Todd Energy Limited
Mangahewa-C Wellsite
Monitoring Programme Report
2012-2014

Technical Report 2014–12

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Executive summary

Todd Energy Limited previously established a hydrocarbon exploration site located off Tikorangi Road East, Tikorangi, within the New Plymouth district, in the Waiau catchment. This wellsite was initially established for earlier exploration efforts, and has since had site upgrades and boundaries extended to accommodate new exploration wells. The site is called Mangahewa-C wellsite. This report covers the period from September 2012 – January 2014. During this period five wells were drilled (MHW09, MHW12, MHW13, MHW14 and MHW15), all were tested, hydraulically fractured and are now producing.

This report describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess Todd Energy Limited's environmental performance in relation to drilling operations at the Mangahewa-C wellsite during the period under review, and the results and environmental effects of Todd Energy Limited's activities.

Todd Energy Limited holds a total of six resource consents for the activities at the Mangahewa-C wellsite, which include a total of 95 consent conditions setting out the requirements that Todd Energy Limited must satisfy. Todd Energy Limited holds consent 6971-1 to take groundwater; consent 6970-1 to discharge stormwater and sediment from earthworks during construction onto and into land; consent 6967-1 to discharge treated stormwater and produced water associated with exploration activities to land and in circumstances where it may enter into an unnamed tributary of the Waiau Stream; consent 6973-1 to discharge emissions to air associated with exploration activities; consent 7971-1 to discharge contaminants in association with hydraulic fracturing activities into land; and consent 6969-1 to discharge drilling waste from hydrocarbon exploration onto and into land via mix-bury-cover**.**

The Council's monitoring programme for the period under review included 40 inspections of the site and surrounding environment, at approximately fortnightly intervals, 37 stormwater samples, 12 groundwater samples (ten of which were in relation to hydraulic fracturing and the remaining two were in relation to mix-bury-cover), six hydraulic fracture fluid samples, six return fracture fluid samples, one soil sample, and one BTEX ambient air monitoring survey.

Flaring was intermittent on site during the monitoring period. Three complaints were received from nearby residents in relation to smoke issues arising from flaring activities at the Mangahewa-C wellsite. However, following inspections these complaints could not be substantiated as no consent conditions were contravened and no off site effects were detected. In addition, Todd Energy Limited were prompt to identify and resolve flaring issues according to on site best practice. Furthermore, the Council undertook an additional investigation at the request of Todd Energy Limited regarding the potential for adverse effects from black smoke occasionally associated with flaring activities at the wellsite. The BTEX ambient air monitoring survey returned results below detectable limits, hence flaring activities were unlikely to have had any significant or ongoing adverse effect on the environment.

A fourth complaint was received during the period under review regarding the settling pond associated with the new skimmer pits. Two of the three samples obtained in conjunction with inspection returned elevated levels of suspended solids. However, upon further investigation, the elevated suspended solid results were not the result of activities at

the Mangahewa-C wellsite, but rather attributed to unrelated earthwork activities occurring at an adjacent site.

Mix-bury-cover was not consistently exercised throughout the monitoring period, as drilling muds, cuttings and wastes were disposed of at an appropriate off site facility. The consent was exercised once during the period under review prior to the commencement of construction activities for the new section of the Mangahewa-C wellsite. Mix-bury-cover was used to dispose of lightly contaminated soil from the redundant flare pit.

During the monitoring period, Todd Energy Limited demonstrated a high level of environmental performance and compliance with the resource consents. The site was generally neat, tidy, and well maintained and site staff were cooperative with requests made by officers of the Council, with any required works being completed quickly and to a satisfactory standard.

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

Table of contents

List of tables

List of Figures

1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period September 2012 – January 2014 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by Todd Energy Limited. During this period, five wells were drilled (MHW09, MHW12, MHW13, MHW14 and MHW15), all were tested, hydraulically fractured and are now producing.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consents held by Todd Energy Limited that relate to exploration activities at Mangahewa-C wellsite located off Tikorangi Road East, in the New Plymouth 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 Todd Energy Limited's use of water, land, and air.

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 Todd Energy Limited in the Waiau 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 Mangahewa-C 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' in as much 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 Resource Management Act 1991, the Council undertakes compliance monitoring for consents and rules in regional plans; and maintains an overview of performance of resource users against regional plans and consents. Compliance monitoring, including impact monitoring, also enables the Council to continuously assess its own performance in resource management as well as that of resource users particularly consent holders. It further enables the Council to continually re-evaluate its approach and that of consent holders to resource management, and, ultimately, through the refinement of methods, 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

Todd Energy Limited holds an 18 year Petroleum Mining Permit No. 38150 to prospect, explore, and mine for condensate, gas, LPG, oil and petroleum within an area of 44.36 Km^2. The Mangahewa-C wellsite is one of many sites within this area that have been established in order to explore, evaluate and produce hydrocarbons.

This wellsite was initially established for previous exploration efforts and has since had site upgrades and boundaries extended to accommodate new exploration wells, as seen in Figure 1 and 2. The Mangahewa-C wellsite is located approximately 2.3 km along Tikorangi Road East, approximately 3.4 km from Tikorangi.

The establishment of the wellsite 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;
- A flare pit; and
- Other on-site facilities such as accommodation, parking and storage.

The nearest residence is approximately 680 m away from the wellsite. Bunding, earthworks and good site location helped minimise any potential for off site effects for the neighbours.

Figure 1 Aerial view depicting the locality of the Mangahewa-C wellsite, with approximate regional location (inset)

Figure 2 Aerial view of the original Mangahewa-C wellsite (left) and aerial view of the Mangahewa-C wellsite post boundary extension and facility upgrade as it operates at present (right)

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 and 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 Mangahewa-C wellsite is located approximately 172 m north-west of the nearest water body, which is an unnamed tributary of the Waiau 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 the 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 an unnamed tributary in the Waiau 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 exploration activities

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

- Well testing and clean-up;
- Production testing;
- Emergencies; and
- Maintenance and enhancement activities [well workovers].

1.3 Resource consents

1.3.1 Background

Todd Energy Limited holds six resource consents related to exploration activities at the Mangahewa-C wellsite site, as follows:

- Water Permit 6971-1; granted 19 October 2006,
- Discharge Permit 6967-1; granted 19 October 2006 (changed 26 March 2013),
- Discharge Permit 6970-1; granted 18 October 2006,
- Discharge Permit 6973-1;granted 19 October 2006 (changed 1 May 2007),
- Discharge Permit 7971-1; granted 20 January 2012 and
- Discharge Permit 6969-1; granted 19 October 2006.

Each of the consent applications were processed on a non-notified basis as Todd Energy Limited 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.*

Todd Energy Limited holds water permit 6971-1 to take groundwater that may be encountered as produced water during exploration and production operations at the Mangahewa-C wellsite.

Any produced water would be from reserves far below that which is used for domestic or farm purposes. In addition, there are no known groundwater abstractions within a radial distance of approximately one kilometre from the 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 19 October 2006 under Section 87(d) of the RMA. It is due to expire on 1 June 2021.

Consent conditions were imposed on Todd Energy Limited to ensure that adverse effects were avoided in the first instance. A summary of conditions can be viewed within Table 17, 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 produced 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, treated produced water and surplus drill 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.

Todd Energy Limited holds water discharge permit 6967-1 to discharge treated stormwater and produced water from hydrocarbon exploration and production operations at the Mangahewa-C wellsite onto and into land, including by the use of a slurry wagon, in circumstances where it may enter into an unnamed tributary of the Waiau Stream.

This permit was initially issued by the Council on 19 October 2006 under Section 87(e) of the RMA. It is due to expire on 1 June 2021.

Consent conditions were imposed on Todd Energy Limited to ensure that adverse effects were avoided in the first instance. A summary of conditions can be viewed in Table 19, Section 3.3.

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

1.3.4 Water discharge permit (stormwater and sediment – earthworks)

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.

Council considered that the application fell under Rule 27 of the RFWP as a controlled activity (which may be non-notified without written approval), subject to one standard/term/condition to be met:

- *A site erosion and sediment control management plan shall be submitted to the Taranaki Regional Council.*

Todd Energy Limited supplied a site erosion and sediment control management plan in support of the application.

The Council was satisfied that the 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:

- Approval of a site erosion and sediment control management plan and the matters contained therein;
- Setting of conditions relating to adverse effects on water quality and the values of the waterbody;
- Timing of works;
- Any measures necessary to reinstate the land following the completion of the activity;
- Monitoring and information requirements;
- Duration of consent;
- Review of conditions of consent and the timing and purpose of the review; and
- Payment of administrative charges and financial contributions.

Todd Energy Limited holds water discharge permit 6970-1 to discharge stormwater and sediment arising from earthworks during the construction of the Mangahewa-C wellsite onto and into land.

This permit was issued by the Council on 18 October 2006 under Section 87(e) of the RMA. It is due to expire on 1 June 2021.

Consent conditions were imposed on Todd Energy Limited to ensure that adverse effects are avoided in the first instance. A summary of conditions can be viewed in Table 20, Section 3.3.

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

1.3.5 Air discharge permit (exploration 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 exploration activities at the Mangahewa-C wellsite fell within Rule 9 of the Regional Air Quality Plan (RAQP).

The standard/term/conditions associated with Rule 9 are as follows:

- *Flare or incinerator point is at least 300 metres from any dwelling house;*
- *The discharge to air from the flare must not last longer than 15 days cumulatively, including of testing, clean-up, and completion stages of well development or work-over, per zone to be appraised; and*
- *No material to be flared or incinerated, other than those derived from or entrained in the well steam.*

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

Todd Energy Limited holds air discharge permit 6973-1 to discharge emissions to air from flaring of hydrocarbons and miscellaneous emissions associated with hydrocarbon exploration activities, including drill stream testing, well clean-up, initial well testing and production testing at the Mangahewa-C wellsite.

This permit was initially issued by the Council on 19 October 2006 under Section 87(e) of the RMA. It is due to expire on 1 June 2021.

Consent conditions were imposed on Todd Energy Limited to ensure that adverse effects are avoided in the first instance. A summary of conditions can be viewed in Table 18, Section 3.3.

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

1.3.6 Land discharge permit (hydraulic fracturing)

Sections 15(1)(b) and (d) of the *Resource Management Act 1991* (RMA) stipulates 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" rule 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 Resource Management Act 1991 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.

Todd Energy Limited holds discharge permit 7971-1 to discharge contaminants associated with hydraulic fracturing activities into land at depths greater than 3,425 mTVD (true vertical depth), beneath the Mangahewa-C wellsite.

This permit was issued by the Council on 20 January 2012 under Section 87(e) of the RMA. It is due to expire on 1 June 2014.

Consent conditions were imposed on Todd Energy Limited to ensure that adverse effects are avoided in the first instance. A summary of conditions can be viewed in Table 21, Section 3.3.

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

1.3.7 Land discharge permit (mix-bury-cover)

Sections 15(1)(b) and (d) of the *Resource Management Act 1991* (RMA) stipulates 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 mix-bury-cover, onto and into land where contaminants may reach water, is a discretionary activity under Rule 44 of the RFWP.

Todd Energy Limited holds discharge permit 6969-1 to discharge drilling muds, cuttings and wastes from hydrocarbon exploration activities at the Mangahewa-C wellsite onto and into land via mix-bury-cover.

This permit was issued by the Council on 19 October 2006 under Section 87(e) of the RMA. It is due to expire on 1 June 2021.

Consent conditions were imposed on Todd Energy Limited to ensure that adverse effects were avoided in the first instance. A summary of conditions can be viewed in Table 22, 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 deep well injection); and
- Biomonitoring surveys.

The monitoring programme for the Mangahewa-C wellsite focused primarily on programme liaison and management, site inspections, physicochemical sampling 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 (land farming), 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, and that on site staff 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 flared when practicable. This requirement was checked to ensure compliance with the conditions.

1.4.7 Discharges to land (hydraulic fracturing)

Sampling and analysis of the hydraulic fracturing, return flow fluids and nearby bores were carried out during the period under review. In addition, inspections of the site and surrounding land and water were carried out to ensure that no observable effects had 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 ecosystems. However, as the Mangahewa-C wellsite is a considerable distance (approximately 172 m) from the nearest surface water course, and inspections of the receiving water have not shown any adverse effects from the discharges, no biomonitoring surveys have been undertaken during this monitoring period.

2. Results

2.1 Water

2.1.1 Inspections

The Mangahewa-C wellsite, adjacent land and streams were inspected 40 times during the monitoring period. Below is a copy of the comments that were noted on the day of each inspection.

13 September 2012
Wireline operations were taking place and a small amount of gas to be flared was anticipated in conjunction with these operations. The site appeared tidy with a small volume of chemicals stored on site. Discussions were held with on site staff regarding the construction of the new flare pit and containment pit, with the potential for the old flare pit to be disposed of off site pending soil sample results. Skimmer pits were not discharging at the time of inspection; however a sample was obtained from the second skimmer pit to ensure compliance with consent conditions in anticipation of potential discharges.

26 September 2012
A meeting was held on site with operation staff regarding the construction and design of the new flare, containment and skimmer pits. All pits were to be lined with PVC and the old flare pit was to be removed. A metre of soil from the base of the old flare pit was to be removed and the soil sampled for any possible contamination. The site appeared clean and tidy.

5 October 2012
A meeting was held on site with representatives from Todd Energy Limited, Burgess & Crowley and BTW. Discussions were held regarding the design and construction of the silt and sediment controls for the new wellsite extension. It was agreed that a settlement pond would be placed at the base of the valley below the wellsite to capture potential solids, should they manage to travel that far. The settlement pond was to be based on 100 m^3 per 1 ha of exposed soil. The position of skimmer pits, shut off valves and the design of reclamation below the site was also discussed. It was established that the new skimmer pits did not need to be constructed and functioning until before activities associated with hydrocarbon exploration were to commence.

10 October 2012
Inspection was conducted following notification that the new flare pit had had plastic lining installed. It was also observed that earthworks had occurred to construct a silt/sediment trap at the base of the valley below the wellsite.

17 October 2012
At the time of inspection, the drilling rig was being erected and set up. Bunding was observed around bulk fluid storage and chemicals were stored within a bund with plastic liners on the ground. Extensive earthworks were occurring to increase the size of the site. Earth was removed from the site and placed below the wellsite in the valley. A stormwater settlement pit had been constructed to capture silt and sediment, which had effectively captured a significant amount of sediment during the last rain event. The pit was to be enlarged to reflect the increased amount of

exposed earth onsite. The skimmer pits were observed to be discoloured but not discharging.

23 October 2012
During inspection, the drilling rig was still being set up and no flaring was occurring. Earthworks were continuing for the construction of the wellsite extension. The silt and sediment trap at the base of the valley appeared to be working well with a considerable amount of silt being captured. No effects were observed as a result of any discharge. The skimmer pits were observed to be discoloured but not discharging.

15 November 2012
Drilling had commenced of well MHW09 and was continuing during inspection. The site appeared mostly dry and tidy. It was observed that a lot of barite and other material had discharged onto the ground during the process of storing/moving and using the product. Discussions were held with on site representatives of Mi Swaco, Ensign and Todd Energy Limited, who agreed that the product would be cleaned up and the storage area tidied. On site staff were also advised that if the area was not maintained and kept tidy an abatement notice and/or infringement fine may be issued. Earthworks were continuing for the construction of the wellsite extension. The settlement pond in the valley was working well to capture silt and sediment. No effects were observed beyond the silt cloth positioned below the pond. The skimmer pits were not discharging at the time of inspection.

27 November 2012
Drilling activities continued on site. The site appeared tidy and clean. The clean up operation that was conducted around the chemical storage area appeared immaculate. The area around the mud tanks and shakers also appeared very clean. The silt containment area at the base of the valley below the site was still working well to capture silt and no effects were observed in the stream below the site. The site was dry and stormwater was not discharging following a period of fine weather.

11 December 2012
During inspection the site appeared tidy. The site extension was reportedly almost complete and construction had begun on the new skimmer pits. The ring drains had been completed and the first conductor and surface casing had been drilled. Another well was scheduled to be drilled (surface casing only) before the rig was to be moved. The silt and sediment containment bund at the bottom of the valley was still working well. The skimmer pits were not discharging at the time of inspection.

9 January 2013
Drilling activities continued on site of well MHW09. The site appeared tidy. Rilling was observed on the bank which may have been created by stormwater pooling and flowing over the side of the bank. The area where stormwater may have pooled looked to be covered with silt. Site staff were advised to ensure all stormwater be directed to the skimmer pit system for treatment and ensure that the site was fully bunded. 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 January 2013
During inspection drilling activities were continued on site. Target depths were reportedly almost reached. Skimmer pits were inspected and found not to be discharging at the time of inspection. A sample was obtained from the second skimmer pit.

7 February 2013
At the time of inspection the target depth of well MHW09 had been reached. The site appeared tidy and clean and a new drain had been constructed on the western side of the site to direct stormwater into the ring drain. No issues were raised 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.

12 February 2013
During inspection the site was observed to be tidy and ring drains were found to be in good working order. Skimmer pits were inspected and found not to be discharging at the time of inspection. A sample was obtained from the second skimmer pit.

22 February 2013
The site appeared clean and tidy with ring drains in good operational condition. Drilling had since been completed and the rig was in the initial stages of being relocated. Skimmer pits were inspected and found not to be discharging at the time of inspection. Samples were obtained from the second pit of both the original and the newly constructed skimmer pits (refer to Figure 3).

1 March 2013
No drilling was occurring on site. A number of small spills were visible on the original site as a result of rigging equipment being moved to another location. These spills were to be cleaned prior to testing at site. The ring drain to the south-eastern boundary of the original drill site needed repairs, as slight damage to bunding was observed. Skimmer pits were inspected and found not to be discharging at the time of inspection. No sample was obtained from the new skimmer pits, as heavy machinery activities were occurring within the immediate vicinity. However, a sample was obtained from the original second skimmer pit.

15 March 2013
The original site was inspected and found to be clean and tidy. Spills that were recorded during the previous inspection had since been cleaned up. The ring drain along the eastern edge of the site was noted to need clearing. The rig had been established within the newer area of the site, and drilling was to commence in the coming days. The site appeared to be clean and tidy at the time of inspection with all ring drains in good order. Bunding about mud tanks were all in place and appropriate. Both sets of skimmer pits were inspected and found not to be discharging at the time of inspection. Samples were obtained from the second pit of both the original and the newly constructed pits.

27 March 2013
An inspection of both the old and new sites was undertaken. Wireline equipment was being set up at the original site. The site appeared to be clean and tidy with cloth observed under equipment to assist with spill containment. Ring drains were in good

order. Drilling was continuing at the new site, which was found to be clean and tidy. The drill cuttings/waste area appeared well managed as no spills of mud were evident about the area. The ring drain to the right of the entrance gate was having work done to place a gas line below it. The ring drain was to be reinstated following the completion of works in the area. Works were also being undertaken to ensure that the chemical storage area remained clean, tidy and free of spills. Both sets of skimmer pits were inspected and found not to be discharging at the time of inspection. Samples were obtained from the second pit of both the original and the newly constructed pits.

4 April 2013
During the time of inspection the site was found to be clean and tidy. Drilling activities were continuing on site. The ring drain at the entrance of the site had been reinstated following the completion of works within the immediate area. The chemical store area appeared clean with no evidence of any recent spills. Skimmer pits were inspected and found not to be discharging at the time of inspection. A sample was obtained from the second skimmer pit at the new site.

11 April 2013
Inspection was conducted in response to a complaint received regarding smoke emissions at the Mangahewa-C wellsite. No odours or emissions were detected off site. Some black smoke was evident over the flare pit. Winds were from North/West. Stockman Road survey: no odours or smoke. Otaoroa Road: no smoke or odours - flare dispersing away from this road towards South/East.

18 April 2013
During the time of inspection testing was continuing at the original site. The well was 'shut-in' so no flaring was occurring on site at the time of inspection. Drilling activities were continued at the new portion of the wellsite with well MHW12 nearing completion. The site appeared to be in a clean and tidy condition with both chemical storage and mud tank areas clean and tidy. All ring drains were in good condition around both sites with all stormwater being directed to the skimmer pits. Some skimmer pit stormwater had been pumped out and put over the flare in recent days preceding the inspection so as to dispose of stormwater within the skimmer pits which had elevated pH levels. Both sets of skimmer pits were inspected and found not to be discharging at the time of inspection. Samples were obtained from the second pit of both the original and the newly constructed pits. Heavy rainfall had preceded the inspection and samples obtained would provide good indication as to whether dilution had helped to decrease the previously high pH readings from both sets of skimmer pits.

24 April 2013
At the time of inspection testing operations were continuing at the original wellsite. Flaring was occurring and a small amount of smoke was produced in relation to this, however the smoke was only visible close to the flare. No odour was being produced as a result of the flaring. Drilling was continuing on the new extended site with well MHW12 nearing completion. The site was clean and tidy at the time of inspection with the chemical store area clean and well covered. The mud tanks and cuttings area were also found to be tidy. Both sets of skimmer pits were inspected and found not to be discharging at the time of inspection. Samples were obtained from the second pit of both the original and the newly constructed pits.

3 May 2013
Hydraulic fracturing was to commence at the original wellsite with well MHW09 in the coming weeks, hence preparation activities at the site were abundant in relation to this during inspection. Drilling was continuing at the new site, with target depths of well MHW12 attained, the completion of this well was anticipated prior to the commencement of the second well (MHW13) on the same site. The site was in a clean and tidy condition with all chemicals stored and protected from the weather appropriately. No spills were observed about the drilling rig. Skimmer pits at the original site were inspected and found not to be discharging at the time of inspection. A sample was obtained from the second skimmer pit at the original site. Skimmer pits at the new wellsite were inspected and found to be discharging. A sample was obtained from the discharge man hole at the base of the paddock in relation to the new set of skimmer pits.

16 May 2013
At the time of inspection both sets of skimmer pits were inspected and found not to be discharging. Samples were obtained from the second pit of both the original and the newly constructed pits.

20 May 2013
Site inspection was conducted in relation to hydraulic fracturing of well MHW09 at the original section of the wellsite. The site appeared clean and tidy with no signs of spills or contamination. The fracturing operation appeared to comply with resource consent conditions at time of inspection and samples of the fracturing fluid were obtained.

21 May 2013
Inspection was conducted following a complaint from a member of the public regarding the settling pond at the base of the hill below the new set of skimmer pits. During investigation samples were obtained from the second skimmer pit in addition to samples from the second/last man hole in the discharge pipe and a sample from the settling pond at the base of the hill. Three streams about the site were inspected and found to be running clear despite recent rains. No hydrocarbons were observed in the streams or settling pond. At the time of inspection nil evidence was located or observed in relation to the alleged breach of consent conditions or unconsented activities at the wellsite.

25 May 2013
Inspection was conducted following a complaint regarding the production of black smoke as a result of flaring at the Mangahewa C wellsite. An on site investigation found that some smoke had been produced at the flare as a result of the well clean up of well MHW09. The gas was quickly diverted to the McKee Production Station to prevent further smoke being produced. At the time of investigation a small flare was burning in the open flare pit due to a faulty valve, essentially meaning that it could not be ceased. At the time of investigation the consent conditions with regards to flaring were complied with.

7 June 2013
Mangahewa-C wellsite inspection found that activity at the original site had ceased. Flaring had stopped and no further testing was planned within the immediate future. The site appeared clean and tidy with ring drains and skimmer pits in good

operational condition. Drilling was continuing on the newer section of the site with well MHW13 nearing completion. Preparations had been put in place for two future wells (MHW14 and MHW15) on the site. The chemical store had been moved and appeared clean and tidy. Shipping containers had been placed along one boundary in an effort to decrease noise produced from the site. Both sets of skimmer pits were inspected and found not to be discharging at the time of inspection. Samples were obtained from the second pit of both the original and the newly constructed pits.

4 July 2013

At the time of inspection the site was found to be clean and tidy. The intermediate section of well MHW15 was being drilled. The area about the mud tanks and cuttings pit appeared clean and tidy with no evidence of recent spills. The cuttings pit was being emptied at the time of the inspection. Water use for the site was via a water bore that had recently been completed on site, no surface water was being taken. The flare pit was inspected and found to be clean and tidy. Flaring activities had not occurred on site in recent weeks, yet was anticipated with impending well testing. Skimmer pits from the new section of the wellsite were discharging at the time of the inspection. The skimmer pits were discharging into the settling pond at the base of the hill. The settling pond was overflowing into the headwaters of the nearby stream via further silt and sediment retention measures. This system of discharge appeared to be operating well at the time of inspection. Samples were obtained of the discharge in addition to a downstream sample.

25 July 2013

During inspection well MHW15 was still being drilled. The rear of the site was undergoing levelling and preparation for the impending testing of recently drilled wells MHW12 and MHW13. The site appeared clean and tidy as did the chemical store area. Areas about the cuttings tank and mud tanks were relatively clean. The containment pit had some liquid (stormwater) residing within it, however was anticipated to be cleaned out the following day. The flare pit appeared clean and tidy with no recent flaring activities occurring on site. Skimmer pits located at the new section of the wellsite were inspected and found to be full and discharging at the time of inspection. A sample of the discharge was obtained.

6 August 2013

At the time of inspection the site appeared clean and tidy. Ring drains appeared to be working well. Installation of water tanks on site required pipes to be placed subsurface, this resulted in areas of the ring drain being dug up and excess piled earth had accumulated in the drain. It was advised to site staff to reinstate the ring drain as soon as possible by removing piled earth from the drain. The chemical store area appeared clean and tidy. Completion of well MHW15 was in progress. The flare pit appeared clean and tidy with no recent flaring activities occurring on site. Skimmer pits were inspected and found not to be discharging at the time of inspection. A sample was obtained from the second skimmer pit of the newly constructed pits.

23 August 2013

Inspection conducted in response to a complaint from the public regarding black smoke being produced from the site. Inspection found that black/dark coloured smoke was being emitted from the site as a result of flaring activities. The flare was large and contained within the flare pit on site. The smoke was visible from the road

and was observed to be a dark colour, although largely the smoke was transparent, an occasional gust of darker cloud could be seen being emitted. The smoke was travelling relatively straight upwards with only a slight wind deflection back towards the wellsite. The smoke was quickly dissipating amongst the backdrop of cloud cover that was in the area at the time of the inspection. There were no off-site effects noted as the smoke was travelling straight upwards with no nearby dwellings or land being affected by the smoke. No odour was detected on or off site as a result of the flaring. Discussions with on site staff revealed flaring of well MHW12 begun at 0915hrs on 23 August 2013. It was discovered through the flaring of well MHW12 that the heater was unable to sufficiently heat the flow from the well head due to the large amount of volume. This then resulted in an incomplete separation of the gas and other product at the separator resulting in the production of a dark coloured smoke being produced at the flare. A replacement heater was being sent to site from Shell Todd Oil Services Ltd, Kapuni and a system to spray water over the flare was also being arranged. Site staff were advised to monitor the situation and should it have deteriorated further or a change in environmental conditions caused off site effects then some form of further positive action had to be taken.

2 September 2013
At time of inspection well MHW13 was in the process of stimulation. All areas were appropriately bunded around the associated stimulation equipment. The perimeter ring drains appeared clean with no evidence of recent pooling. The dry chemical storage area appeared clean and tidy. Skimmer pits were inspected and found not to be discharging at the time of inspection. A sample was obtained from the second skimmer pit of the newly constructed pits.

9 September 2013
Three surface water samples were obtained from the nearby unnamed tributary of the Waiau Stream following the hydraulic fracturing of well MHW13.

25 September 2013
Inspection found that drilling activities at the Mangahewa-C wellsite were nearing completion. Well MHW14 had reached target depth and production tubing was being installed in the well. Mud tanks were still to be used again prior to the completion of the drilling operation. The area about the mud tanks and cuttings area were in a reasonable condition as was the remainder of the. The non-hazardous chemical store area was found to be clean of any spills. Continued well testing was occurring on site at the time of inspection with well MWH13 being tested. Flaring was contained within the flare pit and no black smoke was observed being emitted. A small pilot flare was being produced at the time of the inspection and the flare pit appeared free of any solids. Skimmer pits were inspected and found not to be discharging at the time of inspection. A very slight sheen was observed in the corner of the first pit, however this had not travelled through to the second pit. This sheen was very thin and covered approximately a $1m^2$ area. A sample was obtained from the second skimmer pit of the newly constructed pits.

9 October 2013
Inspection was conducted in response to a notification received the previous evening regarding an oil spill onto the road from vehicle movements. It was found that contractors and traffic management were at the scene and had applied sorbent materials to the road surface to contain and recover the oil. As a precautionary

measure two booms had been placed in the adjacent waterway (Waiau Stream) and one had been placed around a roadside drain inlet. The run-off from Tikorangi Road East was turbid and was being filtered by the roadside vegetation, the discharge into the stream was not having a visual impact on the water-body. A small amount of peat-type sorbent materials were being captured upstream of the first boom and sorbent pads were present, essentially no hydrocarbon sheen was observed in the water-body. It was outlined by staff responding to the incident that a JD Hickman truck had left the wellsite with a piece of machinery which was leaking a light oil, it was thought the volume of oil discharged onto the road was 10-15 litres, along a 500m strip. Heavy equipment was delivered to the site to recover all the materials which had been applied to contain the oil.

21 October 2013

Inspection found that drilling on well MHW14 was complete and the drilling rig had since been removed from site. Preparations had begun on site regarding hydraulic fracturing activities which were set to commence in the coming week. The chemical store on site was found to be clean, tidy and protected from the weather appropriately. No flaring was occurring on site at time of inspection with all wells (MHW12, MHW13, MHW14 and MHW15) on the new pad area all shut in. Ring drains were inspected and found to be in good condition and free of debris. The flare pit was also inspected and found to be clean and tidy. Skimmer pits were inspected and found not to be discharging at the time of inspection. A sample was obtained from the second skimmer pit of the newly constructed pits.

4 November 2013

Inspection was conducted post hydraulic fracturing of well MHW14. Site appeared in a clean and tidy state with operations focused around cleaning and flowing of the wells. Skimmer pits were inspected and found not to be discharging at the time of inspection. A sample was obtained from the second skimmer pit of the newly constructed pits.

13 November 2013

Inspection found well testing activities were being undertaken on site. Well MHW15 was being tested with all gas being sent through to McKee Production Station, with produced water and condensate being transported off site by road tanker. No flaring was occurring on site at the time of inspection, however it was anticipated that flaring may be undertaken in the days to follow. The flare pit was inspected and found to be clean and free of any visible hydrocarbons. A small pilot flare was being maintained within the flare pit. Chemicals and materials associated with the previous drilling activities on site were also being removed at the time of inspection. The site was in a clean and tidy condition with all ring drains in good operational order. Return fracture fluid samples were collected following the hydraulic fracturing activities on site. Skimmer pits were inspected and found not to be discharging at the time of inspection. A sample was obtained from the second skimmer pit of the newly constructed pits.

25 November 2013

A meeting was held on site with representatives from BTW and Burgess and Crowley regarding the remediation of the silt and sediment pond which treats the skimmer pit discharge prior to final entry into the surface water/receiving environment. This pond was established during the earthwork phase of the

operation and is no longer required. It was agreed that the pond would be reinstated with the discharge being captured via a final scruffy dome (additional debris screen for manholes) prior to discharge to surface water. A sock would be fitted on the discharge pipe to prevent scouring at the point of discharge. Testing was also ongoing on site. The flare pit was inspected and found to be clean and tidy. No flaring was occurring on site at the time of the inspection. Earthworks in relation to the construction of a pipeline as well as the establishment of a newly located camp were occurring on site. The site in general appeared to be clean, tidy and well managed. Skimmer pits were inspected and appeared clean. The skimmer pit level was approximately 0.5 metres from the discharge point. A sample was obtained from the second skimmer pit of the newly constructed pits.

7 January 2014

Inspection found that the Mangahewa-C wellsite was in a clean and tidy condition. Testing had been completed on site. Production and construction activities were being undertaken on site at the time of inspection. No flaring was occurring within the flare pit which was found to be clean and tidy. Ring drains appeared in good operational order. Skimmer pits were inspected and found not to be discharging at the time of inspection. A sample was obtained from the second skimmer pit of the newly constructed pits. The final discharge location was inspected and no adverse effects were observed in the receiving environment. The small scale earthworks scheduled and modification to the discharge point had not yet begun.

2.1.2 Results of discharge monitoring

During the period under review a total of 37 stormwater samples were obtained. Stormwater was not observed discharging from the original wellsite skimmer pits, however, 14 samples were obtained from the second skimmer pit to ensure compliance with consent conditions in anticipation of potential discharges. Stormwater was observed discharging from the new wellsite extension skimmer pits on three occasions and four samples were obtained in relation to this. In addition, 16 samples were obtained from the second skimmer pit from the new wellsite extension skimmer pits. Furthermore, three discharge samples from the new wellsite extension skimmer pits were obtained in response to a complaint received from the public.

Analysis of the samples collected showed that all but 14 of the discharges would have been in compliance with resource consent conditions should a discharge have occurred. Results are detailed in Table 1.

Figure 3 Aerial view of the Mangahewa-C wellsite highlighting the extent of the original and new sections of the wellsite in addition to the localities of the original and new skimmer and flare pits.

Table 1 Results of stormwater samples obtained from the Mangahewa-C wellsite during the monitoring period

Date	Chloride *g/m³*	Hydrocarbons *g/m³*	pH *pH*	Suspended solids *g/m³*	Sampling location
13 Sep 2012	16	<0.5	7.4	95	Original skimmer pits
09 Jan 2013	22.1	<0.5	9.2	<2	Original skimmer pits
21 Jan 2013	16.0	1.0	8.9	10	Original skimmer pits
07 Feb 2013	15.0	3.0	7.8	14	Original skimmer pits
12 Feb 2013	14.6	<0.5	9.4	8	Original skimmer pits
22 Feb 2013	15.8	<0.5	9.7	-	Original skimmer pits
22 Feb 2013	6.6	<0.5	6.8	-	New skimmer pits
01 Mar 2013	16.8	<0.5	9.6	5	Original skimmer pits
15 Mar 2013	20.9	<0.5	9.7	4	Original skimmer pits
15 Mar 2013	7.2	<0.5	7.1	2	New skimmer pits
27 Mar 2013	22.7	<0.5	8.9	19	Original skimmer pits
27 Mar 2013	10.6	<0.5	9.4	10	New skimmer pits
04 Apr 2013	11.3	<0.5	9.5	10	New skimmer pits
18 Apr 2013	7.6	4.0	7.6	150	Original skimmer pits
18 Apr 2013	11.0	<0.5	7.8	82	New skimmer pits
24 Apr 2013	7.2	1.7	7.2	90	Original skimmer pits
24 Apr 2013	4.8	<0.5	7.0	83	New skimmer pits
03 May 2013	16.6	0.7	7.6	120	Original skimmer pits
03 May 2013	37.3	-	7.1	44	New pit discharge
16 May 2013	75.2	<0.5	7.7	10	Original skimmer pits

Date	Chloride *g/m³*	Hydrocarbons *g/m³*	pH *pH*	Suspended solids *g/m³*	Sampling location
16 May 2013	13.0	0.6	7.4	33	New skimmer pits
21 May 2013	9.7	-	7.0	140	Investigative - new pit discharge
21 May 2013	44.1	<0.5	7.4	110	Investigative - new pit (mid) discharge
21 May 2013	28.2	<0.5	6.8	60	Investigative - new pit (final) discharge
07 Jun 2013	12.4	1.0	7.4	92	Original skimmer pits
07 Jun 2013	12.3	1.9	7.3	56	New skimmer pits
04 Jul 2013	29.9	<0.5	7.1	17	New pit discharge
04 Jul 2013	19.6	<0.5	7.1	8	New pit final discharge
25 Jul 2013	30.4	<0.5	7.7	2	New pit discharge
06 Aug 2013	47.7	0.9	7.3	20	New skimmer pits
02 Sep 2013	62	4.9	7.6	120	New skimmer pits
25 Sep 2013	13.1	1.2	7.5	52	New skimmer pits
21 Oct 2013	20.3	1.3	7.6	85	New skimmer pits
04 Nov 2013	25	0.9	7.2	29	New skimmer pits
13 Nov 2013	25.6	0.5	7.4	9	New skimmer pits
25 Nov 2013	26.2	0.6	7.9	3	New skimmer pits
07 Jan 2014	6.2	<0.5	7.0	9	New skimmer pits

During the months of January, February, March and April in 2013, eight samples obtained returned elevated pH levels. 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. However, in a proactive approach Todd Energy Limited began to dispose of the stormwater during this period from the skimmer pits via irrigation over the flare (contained within the pit). This method proved successful and simply resulted in the evaporation of the stormwater.

Samples obtained on 18 April 2013, 3 May 2013 and 2 September 2013 returned elevated levels of suspended solids (150 g/m^3, 120 g/m^3 and 120 g/m^3 respectively). Although these values exceed condition 10 (100 g/m^3) of consent 6967-1, no actual non-compliances occurred as these samples were obtained from the skimmer pits to ensure compliance with consent conditions in anticipation of potential discharges. Therefore, no discharges containing elevated levels of suspended solids were released from the skimmer pits into the receiving environment.

On 21 May 2013 three samples were obtained in conjunction with an inspection following a complaint from a member of the public regarding the settling pond associated with the new skimmer pits. Two of the three samples returned elevated levels of suspended solids (140 g/m^3 and 110 g/m^3). Upon further investigation, this was most likely attributed to a man hole located further uphill that was receiving stormwater from a nearby paddock where recent earthworks had occurred, and so soil was being washed into the discharge pipe via the manhole. This material was then entering the settling pond at the base of the hill prior to entry of the surface waters. Therefore, the elevated suspended solid results were not the result of

activities at the Mangahewa-C wellsite, but rather attributed to unrelated earthwork activities occurring at an adjacent site.

All sewage was directed for treatment through a septic tank system and removed by contractor to a licensed disposal facility.

2.1.3 Results of receiving environment monitoring

During the period under review, three samples were obtained on 9 September 2013 from the Waiau Stream and unnamed tributaries of the Waiau Stream, post hydraulic fracturing activities of well MHW13. No exceedences were recorded in relation to consent 6967-1. Results are detailed in Table 2.

Table 2 Samples obtained on 9 September 2013 from the Waiau Stream and unnamed tributaries of the Waiau Stream

	Unit	Sample 1 Waiau Stream	Sample 2 Unnamed Tributary	Sample 3 Unnamed Tributary
Chloride	g/m^3	17.8	13.9	16.2
Hydrocarbons	g/m^3	<0.5	<0.5	<0.5
pH	*pH*	6.8	7.2	7.2
Suspended solids	g/m^3	<2	8	7

The receiving surface water body was inspected regularly in conjunction with site inspections. No effects were observed and the stream appeared clear with no visual change in colour or clarity. In addition, no odour, oil, grease films, scum, foam or suspended solids were observed in the stream during the monitoring period.

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 above for comments concerning site inspections.

2.2.2 Results of discharge monitoring

Todd Energy Limited notified the Council of its intention to test the well and flare gas intermittently at the Mangahewa-C wellsite between 13 September 2012 and 7 January 2014.

During routine inspections, no offensive or objectionable odours, smoke or dust associated with activities at Mangahewa-C wellsite were observed. The flare pit was inspected to ensure that solid and liquid hydrocarbons were not combusted through the gas flare system and there was no evidence to support or suggest this was occurring.

From observations during site inspections, including the inspection of the flare log maintained by Todd Energy Limited, it appeared that special conditions relating to the control of emissions to air from the flaring of hydrocarbons were complied with.

2.2.3 Results of receiving environment monitoring

The Taranaki Regional Council received three complaints from the public regarding smoke from flaring activities at the Mangahewa-C wellsite on 11 April 2013, 25 May 2013 and 23 August 2013. Following each complaint, an Inspectorate Officer visited the site and found that the smoke was not considered as being offensive or contravening consent conditions as there were no off site effects. In addition, Todd Energy Limited were for the most part prompt to identify and resolve flaring issues according to on site best practice.

However, due to concerns raised by members of the public regarding potential adverse effects from the black smoke emissions originating from the wellsite, Todd Energy Limited enlisted the Council's air quality officer to conduct an ambient Benzene, Toluene, Ethylbenzene and Xylene (BTEX) monitoring survey around the Mangahewa-C wellsite. Five sites were selected, as per Figure 4, for the survey with BTEX monitors deployed at each site from 24 September 2013 to 4 October 2013. Results are detailed in Table 3.

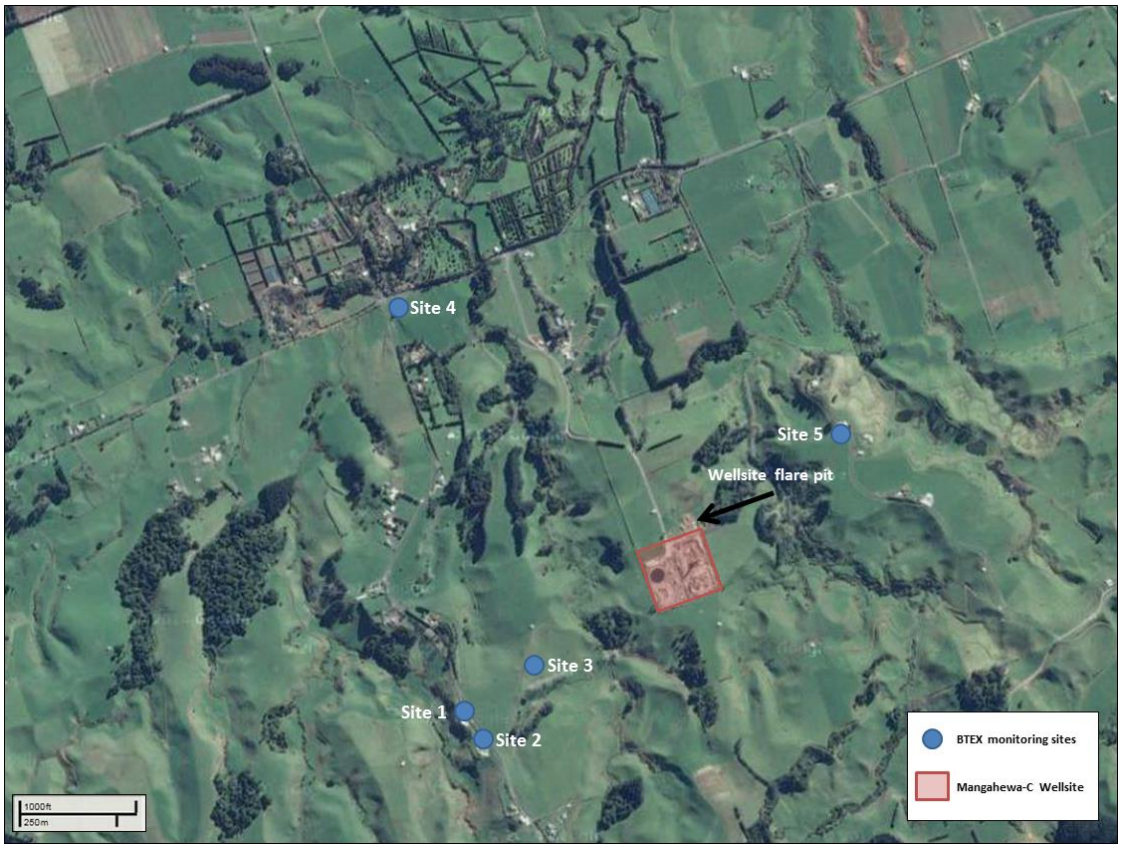

Figure 4 BTEX monitoring survey sites in relation to the Mangahewa-C wellsite and flare pit

Table 3 Actual and recalculated BTEX results regarding flaring emissions at the Mangahewa-C wellsite

Site	24 Sep 2013	04 Oct 2013	Benzene		Toluene		Ethylbenzene	o,m,p – Xylene (total)	
			Lab. Results	1 hr. Calc.	Lab. Results	1 hr. Calc.	Lab. Results	Lab. Results	1 hr. Calc.
1	13:10	13:25	<2	5.98	<2	5.98	<2	<2	5.98
2	13:25	13:30	<2	5.98	<2	5.98	<2	<2	5.98
3	13:30	13:40	<2	5.98	<2	5.98	<2	<2	5.98
4	14:00	13:45	<2	5.98	<2	5.98	<2	<2	5.98
5	14:20	14:00	<2	5.98	<2	5.98	<2	<2	5.98
MfE recommended guidelines (2000), one - hour average			-	22	-	500	-	-	1000

*All results in µg/m^3

The results provide an average exposure (which is the primary factor for health risk), and also provide a calculation (according to recognised modelling) of the theoretical most likely one hour maximum concentrations. Both results (actual and calculated) are evaluated against recommended Ministry for the Environment guidelines. All site samples returned results below detectable limits, hence flaring activities were unlikely to have had any significant or on-going adverse effect on the environment.

It appeared that Todd Energy Limited took practicable and successful steps to mitigate effects of smoke and initiated additional investigative measures when appropriate.

2.2.4 Other ambient monitoring

No other ambient air sampling was undertaken, as the controls implemented by Todd Energy Limited did not give rise to any additional 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 above for comments concerning site inspections.

2.3.2 Results of discharge and receiving environment monitoring (hydraulic fracturing)

Todd Energy Limited notified the Council of the proposed hydraulic fracturing discharge operations for wells MHW09, MHW12, MHW13, MHW14 and MHW15. The Council developed the Mangahewa-C wellsite Groundwater Monitoring Programme in consultation with Todd Energy Limited. This monitoring programme included five sampling locations which were selected based on their proximity to the Mangahewa-C 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 5 shows the sampling sites in relation to the wellsite.

Table 4 Mangahewa-C wellsite associated groundwater monitoring bore details

Site No.	Easting (m)	Northing (m)
GND2254	1712606	5677572
GND2255	1713472	5677892
GND2256	1713212	5677276
GND2257	1712473	5676917
GND2360	1699694	5664377

Figure 5 Aerial photo depicting the locality of the Mangahewa-C wellsite and associated groundwater monitoring bores

The monitoring programme provides for an initial 12 months of groundwater monitoring. Groundwater samples will be obtained from the sampling sites recorded in Table 2 at the following specified intervals:

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

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 Mangahewa-C

wellsite groundwater monitoring programme should follow the latest range. The revised parameters that were analysed are as follows:

- pH;
- Conductivity;
- 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}C-CH_4).

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 5 to 9.

Table 5 Pre and post hydraulic fracturing results obtained from groundwater monitoring bore GND2254

Parameter	Unit	Pre-frac 21 Oct 2013	Post-frac 11 Feb 2014
Alkalinity (total)	g/m^3 CaCO3	126	123
Barium	mg/kg	0.0149	0.0149
Benzene	g/m^3	<0.0010	<0.0010
Bicarbonate	g/m^3 HCO3	152	150.1
Bromine (dissolved)	g/m^3	0.048	0.051
Calcium	g/m^3	24	24
Chloride	g/m^3	13.2	12.8
Conductivity	mS/m@20C	28.3	26.9
Copper (dissolved)	g/m^3	<0.0005	<0.0005
Ethane	g/m^3	<0.003	<0.003
Ethylbenzene	g/m^3	<0.0010	<0.0010
Ethylene	g/m^3	<0.003	<0.004
Ethylene glycol	g/m^3	<4	<4
Formaldehyde	g/m^3	<0.02	<0.02
Hardness (total)	g/m^3 CaCO3	103	101
Hydrocarbons	g/m^3	<0.7	<0.7
Iron (dissolved)	g/m^3	0.31	0.33
Manganese (dissolved)	g/m^3	0.027	0.026
Magnesium	g/m^3	10.2	9.9
Mercury (dissolved)	g/m^3	<0.00008	<0.00008
Methane	g/m^3	2.9	2.5
Methanol	g/m^3	<2	<2

Parameter	Unit	Pre-frac 21 Oct 2013	Post-frac 11 Feb 2014
Nickel	mg/kg	<0.0005	<0.0005
Nitrate nitrogen	g/m3 N	<0.002	<0.002
Nitrite/nitrate nitrogen	g/m3 N	<0.002	<0.002
Nitrite nitrogen	g/m3 N	<0.002	<0.002
pH	pH	7.9	8.0
Potassium	g/m3	2.3	2.6
Propylene glycol	g/m3	<4	<4
Sodium	g/m3	18.2	16.1
Static water level	m	-	-
Sulphate	g/m3	0.5	0.6
Sum of Anions	meq/l	2.9	2.8
Sum of Cations	meq/l	2.9	2.8
Temperature	Deg.C	15.2	15.4
Toluene	g/m3	<0.0010	<0.0010
Total dissolved solids	g/m3	173	174
ortha-Xylene	g/m3	<0.0010	<0.0010
meta-Xylene	g/m3	<0.002	<0.002
Zinc (dissolved)	g/m3	<0.0010	<0.0010

Table 6 Pre and post hydraulic fracturing results obtained from groundwater monitoring bore GND2255

Parameter	Unit	Pre-frac 21 Oct 2013	Post-frac 11 Feb 2014
Alkalinity (total)	g/m3 CaCO3	18.8	20
Barium	mg/kg	0.047	0.046
Benzene	g/m3	<0.0010	<0.0010
Bicarbonate	g/m3 HCO3	22.9	24.4
Bromine (dissolved)	g/m3	0.082	0.085
Calcium	g/m3	6.0	6.3
Chloride	g/m3	24	22
Conductivity	mS/m@20C	14	9.34
Copper (dissolved)	g/m3	0.037	0.031
Ethane	g/m3	<0.003	<0.003
Ethylbenzene	g/m3	<0.0010	<0.0010
Ethylene	g/m3	<0.003	<0.004
Ethylene glycol	g/m3	<4	<4
Formaldehyde	g/m3	<0.02	<0.02
Hardness (total)	g/m3 CaCO3	28	28
Hydrocarbons	g/m3	<0.7	<0.7
Iron (dissolved)	g/m3	<0.02	<0.02
Manganese (dissolved)	g/m3	0.0014	0.0054
Magnesium	g/m3	3.1	3.0
Mercury (dissolved)	g/m3	<0.00008	<0.00008
Methane	g/m3	<0.002	0.003
Methanol	g/m3	<2	<2

Parameter	Unit	Pre-frac 21 Oct 2013	Post-frac 11 Feb 2014
Nickel	mg/kg	<0.0005	<0.0005
Nitrate nitrogen	g/m3 N	1.55	1.27
Nitrite/nitrate nitrogen	g/m3 N	1.55	1.27
Nitrite nitrogen	g/m3 N	<0.002	<0.002
pH	pH	5.9	5.80
Potassium	g/m3	3.5	3.5
Propylene glycol	g/m3	<4	<4
Sodium	g/m3	13.3	12.9
Static water level	m	0.78	0.89
Sulphate	g/m3	3.6	3.4
Sum of Anions	meq/l	1.23	1.19
Sum of Cations	meq/l	1.22	1.21
Temperature	Deg.C	15.4	15.5
Toluene	g/m3	<0.0010	<0.0010
Total dissolved solids	g/m3	95	95
ortha-Xylene	g/m3	<0.0010	<0.0010
meta-Xylene	g/m3	<0.002	<0.002
Zinc (dissolved)	g/m3	0.0128	0.045

Table 7 Pre and post hydraulic fracturing results obtained from groundwater monitoring bore GND2256

Parameter	Unit	Pre-frac 21 Oct 2013	Post-frac 11 Feb 2014
Alkalinity (total)	g/m3 CaCO3	19.7	23
Barium	mg/kg	0.062	0.036
Benzene	g/m3	<0.0010	<0.0010
Bicarbonate	g/m3 HCO3	24.0	28.1
Bromine (dissolved)	g/m3	0.084	0.076
Calcium	g/m3	9.4	7.2
Chloride	g/m3	21	18.3
Conductivity	mS/m@20C	17.3	-
Copper (dissolved)	g/m3	<0.0005	0.0006
Ethane	g/m3	<0.003	<0.003
Ethylbenzene	g/m3	<0.0010	<0.0010
Ethylene	g/m3	<0.003	<0.004
Ethylene glycol	g/m3	<4	<4
Formaldehyde	g/m3	<0.02	<0.02
Hardness (total)	g/m3 CaCO3	42	32
Hydrocarbons	g/m3	<0.7	<0.7
Iron (dissolved)	g/m3	<0.02	<0.02
Manganese (dissolved)	g/m3	0.0018	0.0026
Magnesium	g/m3	4.4	3.4
Mercury (dissolved)	g/m3	<0.00008	<0.00008
Methane	g/m3	<0.002	0.004
Methanol	g/m3	<2	<2

Parameter	Unit	Pre-frac 21 Oct 2013	Post-frac 11 Feb 2014
Nickel	mg/kg	<0.0005	<0.0005
Nitrate nitrogen	g/m3 N	5.4	2.9
Nitrite/nitrate nitrogen	g/m3 N	5.4	2.9
Nitrite nitrogen	g/m3 N	<0.002	<0.002
pH	pH	6.2	6.27
Potassium	g/m3	5.1	3.4
Propylene glycol	g/m3	<4	<4
Sodium	g/m3	12.6	11.2
Static water level	m	0.88	1.92
Sulphate	g/m3	4.2	4.4
Sum of Anions	meq/l	1.46	1.27
Sum of Cations	meq/l	1.52	1.21
Temperature	Deg.C	15.6	17.0
Toluene	g/m3	<0.0010	<0.0010
Total dissolved solids	g/m3	121	110
ortha-Xylene	g/m3	<0.0010	<0.0010
meta-Xylene	g/m3	<0.002	<0.002
Zinc (dissolved)	g/m3	0.0047	0.042

Table 8 Pre and post hydraulic fracturing results obtained from groundwater monitoring bore GND2257

Parameter	Unit	Pre-frac 21 Oct 2013	Post-frac 11 Feb 2014
Alkalinity (total)	g/m3 CaCO3	22	24
Barium	mg/kg	0.021	0.0130
Benzene	g/m3	<0.0010	0.0010
Bicarbonate	g/m3 HCO3	26.8	29.3
Bromine (dissolved)	g/m3	0.083	0.084
Calcium	g/m3	7.8	7.7
Chloride	g/m3	21	21
Conductivity	mS/m@20C	16.3	10.98
Copper (dissolved)	g/m3	0.0128	0.0117
Ethane	g/m3	<0.003	<0.003
Ethylbenzene	g/m3	<0.0010	<0.0010
Ethylene	g/m3	<0.003	<0.004
Ethylene glycol	g/m3	<4	<4
Formaldehyde	g/m3	<0.02	<0.02
Hardness (total)	g/m3 CaCO3	35	37
Hydrocarbons	g/m3	<0.7	<0.7
Iron (dissolved)	g/m3	1.05	1.13
Manganese (dissolved)	g/m3	0.0131	0.0137
Magnesium	g/m3	3.9	4.2
Mercury (dissolved)	g/m3	<0.00008	<0.00008
Methane	g/m3	<0.002	<0.002
Methanol	g/m3	<2	<2
Nickel	mg/kg	<0.0005	<0.0005
Nitrate nitrogen	g/m3 N	4.1	3.7

Parameter	Unit	Pre-frac 21 Oct 2013	Post-frac 11 Feb 2014
Nitrite/nitrate nitrogen	g/m³ N	4.1	3.7
Nitrite nitrogen	g/m³ N	0.003	<0.002
pH	pH	6.4	6.2
Potassium	g/m³	1.82	2.2
Propylene glycol	g/m³	<4	<4
Sodium	g/m³	15.2	15.3
Static water level	m	-	-
Sulphate	g/m³	4.9	6.0
Sum of Anions	meq/l	1.41	1.45
Sum of Cations	meq/l	1.46	1.50
Temperature	Deg.C	14.1	15.3
Toluene	g/m³	<0.0010	<0.0010
Total dissolved solids	g/m³	114	125
ortha-Xylene	g/m³	<0.0010	<0.0010
meta-Xylene	g/m³	<0.002	<0.002
Zinc (dissolved)	g/m³	0.086	0.062

Table 9 Pre and post hydraulic fracturing results obtained from groundwater monitoring bore GND2360

Parameter	Unit	Pre-frac 21 Oct 2013	Post-frac 11 Feb 2014
Alkalinity (total)	g/m³ CaCO3	185	187
Barium	mg/kg	0.025	0.026
Benzene	g/m³	<0.0010	<0.0010
Bicarbonate	g/m³ HCO3	225.7	228.1
Bromine (dissolved)	g/m³	1.13	1.11
Calcium	g/m³	10.2	10.9
Chloride	g/m³	350	310
Conductivity	mS/m@20C	145.9	133.1
Copper (dissolved)	g/m³	<0.0005	<0.0005
Ethane	g/m³	<0.017	0.005
Ethylbenzene	g/m³	<0.0010	<0.0010
Ethylene	g/m³	<0.003	<0.004
Ethylene glycol	g/m³	<4	<4
Formaldehyde	g/m³	<0.02	<0.02
Hardness (total)	g/m³ CaCO3	41	44
Hydrocarbons	g/m³	<0.7	<0.7
Iron (dissolved)	g/m³	0.14	0.20
Manganese (dissolved)	g/m³	0.0081	0.0098
Magnesium	g/m³	3.9	4.1
Mercury (dissolved)	g/m³	<0.00008	<0.00008
Methane	g/m³	<11.6	3.4
Methanol	g/m³	<2	<2
Nickel	mg/kg	<0.0005	<0.0005
Nitrate nitrogen	g/m³ N	<0.002	0.003
Nitrite/nitrate nitrogen	g/m³ N	<0.002	0.003
Nitrite nitrogen	g/m³ N	<0.002	<0.002

Parameter	Unit	Pre-frac 21 Oct 2013	Post-frac 11 Feb 2014
pH	pH	9.0	9.1
Potassium	g/m^3	1.36	1.42
Propylene glycol	g/m^3	<4	<4
Sodium	g/m^3	250	260
Static water level	m	-	-
Sulphate	g/m^3	1.9	2.6
Sum of Anions	meq/l	13.6	12.4
Sum of Cations	meq/l	11.9	12.3
Temperature	Deg.C	-	19.2
Toluene	g/m^3	<0.0010	<0.0010
Total dissolved solids	g/m^3	770	740
ortha-Xylene	g/m^3	<0.0010	<0.0010
meta-Xylene	g/m^3	<0.002	<0.002
Zinc (dissolved)	g/m^3	0.0055	0.0037

The results in Tables 5 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 or changes in levels are of any environmental significance.

In conjunction with the groundwater monitoring programme, prior to the initial hydraulic fracturing process of the wells at the Mangahewa-C wellsite, samples of the fracture fluids were 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. A site inspection was undertaken during the first hydraulic fracturing operation, on 20 May 2013. This inspection found that there were no observed effects from the discharge. The results of each hydraulic fracturing campaign for each well at the Mangahewa-C wellsite returned levels that are of no environmental significance. Results are detailed in Tables 10 to 14.

Table 10 Hydraulic fracture fluid and return hydraulic fracture / produced water fluid results obtained from well MHW09

Parameter	Unit	Campaign One		Campaign Two	
		Fracture fluid 3 May 2013	Return fluid 15 May 2013	Fracture fluid 20 May 2013	Return fluid 25 May 2013
Alkalinity (total)	g/m³ CaCO3	-	1320	-	1890
Barium	mg/kg	-	50	-	6.5
Benzene	g/m³	0.21	19.6	0.0025	63
Bicarbonate	g/m³ HCO3	-	1610	-	-
Bromide	g/m³	-	35	-	6.7
Calcium	g/m³	-	12700	-	250
Chloride	g/m³	-	27000	-	3400
Conductivity	mS/m@20C	-	7110	-	1395
Copper (dissolved)	g/m³	-	<0.005	-	0.005
Ethane	g/m³	-	1.22	-	1.28
Ethylbenzene	g/m³	0.072	0.70	0.0071	22
Ethylene	g/m³	-	<0.007	-	<0.003
Ethylene glycol	g/m³	23	230	188	<4
Formaldehyde	g/m³	-	0.11	-	0.09
Hardness (total)	g/m³ CaCO3	-	32000	-	650
Hydrocarbons	g/m³	30	60	185	1000
Iron (dissolved)	g/m³	-	0.14	-	2.5
Manganese (dissolved)	g/m³	-	3.2	-	1.37
Magnesium	g/m³	-	84	-	7
Methane	g/m³	-	1.71	-	3.2
Methanol	g/m³	<2	<2	<20	<2
Nickel	mg/kg	-	0.28	-	0.03
Nitrate nitrogen	g/m³ N	-	560	-	1.9
Nitrite/nitrate nitrogen	g/m³ N	-	560	-	3.7
Nitrite nitrogen	g/m³ N	-	0.3	-	1.8
pH	pH	-	6.4	-	7.3
Potassium	g/m³	-	460	-	1020
Propylene glycol	g/m³	-	<4	52	-
Sodium	g/m³	-	6100	-	2200
Sulphate	g/m³	-	56	-	136
Sulphur (dissolved)	g/m³	-	19	-	-
Toluene	g/m³	0.74	15.5	0.047	230
ortha-Xylene	g/m³	0.155	1.59	0.0121	40
meta-Xylene	g/m³	0.014	4.5	0.025	134
Zinc (dissolved)	g/m³	-	0.14	-	<0.02

Table 11 Hydraulic fracture fluid and return hydraulic fracture fluid / produced water results obtained from well MHW12

Parameter	Unit	Fracture fluid 9 Sep 2013	Return fluid 18 Sep 2013
Alkalinity (total)	g/m³ CaCO3	-	3200
Barium	mg/kg	-	50
Benzene	g/m³	0.0011	12.4
Bicarbonate	g/m³ HCO3	-	3904
Bromine (dissolved)	g/m³	-	18.9
Calcium	g/m³	-	96
Chloride	g/m³	-	4900
Conductivity	mS/m@20C	-	2090
Copper (dissolved)	g/m³	-	<0.005
Ethane	g/m³	-	0.182
Ethylbenzene	g/m³	<0.0010	1.57
Ethylene	g/m³	-	<0.003
Ethylene glycol	g/m³	280	89
Formaldehyde	g/m³	-	0.89
Hardness (total)	g/m³ CaCO3	-	280
Hydrocarbons	g/m³	169	940
Iron (dissolved)	g/m³	-	2.4
Manganese (dissolved)	g/m³	-	2.7
Magnesium	g/m³	-	9
Methane	g/m³	-	0.64
Methanol	g/m³	8	3
Nickel	mg/kg	-	<0.03
Nitrate nitrogen	g/m³ N	-	1.5
Nitrite/nitrate nitrogen	g/m³ N	-	1.5
Nitrite nitrogen	g/m³ N	-	<0.2
pH	pH	-	7.4
Potassium	g/m³	-	600
Propylene glycol	g/m³	165	24
Sodium	g/m³	-	4700
Sulphate	g/m³	-	34
Sulphur (dissolved)	g/m³	-	11
Toluene	g/m³	0.0039	13.8
ortha-Xylene	g/m³	0.0020	2.6
meta-Xylene	g/m³	0.003	7.7
Zinc (dissolved)	g/m³	-	0.06

Table 12 Hydraulic fracture fluid and return hydraulic fracture fluid / produced water results obtained from well MHW13

Parameter	Unit	Fracture fluid 9 Sep 2013	Return fluid 14 Sep 2013
Alkalinity (total)	g/m³ CaCO3	-	2800
Barium	mg/kg	-	78
Benzene	g/m³	0.0012	14.0
Bicarbonate	g/m³ HCO3	-	3416
Bromine (dissolved)	g/m³	-	25
Calcium	g/m³	-	116
Chloride	g/m³	-	5500
Conductivity	mS/m@20C	-	2170
Copper (dissolved)	g/m³	-	<0.005
Ethane	g/m³	-	0.47
Ethylbenzene	g/m³	<0.0010	0.71
Ethylene	g/m³	-	<0.003
Ethylene glycol	g/m³	320	260
Formaldehyde	g/m³	-	0.47
Hardness (total)	g/m³ CaCO3	-	320
Hydrocarbons	g/m³	117	35
Iron (dissolved)	g/m³	-	2.8
Manganese (dissolved)	g/m³	-	5.3
Magnesium	g/m³	-	7
Methane	g/m³	-	2.1
Methanol	g/m³	4	4
Nickel	mg/kg	-	<0.03
Nitrate nitrogen	g/m³ N	-	<0.2
Nitrite/nitrate nitrogen	g/m³ N	-	0.2
Nitrite nitrogen	g/m³ N	-	<0.2
pH	pH	-	7.1
Potassium	g/m³	-	670
Propylene glycol	g/m³	178	18
Sodium	g/m³	-	4700
Sulphate	g/m³	-	23
Sulphur (dissolved)	g/m³	-	8
Toluene	g/m³	0.0025	10.8
ortha-Xylene	g/m³	0.0018	1.28
meta-Xylene	g/m³	0.002	3.5
Zinc (dissolved)	g/m³	-	0.05

Table 13 Hydraulic fracture fluid and return hydraulic fracture fluid / produced water results obtained from well MHW14

Parameter	Unit	Fracture fluid 30 Oct 2013	Return fluid 10 Nov 2013
Alkalinity (total)	g/m³ CaCO3	-	2000
Barium	mg/kg	-	34
Benzene	g/m³	<0.010	11.8
Bicarbonate	g/m³ HCO3	-	2440
Bromine (dissolved)	g/m³	-	17.4
Calcium	g/m³	-	74
Chloride	g/m³	-	5000
Conductivity	mS/m@20C	-	1975
Copper (dissolved)	g/m³	-	0.007
Ethane	g/m³	-	0.40
Ethylbenzene	g/m³	<0.010	3.3
Ethylene	g/m³	-	<0.003
Ethylene glycol	g/m³	146	<4
Formaldehyde	g/m³	-	0.57
Hardness (total)	g/m³ CaCO3	-	210
Hydrocarbons	g/m³	1890	800
Iron (dissolved)	g/m³	-	10.2
Manganese (dissolved)	g/m³	-	3.0
Magnesium	g/m³	-	7
Mercury (dissolved)	g/m³	-	<0.011
Methane	g/m³	-	1.21
Methanol	g/m³	2	3
Nickel	mg/kg	-	0.04
Nitrate nitrogen	g/m³ N	-	<0.02
Nitrite/nitrate nitrogen	g/m³ N	-	0.03
Nitrite nitrogen	g/m³ N	-	<0.02
pH	pH	-	6.9
Potassium	g/m³	-	720
Propylene glycol	g/m³	17	80
Sodium	g/m³	-	4100
Sulphate	g/m³	-	42
Sulphur (dissolved)	g/m³	-	14
Toluene	g/m³	<0.010	18.4
ortha-Xylene	g/m³	0.012	6.3
meta-Xylene	g/m³	<0.02	18.9
Zinc (dissolved)	g/m³	-	2.6

Table 14 Hydraulic fracture fluid and return hydraulic fracture fluid / produced water results obtained from well MHW15

Parameter	Unit	Fracture fluid 27 Oct 2013	Return fluid 6 Nov 2013
Alkalinity (total)	g/m³ CaCO3	-	2300
Barium	mg/kg	-	46
Benzene	g/m³	<0.010	8.9
Bicarbonate	g/m³ HCO3	-	2806
Bromine (dissolved)	g/m³	-	26
Calcium	g/m³	-	97
Chloride	g/m³	-	6500
Conductivity	mS/m@20C	-	2770
Copper (dissolved)	g/m³	-	0.018
Ethane	g/m³	-	0.49
Ethylbenzene	g/m³	0.029	1.78
Ethylene	g/m³	-	<0.003
Ethylene glycol	g/m³	88	<4
Formaldehyde	g/m³	-	0.29
Hardness (total)	g/m³ CaCO3	-	280
Hydrocarbons	g/m³	650	2000
Iron (dissolved)	g/m³	-	5.9
Manganese (dissolved)	g/m³	-	2.3
Magnesium	g/m³	-	9
Mercury (dissolved)	g/m³	-	<0.011
Methane	g/m³	-	1.18
Methanol	g/m³	3	4
Nickel	mg/kg	-	<0.03
Nitrate nitrogen	g/m³ N	-	<0.02
Nitrite/nitrate nitrogen	g/m³ N	-	<0.02
Nitrite nitrogen	g/m³ N	-	<0.02
pH	pH	-	6.8
Potassium	g/m³	-	550
Propylene glycol	g/m³	52	25
Sodium	g/m³	-	6000
Sulphate	g/m³	-	71
Sulphur (dissolved)	g/m³	-	24
Toluene	g/m³	0.035	14.6
ortha-Xylene	g/m³	0.039	3.4
meta-Xylene	g/m³	0.09	9.8
Zinc (dissolved)	g/m³	-	0.23

2.3.3 Results of discharge and receiving environment monitoring (mix-bury-cover)

Consent 6969-1 to discharge drilling muds, drilling cuttings and drilling wastes from hydrocarbon exploration activities onto and into land via mix-bury-cover was not consistently exercised throughout the monitoring period, as drilling muds, cuttings and wastes were disposed of at an appropriate off site facility.

This consent was exercised once during the period under review prior to the commencement of construction activities for the new section of the Mangahewa-C wellsite, where mix-bury-cover operations were utilized to dispose of lightly contaminated soil from the redundant flare pit from the original section of the wellsite(refer to Figure 6).

Figure 6 Aerial views of the Mangahewa-C wellsite featuring the original section of the wellsite and location of the remediated flare pit (left), and the Mangahewa-C wellsite at present identifying the approximate location of the mix-bury cover operation

Routine inspections and samples obtained from groundwater monitoring bores (constructed specifically for the monitoring of this mix-bury-cover operation) and a composite soil sample of the site have not identified any significant adverse effects in relation to this operation. Results are detailed in Tables 15 and 16.

Table 15 Post mix-bury-cover groundwater results obtained from monitoring bores GND2322 and GND2323

Parameter	Unit	GND2322 *18 Feb 2013*	GND2323 *18 Feb 2013*
Benzene	g/m^3	<0.0010	<0.0010
Toluene	g/m^3	<0.0010	<0.0010
Ethylbenzene	g/m^3	<0.0010	<0.0010
meta-Xylene	g/m^3	<0.002	<0.002
ortha-Xylene	g/m^3	<0.0010	<0.0010
Hydrocarbons	g/m^3	<0.7	<0.7
C7-C9	g/m^3	<0.10	<0.10
C10-C14	g/m^3	<0.2	<0.2
C15-C36	g/m^3	<0.4	<0.4
Chloride	g/m^3	25.7	16.2

Parameter	Unit	GND2322 *18 Feb 2013*	GND2323 *18 Feb 2013*
Conductivity	mS/m@20C	14.3	11.0
pH	pH	6.2	6.2
Sodium	g/m^3	13.4	9.7
Temperature	Deg.C	17.8	17.2

Table 16 Soil results obtained from the mix-bury-cover site

Parameter	Unit	Sample 1 *18 Feb 2013*
Calcium	mg/kg	52.7
Chloride	mg/kg DW	54.2
Conductivity	mS/m@20C	66.3
Hydrocarbons	mg/kg DW	<10
Moisture factor	nil	1.445
Magnesium	mg/kg	9.6
pH	pH	5.8
Sodium	mg/kg	28.9
Sodium absorption ratio	nil	0.96
Total soluble salts	mg/kg	519

2.3.4 Land status

The well site was constructed on relatively flat rural dairy farming area. Relatively minor earthworks were required to construct the site. The land had not been reinstated at the time of the last inspection (7 January 2014) as the site was still in use.

2.4 Contingency plan

Todd Energy Limited have provided a general contingency plan, as required by Condition 6 of resource consent 6967-1 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.

2.5 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 period under review, there were no incidents recorded during inspections. However, the Taranaki Regional Council received four complaints from the public. Three of the complaints recorded were regarding smoke from flaring activities at the Mangahewa-C wellsite on 11 April 2013, 25 May 2013, and 23 August 2013. Following each complaint, an Inspectorate Officer visited the site and found that the

smoke was not considered as being offensive or had contravened consent conditions as there were no off site effects. In addition, Todd Energy Limited were, for the most part, prompt to identify and resolve flaring issues according to on site best practice. Furthermore, the Council undertook an additional investigation at the request of Todd Energy Limited regarding the potential for adverse effects from black smoke occasionally associated with flaring activities at the Mangahewa-C wellsite. The ambient BTEX monitoring survey conducted returned results below detectable limits, hence flaring activities were unlikely to have had any significant or on-going adverse effect on the environment.

The fourth complaint was received regarding the settling pond associated with the new skimmer pits on 21 May 2013. Two of the three samples obtained in conjunction with inspection returned elevated levels of suspended solids. However, upon further investigation, the elevated suspended solid results were not the result of activities at the Mangahewa-C wellsite, but rather attributed to unrelated earthwork activities occurring at an adjacent site. A man hole located further uphill was receiving stormwater from a nearby paddock where recent earthworks had occurred, and so soil was being washed into the discharge pipe via the manhole. This material was then entering the settling pond at the base of the hill prior to entry of the surface waters.

Any other minor actual or potential non-compliance with consent conditions were addressed during site inspections. Todd Energy Limited 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 six resource consent relating to the Mangahewa-C wellsite, consents 6971-1 (to take groundwater), 6973-1 (air discharge associated with exploration), 6967-1 (to discharge treated stormwater and produced water), 6970-1 (to discharge stormwater and sediment from earthworks during construction), 7971-1 (discharge to land – hydraulic fracturing) and 6969-1 (to discharge drilling muds, cuttings and wastes via mix-bury-cover) 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).

Monitoring has shown that the management on-site ensured that no 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, Todd Energy Limited 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.

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.

Todd Energy Limited also undertook the following mitigation measures in order to minimise 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, 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

Small amounts of groundwater may have been encountered as produced water during operations at the wellsite due to the occasional nature of the groundwater abstraction. It is anticipated that the abstraction would not impact on any groundwater resource. Furthermore, the wells are designed to case out groundwater, thus isolating it from the well operation.

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[1]. More recently two studies have focused on field investigations and modelling of emissions from flares involving fracturing fluids.[2]

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_{10} 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.

The measures to be undertaken by Todd Energy Limited 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;

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

- Records of flaring events are kept by Todd Energy Limited and provided to the Council;
- Endeavors were made by Todd Energy Limited to minimise the total volume of gas flared while ensuring that adequate flow and pressure data was gathered to inform their investment decision; and
- Endeavors were made by Todd Energy Limited to minimise smoke emissions from the flare.

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, flare, or some of the chemicals used on-site. Care was taken to minimise the potential for off site odour emissions (e.g. by keeping containers sealed, and ensuring the flare burnt cleanly).

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.

Todd Energy Limited 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;
- Ignition sources were not permitted on any site;
- Sufficient separation of chemicals from the flare pit 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. 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.

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 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 hydrogeological 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 Todd Energy Limited 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 the exploration drilling and hydraulic fracturing activities at the Mangahewa-C wellsite during the monitoring period.

3.3 Evaluation of performance

A tabular summary of Todd Energy Limited's compliance record for the period under review is set out in Tables 17 to 22.

Table 17 Summary of performance for Consent 6971-1 to take groundwater that may be encountered as produced water during hydrocarbon exploration and production operations from up to eight wells at the Mangahewa-C wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. The abstraction must not cause more than a 10% lowering of static water level by interference with any adjacent bore	Complaints and sampling	Yes
2. The abstraction does not cause the intrusion of salt water into any freshwater aquifer	Water sampling adjacent bores pre/post drilling	Yes
3. A well log to 1,000 m must be submitted to the Council	Well log to 1,000 m submitted	Yes
4. Consent holder shall maintain records of abstraction and make available to the Council	Information not requested	N/A
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		High

Table 18 Summary of performance for Consent 6973-1 to discharge emissions to air from flaring of hydrocarbons and miscellaneous emissions associated with drill stem testing, well clean-up, initial well testing and production testing associated with up to eight wells at the Mangahewa-C wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Consent shall not be exercised for more than an accumulated duration of 45 days per zone	Inspection of records	Yes
2. Consent holder shall supply the Council a final site layout plan	Plan received	Yes
3. Council must be notified 24hrs prior to initial flaring of each zone	Notification	Yes
4. At least 24hrs notice prior to flaring required to notify nearby residents when practicable	Notification	Yes
5. No alterations made to plant equipment that will alter the nature or quantity of flare emissions	Inspection, plant procedures and processes	Yes
6. Consent holder shall have regard to prevailing and predicted wind speed and direction with commencement of flaring	Inspection	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
7. Liquid and solid separation to occur before flaring to minimise smoke emissions	Inspection flare pit	Yes
8. If separation could not be implemented / maintained, the consent holder shall notify the Council	Notification	N/A
9. No liquid or solid hydrocarbons shall be combusted within the flare pit	Inspection of flare pit	Yes
10. After flow commences, separated gas shall be combusted through the gas flare system	Inspection of flare pit	Yes
11. Best practicable option to be adopted	Inspections, procedures and processes	Yes
12. Only substances originating from the well stream shall be combusted in the flare pit	Inspection	Yes
13. Consent holder shall not discharge any contaminant to air that is liable to be hazardous , toxic or noxious at or beyond the boundary of the wellsite	Inspections	Yes – additional investigative measures to ensure this
14. No offensive odour or smoke beyond the boundary	Inspection	Yes
15. Opacity of smoke emissions shall not exceed level 1 on Ringelmann Scale	Inspection	Yes – three complaints received regarding smoke; not substantiated
16. Control of carbon monoxide	Chemical analysis of emissions	Yes
17. Control of nitrogen oxides	Chemical analysis of emissions	Yes
18. Control of other emissions	Chemical analysis of emissions	Yes
19. Analysis of typical gas and condensate stream from field to be made available to the Council	Available upon request	N/A
20. Upon request a record be made available to the Council of all smoke-emitting incidents	Available on request	Yes
21. Log all flaring including time, duration, zone, volumes flared and smoke events	Inspection of Company records	Yes
22. Consent shall lapse if not implemented	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		High

Table 19 Summary of performance for Consent 6967-1 to discharge treated stormwater and treated produced water from hydrocarbon exploration and production operations at the Mangahewa-C wellsite onto and into land, including by the use of a slurry wagon, in circumstances where it may enter into an unnamed tributary of the Waiau Stream

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Consent authorises the discharge of treated stormwater and treated produced water from hydrocarbon exploration and operations at the Mangahewa-C wellsite	-	N/A
2. Discharges to land by slurry wagon shall be limited to specific lots	Inspection	N/A
3. Consent holder to adopt best practicable option at all times	Inspections, procedures and processes	Yes
4. Maximum stormwater catchment area shall be no more than 50,000 m^2	Plans, procedures and processes	Yes
5. 7 days written notice prior to site works and drilling	Notification received	Yes
6. Council to approve the contingency plan in relation to the wellsite prior to exercise of consent	Contingency plan approved	Yes
7. All discharges to be directed for treatment through skimmer pits	Inspection of stormwater system	Yes
8. Stormwater pits to be lined with impervious material	Inspection	Yes
9. The stormwater system shall be designed, managed and maintained in accordance with information submitted	Confirming discharges were undertaken in accordance with information submitted	Yes
10. Constituents in discharges shall meet the following standards: a) pH 6.5 – 8.5 b) Suspended solids <100 g/m^3 c) Hydrocarbon <15 g/m^3 d) Chloride 50 g/m^3	Physicochemical sampling	Yes
11. Following a mixing zone of 25 m , discharges shall not give rise to a temperature increase of more than 2°C	Physicochemical sampling	Yes
12. Following the mixing zone, the discharge shall not give rise to adverse effects in/on the receiving waters	Inspection and sampling	Yes
13. Discharges to land shall occur a minimum of 25 m away from any surface water body	Inspection	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
14. Discharge shall be applied so that it infiltrates the soil and does not pond or run off to water	Inspection	N/A
15. Consent holder shall keep records of discharge operations undertaken	Inspection of records	N/A
16. The Council shall be advised in writing 48 hrs prior to reinstatement of the site	Notification	N/A
17. Consent shall lapse if not implemented	Exercise of consent confirmed by inspection	N/A
18. 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		High

Table 20 Summary of performance for Consent 6970-1 to discharge stormwater and sediment arising from earthworks during the construction of the Mangahewa-C wellsite onto and into land in the vicinity of an unnamed tributary of the Waiau Stream in the Waiau catchment

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Consent holder to adopt best practicable option at all times	Inspection, procedures and processes	Yes
2. Prior to the exercise of consent, consent holder shall supply the Council with site erosion and sediment control management plan	Plan received	Yes
3. 7 days written notice prior to site earthworks commencing	Notification received	Yes
4. Following the mixing zone, the discharge shall not give rise to adverse effects in/on the receiving waters	Inspection	Yes
5. Design and management of earthworks and control of stormwater discharge shall be in accordance with information submitted	Comparing submitted & approved plans with the built site inspection	Yes
6. All earth worked areas shall be stabilised as soon as practicable	Inspection	Yes
7. Consent shall lapse if not implemented	Exercise of consent confirmed by inspection	N/A
8. 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		High

Table 21 Summary of performance for Consent 7971-1 to discharge contaminants associated with hydraulic fracturing activities into land at depths greater than 3245mTVD beneath the Mangahewa-C wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Any discharge shall occur below 3,425 mTVDss	Inspection of Company records	Yes
2. No discharge shall occur more than 500 metres horizontally from each well on the wellsite	Inspection of Company records	Yes
3. Exercise of consent shall not contaminate or put at risk freshwater aquifers	Sampling fresh water bores pre/post discharge	Yes
4. Consent holder shall undertake sampling programme	Inspection and sampling fresh water bores pre/post discharge	Yes
5. Sampling programme shall follow recognised field procedures	Inspection, procedures and processes	Yes
6. Consent holder shall notify the Council of hydraulic fracturing discharge	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 received	Yes
8. A post-fracturing discharge report is to be provided to the Council within 30 days after the discharge has ceased	Post-fracturing discharge report received	Yes
9. The reports outlined in conditions 7 and 8 must be emailed to consents@trc.govt.nz	Reports received via email	Yes
10. The consent holder shall provide access to a location where samples of hydraulic fracturing fluids and return fluids can be obtained by the Council officers	Access provided	Yes
11. Consent holder to adopt best practicable option at all times	Inspection, procedures and processes	Yes
12. No hydrocarbon based hydraulic fracturing fluid shall be discharged	Physicochemical sampling and analysis	Yes
13. 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		High

Table 22 Summary of performance for Consent 6969-1 to discharge drilling muds, drilling cuttings and drilling wastes from hydrocarbon exploration activities at the Mangahewa-C wellsite onto and into land via mix-bury-cover

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. The volume of waste discharged shall not exceed 15,000m^3	Inspection, procedures and processes	Yes
2. Prior to exercise of consent the consent holder must provide to the Council for each discharge in writing a scope of the proposed mix-bury-cover discharge	Notification received	Yes
3. The discharge is to take place in accordance with information submitted in support of application	Confirming discharges were undertaken in accordance with information submitted	Yes
4. The Council to be notified 48hrs prior to and completion of each mix-bury-cover discharge	Notification received	Yes
5. Records of composition, volumes and quantities of material to be discharged shall be kept	Inspection of Company records	Yes
6. Mix-bury-cover operations must be 30m from any surface water body, spring or bore	Inspection	Yes
7. All ponded water to be removed from drilling waste retention receptacle prior to recovery/mixing operations	Inspection	Yes
8. All sumps to be permeable	Not utilised	N/A
9. Solid drilling wastes to be incorporated with uncontaminated soils	Inspection and physicochemical sampling	Yes
10. Placement of solid drilling wastes shall as far as practicable be above the water table	Inspection and sampling	Yes
11. The total loading of trace elements in waste is not to exceed Alberta Energy and Utilities Board, 1996, G-50 guidelines	Inspection of Company records	Yes
12. Chloride levels in each mix-bury-cover activity shall not exceed 1,600kg	Physicochemical sampling	Yes
13. Nitrogen levels in each mix-bury-cover shall not exceed 400kg	Physicochemical sampling	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
14. The hydrocarbon content of solid drilling waste shall not exceed 15mg/kg	Physicochemical sampling	Yes
15. Level of total dissolved salts within any surface water or groundwater must not exceed 2,500 g/m^3	Physicochemical sampling	Yes
16. Various metals in the soil covering the mix-bury-cover to be below agreed limits	Physicochemical sampling	Yes
17. Mixture of solid drilling wastes and uncontaminated soil shall be covered by at least one metre of uncontaminated soil and shall be re-vegetated and maintained with pasture cover	Inspection, procedures & processes	Yes
18. The cover material must be compacted and contoured so that stormwater is directed away from the mix-bury-cover site	Inspection	Yes
19. Consent holder to adopt best practicable option at all times	Inspection, procedures and processes	Yes
20. Exercise of consent shall not lead to a direct discharge of contaminants to a surface water body	Inspection	Yes
21. Exercise of consent shall not result in any adverse impact on groundwater, surface water or aquatic ecosystems	Inspection and physicochemical sampling	Yes
22. Hydrocarbon concentrations in the soil covering the mix-bury-cover site shall comply with agreed guideline values	Physicochemical sampling	Yes
23. Soil levels shall not exceed the following parameters: a. Conductivity 290 g/m^3 b. Total dissolved salts 2500 g/m^3 c. Sodium 460 g/m^3 d. Chloride 700 g/m^3	Physicochemical sampling	Yes
24. Consent holder may apply to the Council for a change or cancellation of the conditions of this consent	No applications lodged during period under review	N/A
25. The Council may review any or all of the consent conditions within two months of receiving data regarding condition 5	No reviews made during period under review	N/A

Condition requirement	Means of monitoring during period under review	Compliance achieved?
26. Consent shall lapse if not implemented by date specified	Exercise of consent confirmed by inspection	N/A
27. 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		High

During the monitoring period, Todd Energy Limited demonstrated a high level of environmental performance and compliance with the resource consents. The incidents that occurred with respect to flaring activity complaints have been discussed in Section 2.5. 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 2015.

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

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. Furthermore, with regard to hydraulic fracturing activities, baseline groundwater monitoring samples have demonstrated that hydraulic fracturing discharges have not given rise to any significant adverse effects on groundwater aquifers within the region. However, 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.

In addition, 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. 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 Mangahewa-C 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 Mangahewa-C wellsite be extended 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 Mangahewa-C wellsite be extended to include a biomonitoring survey;

4. THAT, subject to the findings of monitoring of any further activities at the Mangahewa-C wellsite consents 6967-1, 6973-1, 6970-1, 6969-1 and 6971-1 shall not be reviewed in 2015.

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^3	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_4	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH_3	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NO_3	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_{10}	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

Name of Consent Holder:	Todd Energy Limited P O Box 802 NEW PLYMOUTH 4340
Decision Date:	20 January 2012
Commencement Date:	20 January 2012

Conditions of Consent

Consent Granted:	To discharge contaminants associated with hydraulic fracturing activities into land at depths greater than 3425mTVD beneath the Mangahewa-C wellsite at or about (NZTM) 1713435E-5676634N
Expiry Date:	1 June 2014
Review Date(s):	June 2013
Site Location:	Mangahewa-C wellsite, Tikorangi Road East, Waitara [Property owners: PG & BM Bourke]
Legal Description:	Lot 9 DP 408656 (Discharge source & site)
Catchment:	Waiau

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 to section 36 of the Resource Management Act.

Special conditions

1. Any discharge shall occur below 3425 mTVD.

   Note: mTVD = metres true vertical depth, i.e. the true vertical depth in metres below the surface.

2. No discharge shall occur more than 500 metres horizontally from each wellbore on the Mangahewa-C wellsite.

3. The consent holder shall ensure that the exercise of this consent does not contaminate or put at risk actual or potential usable freshwater aquifers above the hydrocarbon reservoir.

4. The consent holder shall undertake a programme of sampling and testing that, to the satisfaction of the Chief Executive, Taranaki Regional Council, monitor the effects of the exercise of this consent on groundwater users within 2.5 km of the Mangahewa-C wellsite. Any groundwater samples shall be taken in accordance with recognized field procedures and analysed for:

   (a) pH;
   (b) Conductivity;
   (c) Total dissolved solids;
   (d) Total suspended solids;
   (e) Major ions (Ca, Mg, K, Na, total alkalinity, chloride, nitrate-nitrogen, and sulfate);
   (f) Trace metals (cadmium, copper, iron, manganese, nickel, and zinc);
   (g) Total organic carbon;
   (h) Formaldehyde;
   (i) Dissolved methane and ethane gas;
   (j) Carbon-13 composition of dissolved methane gas (^{13}C-CH_4); and
   (k) Benzene, toluene, ethylbenzene, and xylenes (BTEX).

5. All sampling and analysis shall be undertaken in accordance with a *Sampling and Analysis Plan*, which shall be submitted to the Chief Executive, Taranaki Regional Council (CE) for review and certification before the first sampling is undertaken. This Plan shall specify the use of standard protocols recognized to constitute good professional practice including quality control and assurance. A properly accredited laboratory shall be used for all sample analysis. Results shall be provided to the CE within 30 calendar days of sampling and shall include supporting quality control and assurance information. These results will be used to assess compliance with condition 3.

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

6. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing of the date that the discharges are expected to commence. Notification shall occur by email to worknotification@trc.govt.nz, where practicable and reasonable one working day prior to the exercise of the consent, but in any event 24 hours notice shall be given. Notification shall include the consent number and a brief description of the activity consented.

7. The second and subsequent discharges shall only occur after the consent holder has provided a comprehensive 'Pre-fracturing discharge report' to the Chief Executive, Taranaki Regional Council. The report shall be provided at least 10 working days before the discharge commences and, as a minimum, shall contain:

   (a) The intended fracturing intervals and the co-ordinates of the fracture initiation point for each fracture interval;
   (b) The total volume of material planned to be pumped down the well and its composition, including a list of the chemicals or additives to be used;
   (c) The mitigation measures that are in place to ensure the discharge does not cause adverse environmental effects;
   (d) The results of pressure testing the well;
   (e) The extent and characteristics of the geological seals in place above the discharge zone;
   (f) The anticipated well and discharge zone pressures and the duration the pressures;
   (g) The anticipated extent of fractures; and
   (h) Details of the disposal of any returned fluids, including any consents that are relied on to authorise the disposal.

8. At the conclusion of any discharge, the consent holder shall submit a comprehensive 'Post-fracturing discharge report' to the Chief Executive, Taranaki Regional Council. The report shall be provided within 30 working days after the discharge ceases and, as a minimum, shall contain:

   (a) Confirmation of the interval where fracturing occurred;
   (b) Confirmation of volumes and fluid compositions discharged;
   (c) The volume of returned fluids and an estimate of the proportion of fluids and proppant remaining in the reservoir;
   (d) The results of modeling the discharge, including a proppant concentration diagram or a similar diagram, showing the likely extent of the fractures generated by the discharge;
   (e) Well and discharge zone pressure durations and the maximum pressure reached;
   (f) Details of the disposal of any returned fluids, including any consents that are relied on to authorise the disposal; and
   (g) An assessment of the effectiveness of the mitigation measures in place with specific reference to those described in application 6949.

9. The reports described in conditions 7 and 8 shall be emailed to consents@trc.govt.nz with a reference to the number of this consent.

10. The consent holder shall provide access to a location where the Taranaki Regional Council officers can obtain a sample of the fraccing fluids and return fluids.

11. 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 on the environment; in particular, ensuring that the discharge is contained within the discharge zone.

12. No hydrocarbon based fraccing fluid shall be discharged.

13. That 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 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.

Signed at Stratford on 15 November 2013

For and on behalf of
Taranaki Regional Council

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Director-Resource Management

Discharge Permit

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

Name of Consent Holder:	Todd Energy Limited P O Box 802 NEW PLYMOUTH 4340
Decision Date (Change):	1 May 2007
Commencement Date (Change):	1 May 2007 (Granted: 19 October 2006)

Conditions of Consent

Consent Granted:	To discharge emissions to air from flaring of hydrocarbons and miscellaneous emissions associated with drill stem testing, well clean-up, initial well testing and production testing associated with up to eight wells at the Mangahewa-3 wellsite at or about GR: Q19:235-384
Expiry Date:	1 June 2021
Review Date(s):	June 2009, June 2015
Site Location:	Mangahewa-3 wellsite, Tikorangi Road East, Waitara [Land Owners: PG & BM Bourke]
Legal Description:	Lot 2 DP 13702 Secs 52 & 53 Pt Secs 51, 55 & 81 Tikorangi Dist Blk X Waitara SD

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

Condition 1 – changed

Duration

1. This consent shall not be exercised for more than an accumulated duration of 45 days per zone, allowing up to 180 days flaring per well, from up to eight wells. The time interval specified in this condition refers to that period during which this consent is exercised and is not regarded as continuous elapsed time from the first exercise of this consent.

Conditions 2 to 23 – unchanged

Information and notification

2. Prior to the commencement of testing, the consent holder shall supply to the Chief Executive, Taranaki Regional Council, a final site layout plan, demonstrating configuration of the facilities and equipment so as to avoid or mitigate the potential effects of air emissions.

3. The Taranaki Regional Council shall be notified within 24 hours prior to the initial flaring of each zone being commenced.

4. At least 24 hours prior to any flaring, the consent holder shall undertake all practicable measures to notify residents within 1000 metres of the wellsite 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.

5. No alteration shall be made to plant equipment or processes which may substantially alter the nature or quantity of flare emissions or other wellsite 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.

Flaring

6. 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.

7. All gas being flared, at any time during well clean-up, drill stem testing, initial testing, or production testing, or at any other 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.

8. 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 separation and recovery within three hours.

9. Subject to special conditions 7 and 8 no liquid or solid hydrocarbons shall be combusted through the gas flare system.

10. As soon as is practicable after flow commences, the separated gas shall be combusted so that emissions of smoke are minimised.

11. 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 the flare emission, emissions from the flare pit, or any other emissions from the wellsite [including use of a separator during well clean-up]. This requirement applies in addition to any of the specific requirements set out in conditions 1, 6, 7, 8, 9 and 10.

12. Only substances originating from the well stream and treated as outlined by conditions 7, 8, 9, 10 and 11 are to be combusted within the flare pit.

13. 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.

14. 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

15. 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.

16. 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^3 [eight-hour average exposure], or 30 mg/m^3 one-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 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^3 [24 hour average exposure], or 200 mg/m^3 [1-hour average exposure] at or beyond the boundary of the wellsite, or beyond 100 metres from the flare, whichever distance is greater.

18. 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 $1/30^{th}$ 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

19. 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_6 or higher number of compounds.

20. 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.

21. The consent holder shall keep and make available to the Chief Executive, Taranaki Regional Council, logs of all flaring, including time, duration and [as far as is practicable] volumes of substances flared.

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 2009 and/or June 2015, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 15 November 2013

For and on behalf of
Taranaki Regional Council

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Director-Resource Management

Water Permit

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

Name of Consent Holder:	Todd Energy Limited P O Box 802 NEW PLYMOUTH 4340
Decision Date:	19 October 2006
Commencement Date:	19 October 2006

Conditions of Consent

Consent Granted:	To take groundwater that may be encountered as produced water during hydrocarbon exploration and production operations from up to eight wells at the Mangahewa-3 wellsite at or about GR: Q19:235-384
Expiry Date:	1 June 2021
Review Date(s):	June 2009, June 2015
Site Location:	Mangahewa-3 wellsite, Tikorangi Road East, Waitara [Land Owner: PG & BM Bourke]
Legal Description:	Lot 2 DP 13702 Secs 52 & 53 Pt Secs 51, 55 & 81 Tikorangi Dist Blk X Waitara SD
Catchment:	Waiau

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

General conditions

a) On receipt of a 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 ensure the abstraction does not cause more than a 10% lowering of static water-level by interference with any adjacent bore.

2. The consent holder shall ensure the abstraction does not cause the intrusion of salt water into any freshwater aquifer.

3. The consent holder shall submit, to the written satisfaction of the Chief Executive, Taranaki Regional Council, a summary well log to a depth of 1000 metres. The report shall:

   a) provide a log to show the true vertical depth to all geological formation tops intersected within the freshwater zone;
   b) identify the true vertical depth to, and thickness of, any freshwater aquifers intersected by the well;
   c) identify the true vertical depth to the freshwater- saline water interface in the well.

4. The consent holder shall maintain records of abstraction including date, volume of groundwater abstracted per day, and shall make these records available to the Chief Executive, Taranaki Regional Council, upon request.

5. 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.

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 2009 and/or June 2015, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 15 November 2013

For and on behalf of
Taranaki Regional Council

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Director-Resource Management

Discharge Permit

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

Name of Consent Holder:	Todd Energy Limited P O Box 802 NEW PLYMOUTH 4340
Decision Date:	18 October 2006
Commencement Date:	18 October 2006

Conditions of Consent

Consent Granted:	To discharge stormwater and sediment arising from earthworks during the construction of the Mangahewa-3 wellsite onto and into land in the vicinity of an unnamed tributary of the Waiau Stream in the Waiau catchment at or about GR: Q19:235-384
Expiry Date:	1 June 2021
Review Date(s):	June 2009, June 2015
Site Location:	Mangahewa-3 wellsite, Tikorangi Road East, Waitara [Land Owner: P & B Bourke]
Legal Description:	Lot 2 DP 13702 Secs 52 & 53 Pt Secs 51, 55 & 81 Tikorangi Dist Blk X Waitara SD
Catchment:	Waiau

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

General conditions

a) On receipt of a 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 section 2 the Resource Management Act 1991, to prevent or minimise the discharge of sediment to any surface water body and to prevent or minimise any adverse effects of the discharge on any surface water body.

2. Prior to the exercise of this consent, the consent holder shall provide for the written approval of the Chief Executive, Taranaki Regional Council, a site erosion and sediment control management plan.

3. The Chief Executive, Taranaki Regional Council, shall be advised in writing at least 7 days prior to wellsite and access works commencing.

4. After allowing for reasonable mixing, being a mixing zone extending seven times the width of the surface water body at the point of discharge, the discharge shall not give rise to any of the following effects in any surface water body:

a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
b) any conspicuous change in the colour or visual clarity;
c) any emission of objectionable odour;
d) the rendering of fresh water unsuitable for consumption by farm animals;
e) any significant adverse effects on aquatic life.

5. The design and management of the earthworks and control of the stormwater discharge shall be generally undertaken in accordance with the information submitted in support of application 4376, and to the satisfaction of the Chief Executive, Taranaki Regional Council.

6. All earthwork areas shall be stabilised vegetatively or otherwise as soon as is practicable immediately following completion of soil disturbance activities to the satisfaction of the Chief Executive, Taranaki Regional Council.

7. 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.

8. 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 2009 and/or June 2015, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 15 November 2013

For and on behalf of
Taranaki Regional Council

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Director-Resource Management

Discharge Permit

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

Name of Consent Holder:	Todd Energy Limited P O Box 802 NEW PLYMOUTH 4340
Decision Date:	19 October 2006
Commencement Date:	19 October 2006

Conditions of Consent

Consent Granted:	To discharge drilling muds, drilling cuttings and drilling wastes from hydrocarbon exploration activities at the Mangahewa-3 wellsite onto and into land via mix-bury cover at or about GR: Q19:235-384
Expiry Date:	1 June 2021
Review Date(s):	June 2009, June 2015
Site Location:	Mangahewa-3 wellsite, Tikorangi Road East, Waitara [Land Owner: PG & BM Bourke]
Legal Description:	Lot 2 DP 13702 Secs 52 & 53 Pt Secs 51, 55 & 81 Tikorangi Dist Blk X Waitara SD
Catchment:	Waiau

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

General conditions

a) On receipt of a 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. This consent allows for the discharge of up to 12,000 m^3 of solid drilling wastes [including drill cuttings and residual fluids] by way of mix-bury-cover into land on the Mangahewa-3 wellsite and surrounding land. Mix-bury-cover discharge areas for wastes from individual wells shall be kept separate and distinct.

2. Prior to the exercise of this consent for each separate mix-bury-cover discharge the consent holder shall provide to the written satisfaction of the Chief Executive, Taranaki Regional Council, a report describing proposed mix-bury-cover, including area, location, nature of material, means of compliance with conditions, etc, and the results of any relevant monitoring of existing mix-bury-cover discharge sites under this consent. In any case additional mix-bury-cover discharges shall not take place under this consent within 12 months of any previous mix-bury-cover discharge, unless this requirement is waived in writing by the Chief Executive, Taranaki Regional Council.

3. The consent holder shall ensure that the discharge, licensed by this consent, takes place in general accordance with the information submitted in support of application 4375. In particular but without limitation, any amendment to the location of the mix-bury-cover site, pre-treatment of solids, changes to fluids/additives, method of mix-bury-cover, or post burial site management, shall be advised to the Chief Executive, Taranaki Regional Council, prior to any discharge to the mix-bury-cover site, and shall not provide or result in any less environmental protection than that set out or provided for in the information submitted in support of application 4375.

4. The consent holder shall notify the Taranaki Regional Council at least 48 hours prior to commencement, and upon completion of the discharge to the mix-bury-cover site[s].

5. The consent holder shall keep records of the composition and volumes of the material to be discharged, including records of quantities and types of drilling fluids and additives used [materials and their composition], and shall forward the records to the Taranaki Regional Council prior to the discharge.

6. The edge of the mix-bury-cover zone shall be at least 30 metres from any surface water body, spring, or any pre-existing groundwater supply bore.

7. All ponded water shall be removed from the drilling waste holding receptacle prior to the recovery/mixing operation.

8. If sumps are used as drilling waste holding receptacles on the site, and the sump is to be used for a disposal area, the impermeable liner shall be perforated, and where possible removed, so that it no longer encloses the solid drilling wastes.

9. The solid drilling wastes [drill cuttings and residual fluids] shall be incorporated with uncontaminated soils with a mixing ratio of 1 part solid drilling wastes [drill cuttings, additives and residual fluids] to a minimum of 3 parts uncontaminated soil.

10. The placement of the solid drilling wastes [drill cuttings and residual fluids] shall as far as practicable be above the watertable.

11. The total loading of trace elements in the solid drilling wastes to be disposed of in the mix-bury-cover operation shall not exceed those listed in Table 3-1 of the Alberta Energy and Utilities Board, 1996, G-50 guidelines.

12. The loading of chloride must not exceed 1,600 kg for each distinct mix-bury-cover disposal area for wastes from an individual well.

13. The loading of nitrogen must not exceed 400 kg for each distinct mix-bury-cover disposal area for wastes from an individual well.

14. The hydrocarbon content of the soil waste mix shall not exceed 0.0015% [15 mg/kg] on a dry weight basis.

15. The exercise of this consent shall not result in a level of total dissolved salts within any surface water or ground water of more than 2500 gm^{-3}.

16. The disposal of solid drilling wastes shall comply with the heavy metal receiving environment concentration limits specified in Table C, Section 9, Public Guidelines for the Safe Use of Sewage Effluent and Sewage Sludge on Land, Ministry of Health, 1992.

17. The solid drilling wastes [drill cuttings and residual fluids] shall be covered by at least one metre of uncontaminated soil, and shall be revegetated and thereafter maintained with pasture cover within 6 months of the completion of any mix-bury-cover operation.

18. The consent holder shall compact and contour the cover material such that all surface stormwater is directed away from the mix-bury-cover site and shall maintain the cover layer of soil so as to ensure its integrity at all times to the satisfaction of the Chief Executive, Taranaki Regional Council.

19. 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 adverse effects on the environment arising from the discharge, including but not limited to any water body or soil.

20. The exercise of this consent shall not lead, or be liable to lead, to a direct discharge of contaminants to a surface water body.

21. The exercise of this consent shall not result in any adverse impacts on groundwater as a result of leaching, or on surface water including aquatic ecosystems, and/or result in a change to the suitability of use of the receiving water as determined by the Chief Executive, Taranaki Regional Council.

22. At any time the levels of hydrocarbons in the soil shall comply with the guideline values for the designated soil type in the surface layer [less than 0.5 metre depth] set out in Tables 4.12 and 4.15 of the Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand [Ministry for the Environment, 1999].

23. At any time the upper [less than 0.5 metre depth] soil levels shall not exceed the following limits: conductivity 290 mSm^{-1}; total dissolved salts 2500 gm^{-3}; sodium 460 gm^{-3}; and chloride 700 gm^{-3}.

24. The consent holder may apply to the Taranaki Regional Council for a change or cancellation of any of the conditions of this consent in accordance with section 127(1)(a) of the Resource Management Act 1991 to take account of operational requirements or the results of monitoring.

25. The Taranaki Regional Council may review any or all of the conditions of this consent within two months of receiving data on the volume and composition of the material under condition 5 for the purpose of assessing the adequacy of monitoring and mitigation measures.

26. 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.

27. 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 2009 and/or June 2015, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 15 November 2013

For and on behalf of
Taranaki Regional Council

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Director-Resource Management

Discharge Permit

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

Name of Consent Holder:	Todd Energy Limited P O Box 802 NEW PLYMOUTH 4340
Decision Date (Change):	26 March 2013
Commencement Date (Change):	26 March 2013 (Granted: 19 October 2006)

Conditions of Consent

Consent Granted:	To discharge treated stormwater and treated produced water from hydrocarbon exploration and production operations at the Mangahewa-C wellsite onto and into land, including by the use of a slurry wagon, in circumstances where it may enter into an unnamed tributary of the Waiau Stream
Expiry Date:	1 June 2021
Review Date(s):	June 2015
Site Location:	Mangahewa-C wellsite, Tikorangi Road East, Waitara (Property Owner: PG & BM Bourke)
Legal Description:	Lot 9 DP 408656 (Discharge source & site) Lots 1, 2, 4, 8 & 10 (Discharge sites)
Grid Reference (NZTM)	1713574E-5677018N
Catchment:	Waiau

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

General conditions

a. On receipt of a 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. This consent authorises the discharge of treated stormwater and treated produced water from hydrocarbon exploration and production operations at the Mangahewa-C wellsite onto and into land, including by the use of a slurry wagon.

2. The discharge to land by slurry wagon shall be limited to the following sites: Lots 1, 2, 4, 8, 9 & 10 DP 408656.

3. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any adverse effects of the discharge on any water body.

4. The maximum stormwater catchment area shall be no more than 50,000 m^3.

5. The Chief Executive, Taranaki Regional Council, shall be advised in writing at least 7 days prior to any site works commencing, and again in writing at least 7 days prior to any well drilling operation commencing.

6. Prior to the exercise of this consent, the consent holder shall provide for the written approval of the Chief Executive, Taranaki Regional Council, site specific details relating to contingency planning for the wellsite.

7. All stormwater and produced water to be discharged under this permit shall be directed for treatment through the stormwater treatment system for discharge in accordance with the special conditions of this permit.

8. All skimmer pits and stormwater retention areas shall be lined with an impervious material to prevent seepage through the bed and sidewalls.

9. The design, management and maintenance of the stormwater system shall be generally undertaken in accordance with the information submitted in support of applications 4373, 6333 and 7206.

10. The following concentrations shall not be exceeded in the discharge:

Component	**Concentration**
pH (range)	6.5 - 8.5
suspended solids	100 gm^{-3}
total recoverable hydrocarbons (infrared spectroscopic technique)	15 gm^{-3}
chloride	50 gm^{-3}

This condition shall apply prior to the entry of the treated stormwater and produced water either onto and into land, or into surface water, at a designated sampling point approved by the Chief Executive, Taranaki Regional Council.

11. After allowing for a mixing zone of 25 metres, the discharge shall not give rise to an increase in the temperature of the receiving waters of more than 2 degrees Celsius.

12. After allowing for reasonable mixing, within a mixing zone extending seven times the width of the water body downstream of a designated discharge point, the discharge shall not give rise to any of the following effects in the receiving waters:

a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
b) any conspicuous change in the colour or visual clarity;
c) any emission of objectionable odour;
d) the rendering of fresh water unsuitable for consumption by farm animals;
e) any significant adverse effects on aquatic life.

13. The discharge onto and into land shall occur a minimum of 25 metres from any surface water body. Discharge shall be onto and into land and there shall be no direct discharge to surface water.

14. The discharge shall be applied at such a rate and over such an area of land that it infiltrates the soil and does not pond or run off to water.

15. The consent holder shall keep a record of the discharge operation undertaken, including, but not necessarily limited to the following information:

a. volume of water collected and discharged;

b. date of discharge;

c. location of discharge; and

d. distance from the nearest stream.

This record shall be made available to the Chief Executive, Taranaki Regional Council on request.

16. The Chief Executive, Taranaki Regional Council, shall be advised in writing at least 48 hours prior to the reinstatement of the site and the reinstatement shall be carried out so as to minimise effects on stormwater quality.

17. 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.

18. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2015, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 15 November 2013

For and on behalf of
Taranaki Regional Council

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Director-Resource Management