	Aluminium.
As*	Arsenic.
Biomonitoring	Assessing the health of the environment using aquatic organisms.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODF	Biochemical oxygen demand of a filtered sample.
Bund	A wall around a tank to contain its contents in the case of a leak.
CBOD	Carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate .
cfu	Colony forming units. A measure of the concentration of bacteria usually expressed as per 100 millilitre sample.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
Condy	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
cu*	Copper.
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
E.coli	Escherichia coli, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Ent	Enterococci, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre of sample.
F	Fluoride.
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
g/m <sup>3</sup>	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
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.

l/s	Litres per second.
MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
mS/m	Millisiemens per metre.
Mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
NH <sub>4</sub>	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH <sub>3</sub>	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO <sub>3</sub>	Nitrate, normally expressed in terms of the mass of nitrogen (N).
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water.
O&G	Oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons).
Pb*	Lead.
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly 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.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
PM <sub>10</sub>	Relatively fine airborne particles (less than 10 micrometre diameter).
Resource consent	Refer Section 87 of the RMA. Resource consent 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.
SS	Suspended solids.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.
UIR	Unauthorised Incident Register – contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
Zn*	Zinc.

\*an abbreviation for a metal or other analyte may be followed by the letters 'As', to denote the amount of metal recoverable in acidic conditions. This is taken as indicating the total amount of metal that might be solubilised under extreme environmental conditions. The abbreviation may alternatively be followed by the letter 'D', denoting the amount of the metal present in dissolved form rather than in particulate or solid form.

For further information on analytical methods, contact the Council's laboratory.

## **Appendix I**

### **Resource consents**







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

CHIEF EXECUTIVE  
PRIVATE BAG 713  
47 CLOTEN ROAD  
STRATFORD  
NEW ZEALAND  
PHONE: 06-765 7127  
FAX: 06-765 5097  
www.trc.govt.nz

Please quote our file number  
on all correspondence .

Name of  
Consent Holder: Shell Todd Oil Services Ltd  
Private Bag 2035  
NEW PLYMOUTH 4342

Decision Date  
[Change]: 12 January 2011



Commencement  
Date [Change]: 12 January 2011 [Granted: 16 September 2003]

**Conditions of Consent**

Consent Granted: To discharge treated stormwater and treated site water  
from hydrocarbon exploration and production operations  
onto and into land at the KA-1/7 wellsite at or about  
(NZTM) 1701143E-5630060N

Expiry Date: 1 June 2017

Review Date(s): June 2005, June 2011

Site Location: KA-1/7 wellsite, 360 Palmer Road, Kapuni

Legal Description: Lot 2 DP 11138 Pt Lot 1 DP 10737 Blk XVI Kaupokonui SD  
[Discharge source & site]

Catchment: Kapuni

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

**General conditions**

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



**Special conditions**

- 1. The consent holder shall at all times adopt the best practicable option, as defined in the Resource Management Act 1991, to prevent or minimise any adverse effects of the discharge on the receiving environment.
- 2. The maximum stormwater catchment area shall be no more than 2 hectares.
- 3. Prior to the exercise of this consent, the consent holder shall prepare a contingency plan to be approved by the Chief Executive, Taranaki Regional Council, outlining measures and procedures to be undertaken to prevent spillage or accidental discharge of contaminants not licensed by this consent and measures to avoid, remedy or mitigate the environmental effects of such a spillage or discharge.
- 4. The design, management and maintenance of the stormwater system shall be generally undertaken in accordance with the information submitted in support of the application.
- 5. Any above ground hazardous substances storage areas shall be bunded with drainage to appropriate recovery systems, and not directly to the stormwater catchment.
- 6. The following concentrations shall not be exceeded in the discharge:

<b>Component</b>	<b>Concentration</b>
pH (range)	6.5 - 8.5
suspended solids	100 gm <sup>3</sup>
total recoverable hydrocarbons [infrared spectroscopic technique]	15 gm <sup>3</sup>


This condition shall apply prior to the discharge of the treated stormwater into the receiving environment, at a designated sampling point approved by the Chief Executive, Taranaki Regional Council.

Consent 6200-1

7. The exercise of this consent, including the design, management and implementation of the discharge shall not lead or be liable to lead to the discharge entering a surface water body by direct surface overland flow.
8. The Chief Executive, Taranaki Regional Council, shall be advised 48 hours prior to the reinstatement of the site and the reinstatement shall be carried out so as to minimise effects on stormwater quality.
9. 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 2005 and/or June 2011, 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 12 January 2011

For and on behalf of  
Taranaki Regional Council

  
\_\_\_\_\_  
Director-Resource Management



Consent 6646-1



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

CHIEF EXECUTIVE  
PRIVATE BAG 713  
47 CLOTEN ROAD  
STRATFORD  
NEW ZEALAND  
PHONE: 06-765 7127  
FAX: 06-765 5097  
[www.trc.govt.nz](http://www.trc.govt.nz)

Please quote our file number  
on all correspondence

Name of  
Consent Holder: Shell Todd Oil Services Limited  
Private Bag 2035  
NEW PLYMOUTH

Consent Granted  
Date: 18 July 2005

**Conditions of Consent**

Consent Granted: To take and use groundwater from a bore as a contingency backup supply for fire fighting, well killing, workover and domestic purposes at the KA-1/7 wellsite at or about GR: Q20:111-918

Expiry Date: 1 June 2023

Review Date(s): June 2011, June 2017

Site Location: KA-1/7 wellsite, Palmer Road, Kapuni

Legal Description: Lots 1 & 2 DP 11138 Blk XVI Kaupokonui SD

Catchment: Kapuni

*For General, Standard and Special conditions  
pertaining to this consent please see reverse side of this document*  
[www.trc.govt.nz](http://www.trc.govt.nz)

**Working with people • Caring for our environment**

### **General conditions**

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

### **Special conditions**

1. The exercise of this consent shall be undertaken in general accordance with the documentation submitted in support of application 3842. In the case of any contradiction between the documentation submitted in support of application 3842 and the conditions of this consent, the conditions of this consent shall prevail.
2. The volume of water abstracted shall not exceed 300 cubic metres per day at a rate not exceeding 4.0 litres per second.
3. Prior to the exercise of this consent, the consent holder shall provide a bore completion log to the satisfaction of the Chief Executive, Taranaki Regional Council.
4. This consent shall be subject to monitoring by the Taranaki Regional Council and the consent holder shall meet all reasonable costs associated with the monitoring.
5. This consent shall lapse on the expiry of five years after the date of commencement of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

Consent 6646-1

6. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2011 and June 2017, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 18 July 2005

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: Shell Todd Oil Services Ltd  
Private Bag 2035  
NEW PLYMOUTH 4342

Decision Date [change]: 9 August 2013

Commencement Date [change]: 9 August 2013 [Granted: 21 March 2006]

**Conditions of Consent**

Consent Granted: To discharge emissions into the air from well workovers and in emergency situations and miscellaneous emissions associated with production activities at the KA-1/7 wellsite

Expiry Date: 1 June 2023

Review Date(s): June 2017

Site Location: KA-1/7 wellsite, 360 Palmer Road, Kapuni

Legal Description: Lots 1 & 2 DP 11138 Blk XVI Kaupokonui SD  
[Discharge source & site]

Grid Reference (NZTM) 1701216E-5630166N

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

### **General conditions**

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

### **Special conditions**

#### **Information and notification**

1. At least 24 hours prior to any flaring, other than in emergencies, the consent holder shall undertake all practicable measures to notify residents within 1000 metres of the site of the commencement of flaring. The consent holder shall include in the notification a 24-hour contact telephone number for a representative of the consent holder, and shall keep and make available to the Chief Executive, Taranaki Regional Council, a record of all queries and/or complaints received.
2. The consent holder shall, whenever practicable, notify the Chief Executive, Taranaki Regional Council, whenever the continuous flaring of hydrocarbons [other than purge gas] is expected to occur for more than five minutes in duration. Notification shall, as far as practicable, be no less than 24 hours prior to such flaring being commenced.
3. No alteration shall be made to plant equipment or processes which may substantially alter the nature or quantity of flare emissions or other site emissions, including but not limited to the recovery of produced gas, other than as notified in this consent application, without prior consultation with the Chief Executive, Taranaki Regional Council, and the consent holder shall obtain any necessary approvals under the Resource Management Act 1991.

#### **Emissions from the site**

4. Other than for the maintenance of a pilot flare flame, the consent holder shall have regard to the prevailing and predicted wind speed and direction at the time of initiation of any episode of flaring or other combustion of hydrocarbons.
5. All gas being flared, at any time must first be treated by effective liquid and solid separation and recovery, as far as is practicable, to ensure that smoke emission during flaring is minimised.

## Consent 6822-1

6. If separation cannot be implemented and/or maintained at any time while there is a flow from the well, whether natural or induced, then the consent holder shall notify the Chief Executive, Taranaki Regional Council, and shall in any case re-establish liquid and solid separation and recovery within three hours.
7. Subject to special conditions 5 and 6, no liquid or solid hydrocarbons shall be combusted through the gas flare system other than in an emergency.
8. Only substances originating from the well stream and treated as outlined by conditions 5, 6, 7, and 10 shall be combusted within the flare pit.
9. Conditions 5, 6, 7 and 8 shall not apply to flaring associated with drilling, workover, and fracking activities, occurring on not more than 30 days between 1 October 2011 and 31 October 2012.
10. The consent holder shall adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or potential effect on the environment arising from any emission to air from the flare or any other emissions to air from the Kapuni wellsites. Any adoption of the best practicable option as outlined in this special condition shall be to the satisfaction of the Chief Executive, Taranaki Regional Council.
11. The consent holder shall not discharge any contaminant to air authorised by this consent at a rate or a quantity such that the contaminant, whether alone or in combination with other contaminants, is or is liable to be hazardous or toxic or noxious at or beyond the boundary of the wellsite, or beyond 100 metres of the flare, whichever distance is greater.
12. There shall not be any offensive odour or smoke, as determined by an enforcement officer of the Taranaki Regional Council, beyond the boundary of the wellsite or beyond 100 metres of the flare, whichever distance is greater, arising from the exercise of this consent.
13. All hydrocarbon storage vessels shall be fitted with vapour recovery systems.
14. The opacity of any smoke emissions shall not exceed a level of 1 as measured on the Ringelmann Scale for more than four minutes cumulative duration in any 60-minute period.
15. The consent holder shall control all emissions of carbon monoxide to the atmosphere from the flare, whether alone or in conjunction with any other emissions from the wellsite, in order that the maximum ground level concentration of carbon monoxide arising from the exercise of this consent measured under ambient conditions does not exceed 10 mg/m<sup>3</sup> [eight-hour average exposure], or 30 mg/m<sup>3</sup> one-hour average exposure] at or beyond the boundary of the wellsite or beyond 100 metres from the flare, whichever distance is greater.

16. The consent holder shall control all emissions of nitrogen oxides to the atmosphere from the flare, whether alone or in conjunction with any other emissions from the wellsite, in order that the maximum ground level concentration of nitrogen dioxide arising from the exercise of this consent measured under ambient conditions does not exceed 100 mg/m<sup>3</sup> [24-hour average exposure], or 200 mg/m<sup>3</sup> [1-hour average exposure] at or beyond the boundary of the wellsite, or beyond 100 metres from the flare, whichever distance is greater.
17. The consent holder shall control emissions to the atmosphere from the wellsite and flare of contaminants other than carbon dioxide, carbon monoxide, and nitrogen oxides, whether alone or in conjunction with any emissions from the flare, in order that the maximum ground level concentration for any particular contaminant arising from the exercise of this consent measured at or beyond the boundary of the wellsite or beyond 100 metres from the flare, whichever distance is greater, is not increased above background levels:
  - a) by more than 1/30<sup>th</sup> of the relevant Occupational Threshold Value-Time Weighted Average, or by more than the Short Term Exposure Limit at any time [all terms as defined in Workplace Exposure Standards, 2002, Department of Labour]; or
  - b) if no Short Term Exposure Limit is set, by more than three times the Time Weighted Average at any time [all terms as defined in Workplace Exposure Standards, 2002, Department of Labour].

### **Recording and reporting information**

18. The consent holder shall keep and make available to the Chief Executive, Taranaki Regional Council, upon request, a record of all smoke-emitting incidents noting time, duration and cause.
19. The consent holder shall keep and maintain a log of all continuous flaring incidents longer than five minutes, and any intermittent flaring lasting for an aggregate of ten minutes or longer in any 120-minute period. Such a log shall contain the date, the start and finish times, the quantity and type of material flared, and the reason for flaring. This log shall be made available to the Chief Executive, Taranaki Regional Council, upon request, and summarised annually in the report required under condition 20.
20. The consent holder shall provide to the Taranaki Regional Council during August of each year, for the duration of this consent, a report:
  - i) detailing any energy efficiency measures implemented on the site;
  - ii) detailing smoke emissions as required under condition 18;
  - iii) detailing any measures to reduce smoke emissions;
  - iv) detailing any measures to reduce flaring;
  - v) addressing any other issue relevant to the minimisation or mitigation of emissions from the flare;
  - vi) detailing any complaints received and any measures undertaken to address complaints; and
  - vii) reviewing all options and technological advances relevant to the reduction or mitigation of any discharge to air from the site, how these might be applicable and/or implemented at the site, and the benefits and costs of these advances.

## Consent 6822-1

21. The consent holder shall make available to the Chief Executive, Taranaki Regional Council, upon request, an analysis of a typical gas and crude oil stream from the field, covering sulphur compound content and the content of carbon compounds of structure C<sub>6</sub> or higher number of compounds.

### **Lapse and Review**

22. This consent shall lapse on the expiry of five years after the date of issue of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.
23. 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 2017, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 09 August 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: Shell Todd Oil Services Ltd  
Private Bag 2035  
NEW PLYMOUTH 4342

Decision Date: 28 March 2012

Commencement  
Date: 28 March 2012

**Conditions of Consent**

Consent Granted: To discharge contaminants associated with hydraulic fracturing activities into land at depths greater than 3000 mTVDss beneath the KA-1/7/19/20 wellsite at or about (NZTM) 1701152E-5630141N

Expiry Date: 1 June 2017

Review Date(s): June 2012, June 2013, June 2014, June 2015, June 2016

Site Location: KA-1/7/19/20 wellsite, 360 Palmer Road, Kapuni

Legal Description: Lot 2 DP 11138 Blk XVI Kaupokonui SD  
(Discharge source & site)

Catchment: Kapuni

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

### General condition

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

### Special conditions

1. The discharge point shall be deeper than 3000 mTVDss.

Note: mTVDss = metres true vertical depth subsea, i.e. the true vertical depth in metres below mean sea level.

2. 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.

3. 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 2 (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 the discharge point(s);
- (b) the location of sampling sites; and
- (c) sampling frequency with reference to a hydraulic fracturing programme.

4. 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 (<sup>13</sup>C-CH<sub>4</sub>).

Note: *The samples required, under conditions 3 and 4, could be taken and analysed by the Council or other contracted party on behalf of the consent holder.*



5. 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 2.

*Note: The Sampling and Analysis Plan may be combined with the Monitoring Programme required by condition 2.*

6. The consent holder shall undertake well and equipment pressure testing prior to any hydraulic fracture programme on a given well to ensure any discharge will not affect the integrity of the well and hydraulic fracturing equipment.
7. Any hydraulic fracture discharge shall only occur after the consent holder has provided a comprehensive 'Pre-fracturing discharge report' to the Chief Executive. The report shall be provided at least 14 days before the discharge is proposed to commence and shall detail the hydraulic fracturing programme proposed, including as a minimum:
  - (a) the specific well in which each discharge is to occur and the intended fracture interval(s) ('fracture interval' is the discrete subsurface zone to receive a hydraulic fracture treatment);
  - (b) the number of discharges proposed and the geographical position (i.e. depth and lateral position) of each intended discharge point;
  - (c) the total volume of fracture fluid planned to be pumped down the well and its intended composition, including a list of all contaminants and Material Safety Data Sheets for all the chemicals to be used;
  - (d) the results of the reviews required by condition 12;
  - (e) results of modelling showing an assessment of the likely extent and dimensions of the fractures that will be generated by the discharge;
  - (f) the preventative and mitigation measures to be in place to ensure the discharge does not cause adverse environmental effects and complies with condition 2;
  - (g) the extent and permeability characteristics of the geology above the discharge point to the surface;
  - (h) any identified faults within the modeled fracture length plus a margin of 50%, and the potential for adverse environmental effects due to the presence of the identified faults;
  - (i) the burst pressure of the well and the anticipated maximum well and discharge pressures and the duration of the pressures; and
  - (j) details of the disposal of any returned fluids, including any consents that are relied on to authorise the disposal.

*Note: For the avoidance of doubt, the information provided with a resource consent application would usually be sufficient to constitute a 'Pre-fracturing discharge report' for any imminent hydraulic fracturing discharge. The Pre-fracturing discharge report provided for any later discharge may refer to the resource consent application or earlier Pre-fracturing discharge reports noting any differences.*

8. The consent holder shall notify the Taranaki Regional Council of each discharge by emailing [worknotification@trc.govt.nz](mailto:worknotification@trc.govt.nz). Notification shall include the date that the discharge is to occur and identify the 'Pre-fracturing discharge report', required by condition 7, which details the discharge. Where practicable and reasonable notice shall be given between 3 days and 14 days before the discharge occurs, but in any event 24 hours notice shall be given.
9. At the conclusion of a hydraulic fracturing programme on a given well, the consent holder shall submit a comprehensive 'Post-fracturing discharge report' to the Chief Executive. The report shall be provided within 60 days after the programme is completed and, as a minimum, shall contain:
  - (a) confirmation of the interval(s) where fracturing occurred for that programme, and the geographical position (i.e. depth and lateral position) of the discharge point for each fracture interval;
  - (b) the contaminant volumes and compositions discharged into each fracture interval;
  - (c) the volume of return fluids from each fracture interval;
  - (d) an analysis for the constituents set out in conditions 4(a) to 4(k), in a return fluid sample taken within the first two hours of flow back, for each fracture interval if flowed back individually, or for the well if flowed back with all intervals comingled;
  - (e) an estimate of the volume of fluids (and proppant) remaining underground;
  - (f) the volume of water produced with the hydrocarbons (produced water) over the period beginning at the start of the hydraulic fracturing programme and ending 50 days after the programme is completed;
  - (g) an assessment of the extent and dimensions of the fractures that were generated by the discharge, based on modelling undertaken after the discharge has occurred and other diagnostic techniques, including production analysis, available to determine fracture length, height and containment;
  - (h) the results of pressure testing required by condition 6, and the well and discharge pressure durations and the maximum pressure reached during the hydraulic fracture discharge;
  - (i) details of the disposal of any returned fluids, including any consents that are relied on to authorise the disposal;
  - (j) details of any incidents where hydraulic fracture fluid is unable to pass through the well perforations (screen outs) that occurred, their likely cause and implications for compliance with conditions 1 and 2; and
  - (k) an assessment of the effectiveness of the mitigation measures in place with specific reference to those described in the application for this consent.
10. The reports described in conditions 7 and 9 shall be emailed to [consents@trc.govt.nz](mailto:consents@trc.govt.nz) with a reference to the number of this consent.
11. The consent holder shall provide access to a location where the Taranaki Regional Council officers can obtain a sample of the hydraulic fracturing fluids and the return fluids.

12. 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 minimize any actual or likely adverse effect of the activity on the environment by, as a minimum, ensuring that:
  - (a) the discharge is contained within the fracture interval;
  - (b) regular reviews are undertaken of the preventative and mitigation measures adopted to ensure the discharge does not cause adverse environmental effects; and
  - (c) regular reviews of the chemicals used are undertaken with a view to reducing the toxicity of the chemicals used.
13. The fracture fluid shall be comprised of no less than 95% water and proppant by volume.
14. The Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during the month of June each year, for the purposes of:
  - (a) ensuring that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of this 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; and/or
  - (b) further specifying the best practicable option as required by condition 12; and/or
  - (c) ensuring hydraulic fracturing operations appropriately take into account any best practice guidance published by a recognised industry association or environmental regulator.

Signed at Stratford on 28 March 2012

For and on behalf of  
Taranaki Regional Council

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**Director-Resource Management**

