

Greymouth Petroleum  
Turangi-A wellsite  
Monitoring Programme  
Annual Report  
2008-2009  
Technical Report 2009–37

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## **Executive summary**

The Greymouth Petroleum Acquisition Company Limited operates a wellsite on Turangi Road at Motunui, in the Parahaki catchment. This report for the period July 2008-June 2009 describes the monitoring programme implemented by the Taranaki Regional Council to assess the Company's environmental performance during the period under review, and the results and environmental effects of the Company's activities.

The Company holds two resource consents in relation to production activities at the Turangi-A wellsite, which include a total of 46 conditions setting out the requirements that the Company must satisfy. The Company holds one consent to discharge produced water and stormwater onto and into land, and one consent to discharge emissions into the air.

The Council's monitoring programme for the year under review included six inspections, two water samples collected for physicochemical analysis and one air quality survey.

The monitoring showed that production operations at the Turangi-A wellsite do not appear to be causing any adverse environmental effects.

An improvement in the Company's environmental performance is desirable, with respect to the provision of a stormwater management plan for the site and the significant breach of the stormwater discharge consent chloride limit.

This report includes recommendations for the 2009-2010 year.



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# **1. Introduction**

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

### **1.1.1 Introduction**

This report is the Annual Report for the period July 2008-June 2009 by the Taranaki Regional Council on the monitoring programme associated with resource consents held by the Greymouth Petroleum Acquisition Company Limited [Greymouth]. The Company operates a wellsite situated on Turangi Road at Motunui, in the Parahaki catchment.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the consents held by Greymouth that relate to discharges of water within the Parahaki catchment, and the air discharge permit held by Greymouth to cover emissions to air from the site.

One of the intents of the Resource Management Act (1991) 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 Taranaki Regional Council generally implements integrated environmental monitoring programmes and reports the results of the programmes jointly. This report discusses the environmental effects of the Company's use of water, land, and air, and is the second combined annual report by the Taranaki Regional Council for the Company.

### **1.1.2 Structure of this report**

Section 1 of this report is a background section. It sets out general information about compliance monitoring under the Resource Management Act and the Council's obligations and general approach to monitoring sites through annual programmes, the resource consents held by Greymouth in the Parahaki 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 Company's site.

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 in the 2009-2010 monitoring year.

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

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

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

- (a) the neighbourhood or the wider community around a discharger, and may include cultural and socio-economic effects;
- (b) physical effects on the locality, including landscape, amenity and visual effects;
- (c) ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;
- (d) natural and physical resources having special significance (eg, recreational, cultural, or aesthetic);
- (e) risks to the neighbourhood or environment.

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Taranaki Regional Council is recognising the comprehensive meaning of 'effects' inasmuch as is appropriate for each discharge source. Monitoring programmes are not only based on existing permit conditions, but also on the obligations of the Resource Management Act 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 performance

Besides discussing the various details of the performance and extent of compliance by Greymouth 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 trivial (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 year were negligible or minor at most, items of concern were resolved positively, co-operatively, and quickly, the Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices, 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.
- **improvement desirable** indicates that the Council may have been obliged to record a verified unauthorised incident involving significant environmental

impacts against the company, and/or abatement notices may have been issued; there were adverse 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 end of the period under review.

- **poor** performance is used when there were grounds for prosecution or infringement notice.



Photograph 1 Turangi-A wellsite

## 1.2 Process description

The Turangi-A wellsite production facilities were commissioned in late 2006 following the successful drilling and testing of the Turangi-1 well. Two further production wells were drilled on the wellsite in 2008. The production facilities currently treat condensate and gas from the three wells.

The primary facilities on the Turangi-A wellsite consist of:

- Wellhead shutdown systems.
- Sand catcher and heating systems.
- Inlet separator and LTS.
- Methanol storage and dosing system.
- A low pressure gas compressor.
- Flare system and flare pit.
- Storage tanks (condensate, methanol, and produced water) and a condensate loadout facility.
- Utilities - power, air, potable water, toilet/septic tank.

Gas is compressed, metered and exported to the national gas network. Condensate storage is located on the wellsite and currently consists of three 60m<sup>3</sup> above ground tanks and a truck loadout facility, condensate is trucked to the Omata tank farm on a daily basis. Produced formation water is stored on the site in bunded tanks prior to being pumped down the Turangi-3 well annulus into the Mt Messenger formation for disposal.

All chemical storage is contained within bunds and isolated from the stormwater system. The stormwater drain system consists of open culverts which drain general surface water run-off from the site and some surrounding farmland. Stormwater from the site passes through two clay lined skimmer pits before discharging to a tributary of the Parihaki Stream. The oily water drainage system consists of a buried pipe which gathers oily water from spill containment areas (i.e. curbed foundations and tank bunds) and directs these flows into a triple interceptor pit located near the truck loading bay. Oily water drains from the compressor house are collected in a buried fibreglass tank and are routinely pumped out into the storage tanks.

## 1.3 Resource consents

### 1.3.1 Water discharge permit

Section 15(1)(a) of the Resource Management Act 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.

Greymouth holds water permit **6498-1** issued by the Taranaki Regional Council on 7 December 2004 under Section 87(d) of the Resource Management Act, as described in Table 1 below.

**Table 1** Water abstraction permit 6498-1 - Consent Purpose Summary

Consent	Issued	Term	Reviews	Expiry	Purpose/Comment
6498-1	07/12/2004	16.5 years	2009, 2015	01/06/2021	To discharge treated stormwater and treated produced water from hydrocarbon exploration and production operations at the Turangi wellsite onto and into land in the vicinity of the Parahaki Stream.
<b>Description</b>	Q19:239-431				
<b>Special Conditions</b>	<b>Purpose of conditions</b>				
1 and 6	Relate to the discharge of treated water and the perimeter drain.				
2 to 5	Set out contaminant concentrations that must not be exceeded in the soil layer.				
7, 8 and 12	Require records to be kept, and the provision of management and contingency plans.				
9 – 11	Relate to the best practicable option, catchment area and notifications.				
13 - 15	Relate to the stormwater treatment system and bunding of hazardous substance storage areas.				
16 – 19	Specify limits in the discharge, effects on receiving waters and no direct discharge to surface water.				
20 – 22	Relate to site reinstatement, lapse and review.				

The permit is attached to this report in Appendix I.

### 1.3.2 Air discharge permit

Section 15(1)(c) of the Resource Management Act 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.

Greymouth holds air discharge permit **6497-1** issued by the Taranaki Regional Council on 7 December 2004 under Section 87(d) of the Resource Management Act, as described in Table 2 below.

**Table 2** Air discharge permit 6497-1 - Consent Purpose Summary

Consent	Issued	Term	Reviews	Expiry	Purpose/Comment
6497-1	07/12/2004	16.5 years	2009, 2015	01/06/2021	To discharge emissions to air during flaring from well workovers and in emergency situations and miscellaneous emissions associated with production activities at the Turangi Road wellsite.
<b>Description</b>	Q19:239-431				
<b>Special Conditions</b>	<b>Purpose of conditions</b>				
1 – 4 and 7	Relate to notifications.				
5 and 6	Require consideration of the wind and effective liquid and solid separation.				
8 and 9	State that no liquid or solid hydrocarbons shall be flared and only substances from the well stream be combusted.				
10 - 12	Relate to the best practicable option and prohibit effects beyond the boundary.				
13	Requires vapour recovery on storage vessels.				
14	Specifies the opacity of smoke emissions.				
15 – 17	Place limits on contaminant concentrations due to air emissions.				
18 – 22	Specify records to be kept and reporting requirements.				
23 and 24	Are lapse and review provisions.				

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 sets out an obligation for the Taranaki Regional Council to gather information, monitor, and conduct research on the exercise of resource consents, and the effects arising, within the Taranaki region.

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

The monitoring programme for the Turangi-A wellsite consisted of three primary components.

#### **1.4.2 Programme liaison and management**

There is generally a significant investment of time and resources by the Taranaki Regional 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**

The Turangi-A wellsite was visited six times during the monitoring period. With regard to consents for discharge to water, the main points of interest were plant processes with potential or actual discharges to receiving watercourses, including contaminated stormwater and process wastewaters. Air inspections focused on plant processes with associated actual and potential emission sources and characteristics, including potential odour, dust, noxious or offensive emissions. Sources of data being collected by the consent holder were identified and accessed, so that performance in respect of operation, internal monitoring, and supervision could be reviewed by the Council. The neighbourhood was surveyed for environmental effects.

#### **1.4.4 Chemical sampling**

The Taranaki Regional Council undertook sampling of the skimmer pit discharge from the site on two occasions. The samples were analysed for chlorides, hydrocarbons, pH and suspended solids.

The Council also undertook sampling of the ambient air quality in the vicinity of the site. A multi-gas meter was deployed downwind for approximately 24 hours on one occasion.

## 2. Results

### 2.1 Water

#### 2.1.1 Inspections

The Turangi-A wellsite was inspected on six occasions during the 2008-2009 monitoring year with respect to production activities. Inspection dates were 7 August, 16 October 2008, 13 January, 13 March, 6 May and 28 June 2009. On each occasion skimmer pits, bunded areas and air emissions were all in good order.

#### 2.1.2 Results of discharge monitoring

Two samples of the skimmer pit discharge were collected and the results are presented in Table 3.

**Table 3** Results of skimmer pit discharge sampling

Date	Alkalinity (g/m <sup>3</sup> CaCO <sub>3</sub> )	Chloride (g/m <sup>3</sup> )	Hydrocarbons (g/m <sup>3</sup> )	pH	Suspended solids (g/m <sup>3</sup> )
<i>Consent limits</i>		50	15	6.5-8.5	100
9 December 2008	732	1,900	2.2	7.5	53
29 April 2009		10.3	0.6	7.3	130

These results show that conditions of consent 6498 were breached on both occasions. The chloride result of 1,900 g/m<sup>3</sup> was recorded as an incident and is discussed in more detail in Section 2.3. The suspended solids result of 130 g/m<sup>3</sup> did not result in any adverse effects as the discharge is to land.



**Photograph 2** Skimmer pit discharge point and nearest surface water body

### 2.1.3 Results of receiving environment monitoring

Greymouth provided the Council with the results for soil samples collected on 10 June 2009, to assess compliance with limits specified in consent 6498, these results are presented in Table 4.

**Table 4** Results of soil sampling

Parameter/Compound	Consent limit	Units	Mid Soil 15m from Admin (500 mm depth)	Rear soil 5 m from diesel burner (200 mm depth)
Total soluble salts*	2,500	g/m <sup>3</sup>	3,400	3,500
Conductivity	400	mS/m	98	99
Conductivity*	290	mS/m	98	99
Calcium			1,900	4,100
Magnesium			2,300	2,300
Sodium*	460	g/m <sup>3</sup>	830	1,200
Sodium absorption ratio	18.0		3.0	3.7
Chloride*	700	g/m <sup>3</sup>	1,600	1,100
<b>TPH</b>				
C <sub>7</sub> -C <sub>9</sub>	(120 – 15,000) <sup>#</sup>	mg/kg	-	-
C <sub>10</sub> -C <sub>14</sub>	58	mg/kg	-	-
C <sub>15</sub> -C <sub>36</sub>	4,000	mg/kg	-	-
<b>BTEX</b>				
Benzene	(1.1 – 5.7) <sup>#</sup>	mg/kg	<0.10	<0.080
Toluene	(68 – 2,500) <sup>#</sup>	mg/kg	<0.10	<0.080
Ethylbenzene	(53 – 2,200) <sup>#</sup>	mg/kg	<0.10	<0.080
Xylenes	(48 – 1,700) <sup>#</sup>	mg/kg	<0.30	<0.24
<b>PAH</b>				
Napthalene	7.2	mg/kg	<0.47	<0.20
Non-carc (Pyrene)	160	mg/kg	<0.093	<0.039
Benzo(a)pyrene eq.	0.027	mg/kg	<0.093	<0.039

\* Prior to expiry, cancellation, or surrender

<sup>#</sup> Dependant on soil type

SAR calculated from results provided for Na, Ca, Mg

Further analysis for TPH is required to demonstrate compliance with the consent. Total soluble salts, sodium and chloride levels exceed the expiry, cancellation, surrender criteria. BTEX and PAH results are below the laboratory detection limit.

## 2.2 Air

### 2.2.1 Inspections

Inspections in relation to emissions and their effects were conducted at the same time as the inspections described above. Matters checked included the flare for smoke or odour, other odour sources, compliance with plans and documentation relating to control of emission sources, potential dust, on-site records and notification procedures.

### 2.2.2 Results of receiving environment monitoring

During the monitoring year, a multi-gas meter was deployed on one occasion in the vicinity of the plant. The deployment lasted approximately twenty-four hours, with the instrument placed in a down-wind position at the start of the deployment. Monitoring consisted of continual measurements of gas concentrations for the gases of interest (carbon monoxide, combustible gases, and volatile organic compounds).

Because of the nature of the activities on the site, it was considered that the primary information of interest in respect of gases potentially emitted from the site was the average downwind concentration, rather than any instantaneous peak value. That is, the long-term exposure levels, rather than short-term maxima, are of most interest. The gas meter was therefore set up to create a data set based on recording the average concentration measured during each minute as raw data.

The consent covering air discharges from the Turangi-A wellsite has specific limits related to particular gases. Special condition 15 of consent 6497 sets a limit on the carbon monoxide concentration at or beyond the production station's boundary. The limit is expressed as 10 mg/m<sup>3</sup> for an eight hour average or 30 mg/m<sup>3</sup> for a 1 hour average exposure. The maximum concentration of carbon monoxide found during the monitoring run was only 6.97 mg/m<sup>3</sup> which complies with the consent condition. This continues the pattern found in previous years.

The volatile organic compound sensor on the instrument used reacts to a range of organic chemicals (both aromatics, and linear chain carbon compounds), together with some inorganic compounds. It is intended for use as a screening device, to assist in determining whether further, more specific investigations are justified. The levels detected are well below levels of concern for the likely compounds that could be emitted from the site, and based on these results no additional investigations are warranted.

LEL% gives the percentage of the lower explosive limit, expressed as methane, that is detected in the air sampled. The sensor on the instrument reacts to gases and vapours such as acetone, benzene, butane, methane, propane, carbon monoxide, ethanol, and higher alkanes and alkenes, with varying degrees of sensitivity. The Council's Regional Air Quality Plan has a typical requirement that no discharge shall result in a dangerous level of airborne contaminants, including any risk of explosion. At no time did the level of explosive gases downwind of the Turangi-A wellsite reach any more than a very low level. The maximum concentration of LEL found during the monitoring run was only 1.50%.

Special conditions 20 and 21 of consent 6497 require that Greymouth provide flaring information on a monthly basis and an annual report on flaring and emissions. These were both provided, the amount of gas flared decreased dramatically in July 2007, when the JGK-2 gas compressor began to circulate gas instead of flaring.

A copy of the report on ambient air monitoring is attached in Appendix II.

## 2.3 Register of incidents

The Taranaki Regional 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 register ('unauthorised incident register') 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 2008-2009 year, there was one incident recorded by the Council that was associated with the Turangi-A wellsite. A sample of the skimmer pit discharge collected on 9 December 2008 returned a result of 1,900 g/m<sup>3</sup> of chlorides which is well in excess of the 50 g/m<sup>3</sup> authorised by consent 6498. Investigation found that it was most likely due to the discharge of produced water onto the site, which is allowed under consent 6498. Some must have entered the stormwater drains and made it to the final skimmer pit.

Greymouth provided the Council with water quality data from the unnamed tributary of the Parahaki Stream. This monitoring showed that the skimmer pit rarely discharged and that there was no significant difference between the water quality upstream and downstream. Produced water is no longer discharged to the site and is now re-injected down the Turangi 3 well.

### **3. Discussion**

#### **3.1 Discussion of plant performance**

Inspections of the Turangi-A wellsite during the 2008-2009 monitoring year found no compliance issues. There was an incident recorded for a significant breach of the chloride limit on the stormwater discharge from the site.

To date the stormwater management plan required by consent 6498 has not been received by the Council.

#### **3.2 Environmental effects of exercise of consents**

Monitoring of the skimmer pit discharge from the site found that on one occasion the chloride concentration was well in excess of that allowed by consent 6498.

Greymouth provided the Council with water quality data from the unnamed tributary of the Parahaki Stream. This monitoring showed that the skimmer pit rarely discharged and that there was no significant difference between the water quality upstream and downstream. Produced water is no longer discharged over the site for dust suppression.

The suspended solids limit was also exceeded on one occasion. The consent prohibits any direct discharge to surface water, therefore no adverse effects on the water quality of the unnamed tributary of the Parahaki Stream are anticipated. However, the discharge point is on to a steep bank which slopes down to the unnamed tributary. It is possible that during periods of high rainfall the skimmer pit discharge would flow overland and into the watercourse, this will continue to be monitored during inspections and routine sampling runs.

Greymouth provided soil sampling results in relation to the discharge of produced water to land. The results indicate interim compliance with the consent, although TPH analysis was not completed and surrender criteria were exceeded in some cases. All produced water is now being discharged via deep well injection.

There were no adverse effects on the environment resulting from the exercise of the air discharge consent. The ambient air quality monitoring at the site showed that levels of carbon monoxide, volatile organic compounds and combustible gases were all below levels of concern at the time of sampling. No offensive or objectionable odours were detected beyond the boundary during inspections and there were no complaints in relation to odours or smoke from the site.

### 3.3 Evaluation of performance

A tabular summary of the Company's compliance record for the year under review is set out in Tables 5 and 6.

**Table 5** Summary of performance for Consent 6497-1 to discharge emissions to air during flaring from well workovers and in emergency situations and miscellaneous emissions associated with production activities at the Turangi Road wellsite

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. Notification to Council one month prior to production operations	Notification received	Yes
2. Notification to neighbours 24 hrs prior to flaring & record of complaints	Complaints log reviewed during inspections	Yes
3. Notification to Council 24 hrs prior to flaring	Notifications received	Yes
4. No alterations without approval	Inspections and liaison with consent holder	Yes
5. Take into account wind speed & direction when flaring	Inspection and Company records	Yes
6. Effective separation to minimise smoke	Inspection	Yes
7. Notification to Council of ineffective separation	Notifications received, inspections and liaison with consent holder	Yes
8. No liquid or solid hydrocarbons to be flared	Inspections and liaison with consent holder	Yes
9. Only substances from well stream to be flared	Inspections and liaison with consent holder	Yes
10. Adoption of the best practicable option	Inspection and liaison with consent holder	Yes
11. No hazardous/toxic/noxious contaminants beyond boundary	Inspection and air monitoring	Yes
12. No offensive odour or smoke beyond boundary	Inspection	Yes
13. Hydrocarbon storage vessels to have vapour recovery systems	Not assessed	N/A
14. Specified opacity for smoke emissions	Not assessed	N/A
15. Control of carbon monoxide emissions	Air monitoring	Yes
16. Control of nitrogen oxide emissions	Not measured, sampling in previous years	N/A
17. Control of emissions to achieve specified contaminant concentrations	Not assessed	N/A

Condition requirement	Means of monitoring during period under review	Compliance achieved?
18. Keep & maintain record of smoke emitting incidents	Inspection and annual flaring report	Yes
19. Keep & maintain flaring log	Inspection and annual flaring report	Yes
20. Monthly flaring information supplied	Information received	Yes
21. Provision of annual flaring & air emissions report during May	Report received	Yes
22. Analysis of typical gas and crude oil stream	Analysis not requested	N/A
23. Lapse provision	Not applicable – consent exercised	N/A
24. Optional review provision	Recommendation not to review in June 2009	Yes

**Table 6** Summary of performance for Consent 6498-1 to discharge treated stormwater and treated produced water from hydrocarbon exploration and production operations at the Turangi wellsite onto and into land in the vicinity of the Parahaki Stream

Condition requirement	Means of monitoring during period under review	Compliance achieved?
1. No observable hydrocarbon run-off to perimeter drain	Inspection	Yes
2. Soil conductivity < 400 mS/m, if background > 400 mS/m then discharge shall not cause increase of > 100 mS/m	Sampling	Yes
3. Soil SAR < 18, if background > 18 then discharge shall not cause increase of > 1	Sampling – no results provided	<b>No</b>
4. Concentrations in soil not to be exceed prior to expiry/cancellation/surrender	Not applicable – applies prior to expiry/cancellation/surrender	N/A
5. Hydrocarbons in soil to comply with MfE guidelines	Sampling – no results for TPH	Partly
6. Treated produced water discharged to land shall be within perimeter drain	Inspection	Yes
7. Records to be kept and forwarded to Council quarterly	Produced water now re-injected	N/A
8. Approved management plan	Plan received and approved	<b>No</b>
9. Adoption of the best practicable option	Inspection and liaison with consent holder	Yes
10. Maximum stormwater catchment area	Inspection and company records	Yes
11. Notification to Council 7 days prior to site works and well drilling	Notification received	Yes

Condition requirement	Means of monitoring during period under review	Compliance achieved?
12. Approved contingency plan	Plan received and approved	Yes
13. All stormwater & produced water discharged through treatment system	Inspection	Yes
14. Consent exercised generally in accordance with application documentation	Inspection and liaison with consent holder	Yes
15. Bunding and drainage of hazardous substances	Inspection	Yes
16. Concentrations not to be exceeded in the discharge	Sampling	<b>No</b>
17. Temperature increase of not more than 2 degrees celcius	Not monitored – refer to 19	N/A
18. No effects upon surface water bodies	Inspection	Yes
19. No direct discharge to surface water	Inspection	Yes
20. 48 hrs notice prior to reinstatement	Not applicable	N/A
21. Lapse provision	Not applicable – consent exercised	N/A
22. Optional review provision	Recommendation not to review in June 2009	Yes

An improvement is desirable in the performance of Greymouth, with respect to the provision of a stormwater management plan for the site and the significant breach of the stormwater discharge consent chloride limit.

### 3.4 Recommendations from the 2007-2008 Annual Report

In the 2007-2008 Annual Report, it was recommended:

1. THAT inspections of the Turangi-A wellsite in the 2008-2009 year continue at the same level as in 2007-2008.
2. THAT monitoring of air emissions from the Turangi-A wellsite in the 2008-2009 be amended from that undertaken in 2007-2008, by removing the requirement for particulate and nitrogen oxide monitoring, and reducing ambient carbon monoxide and methane monitoring from twice per year to once per year.
3. THAT monitoring of discharges from the Turangi-A wellsite in the 2008-2009 be amended from that undertaken in 2007-2008, by reducing the frequency of stormwater discharge sampling from four times per year to twice per year.
4. THAT the annual report on flaring and emissions required by condition 21 of consent 6497 is received by the Council in May 2009, to avoid possible enforcement action.

5. THAT a stormwater management plan and spill contingency plan for the site are prepared and forwarded to the Council for approval prior to 30 June 2009, to avoid possible enforcement action.
6. THAT the option for a review of resource consents 6497 and 6498 in June 2009, as set out in conditions of the consents, not be exercised, on the grounds that the conditions are adequate to deal with any significant adverse effects on the environment arising from the exercise of the consents.

These recommendations were implemented. However with respect to Recommendation 5 a stormwater management plan for the site is still outstanding.

### **3.5 Alterations to monitoring programmes for 2009-2010**

In designing and implementing the monitoring programmes for air/water discharges in the region, the Taranaki Regional Council has taken into account the extent of information made available by previous authorities, its relevance under the Resource Management Act, the obligations of the Act in terms of monitoring emissions/discharges and effects, and 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 industrial processes within Taranaki emitting to the atmosphere/discharging to the environment.

In the case of the Turangi-A wellsite, the programme for 2008-2009 was significantly altered from that for 2007-2008 by decreasing the level of monitoring (discharge sampling and air monitoring), on the grounds that the 2007-2008 programme provided for an elevated level of monitoring, for the first full year of production activities at the site. It is now proposed that for 2009-2010, the programme remain unchanged from that for 2008-2009.

A recommendation to this effect is presented in Section 4 of this report.

#### **4. Recommendations**

THAT monitoring of resource consents associated with Greymouth's Turangi-A wellsite in the 2009-2010 year continue at the same level as in 2008-2009.

## Glossary of common terms and abbreviations

The following abbreviations and terms are 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
BTEX	MAH's benzene, toluene, ethylbenzene and xylene
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
<i>E.coli</i>	<i>escherichia coli</i> , an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample
Ent	enterococci, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre of sample
F	fluoride
FC	faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample
fresh	elevated flow in a stream, such as after heavy rainfall
g/m <sup>3</sup>	grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures
l/s	litres per second
MAHs	monocyclic aromatic hydrocarbons, molecules consist of a single six-sided hydrocarbon ring
MCI	macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats
mS/m	millisiemens per metre
mixing zone	the zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point

NH <sub>4</sub>	ammonium, normally expressed in terms of the mass of nitrogen (N)
NH <sub>3</sub>	unionised ammonia, normally expressed in terms of the mass of nitrogen (N)
NO <sub>3</sub>	nitrate, normally expressed in terms of the mass of nitrogen (N)
NTU	Nephelometric Turbidity Unit, a measure of the turbidity of water
O&G	oil and grease, defined as anything that will dissolve into a particular organic solvent (e.g. hexane). May include both animal material (fats) and mineral matter (hydrocarbons)
PAHs	polycyclic aromatic hydrocarbons, molecules consist of more than two six-sided hydrocarbon rings
Pb*	lead
pH	a numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5
Physicochemical	measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment
PM <sub>10</sub>	relatively fine airborne particles (less than 10 micrometre diameter)
resource consent	refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15)
RMA	Resource Management Act 1991 and subsequent amendments
SS	suspended solids
Temp	temperature, measured in °C (degrees Celsius)
TPH	total petroleum hydrocarbons
Turb	turbidity, expressed in NTU
UIR	Unauthorised Incident Register entry- an event recorded by the Council on the basis that it had 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.

## **Bibliography and references**

Taranaki Regional Council Memorandum, 25 January 2009: 'Ambient gas monitoring and flaring inventory for the Turangi-A wellsite'

Taranaki Regional Council 2009: 'Greymouth Petroleum Turangi-A wellsite Monitoring Programme Annual Report 2007-2008'. Technical Report 2008-91, Taranaki Regional Council, Stratford.



## **Appendix I**

**Resource consents held by  
Greymouth Petroleum - Turangi-A wellsite**





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

CHIEF EXECUTIVE  
PRIVATE BAG 713  
47 CLOTON ROAD  
STRATFORD  
NEW ZEALAND  
PHONE 06-765 7127  
FAX 06-765 5097

Please quote our file number  
on all correspondence

Name of  
Consent Holder: Greymouth Petroleum Acquisition Company Limited  
P O Box 3394  
Fitzroy  
NEW PLYMOUTH

Consent Granted  
Date: 7 December 2004

**Conditions of Consent**

Consent Granted: To discharge emissions to air during flaring from well workovers and in emergency situations and miscellaneous emissions associated with production activities at the Turangi Road wellsite at or about GR: Q19:239-431

Expiry Date: 1 June 2021

Review Date(s): June 2009, June 2015

Site Location: Turangi Road wellsite, Turangi Road, Motunui  
[Property owner: D & M McKenzie;  
B & J McKenzie;  
Parininihi Ki Waitotara Inc]

Legal Description: Sec 21 Blk VI Waitara SD

Catchment: Parahaki

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

**General conditions**

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

**Special conditions**

**Information and notification**

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

**Emissions from the site**

5. 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.

## Consent 6497-1

6. All gas being flared, at any time must first be treated by effective liquid and solid separation and recovery, as far as is practicable, to ensure that smoke emission during flaring is minimised.
7. If separation cannot be implemented and/or maintained at any time while there is a flow from the well, whether natural or induced, then the consent holder shall notify the Chief Executive, Taranaki Regional Council, and shall in any case re-establish liquid and solid separation and recovery within three hours.
8. Subject to special conditions 6 and 7, no liquid or solid hydrocarbons shall be combusted through the gas flare system other than in an emergency.
9. Only substances originating from the well stream and treated as outlined by conditions 6, 7, 8, and 10 are to be combusted within the flare pit.
10. The consent holder shall adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or potential effect on the environment arising from any emission to air from the flare or any other emissions to air from the Turangi Road wellsite. Any adoption of the best practicable option as outlined in this special condition shall be to the satisfaction of the Chief Executive, Taranaki Regional Council.
11. The consent holder shall not discharge any contaminant to air authorised by this consent at a rate or a quantity such that the contaminant, whether alone or in combination with other contaminants, is or is liable to be hazardous or toxic or noxious at or beyond the boundary of the wellsite, or beyond 100 metres of the flare, whichever distance is greater.
12. There shall not be any offensive odour or smoke, as determined by an enforcement officer of the Taranaki Regional Council, beyond the boundary of the wellsite or beyond 100 metres of the flare, whichever distance is greater, arising from the exercise of this consent.
13. All hydrocarbon storage vessels shall be fitted with vapour recovery systems.
14. The opacity of any smoke emissions shall not exceed a level of 1 as measured on the Ringelmann Scale for more than four minutes cumulative duration in any 60-minute period.
15. The consent holder shall control all emissions of carbon monoxide to the atmosphere from the flare, whether alone or in conjunction with any other emissions from the wellsite, in order that the maximum ground level concentration of carbon monoxide arising from the exercise of this consent measured under ambient conditions does not exceed 10 mg/m<sup>3</sup> [eight-hour average exposure], or 30 mg/m<sup>3</sup> one-hour average exposure] at or beyond the boundary of the wellsite or beyond 100 metres from the flare, whichever distance is greater.
16. The consent holder shall control all emissions of nitrogen oxides to the atmosphere from the flare, whether alone or in conjunction with any other emissions from the wellsite, in order that the maximum ground level concentration of nitrogen dioxide arising from the exercise of this consent measured under ambient conditions does not exceed 100 micrograms per cubic metre [24-hour average exposure], or 200 micrograms per cubic metre [1-hour average exposure] at or beyond the boundary of the wellsite, or beyond 100 metres from the flare, whichever distance is greater.

17. The consent holder shall control emissions to the atmosphere from the wellsite and flare of contaminants other than carbon dioxide, carbon monoxide, and nitrogen oxides, whether alone or in conjunction with any emissions from the flare, in order that the maximum ground level concentration for any particular contaminant arising from the exercise of this consent measured at or beyond the boundary of the wellsite or beyond 100 metres from the flare, whichever distance is greater, is not increased above background levels:
- a) by more than  $1/30^{\text{th}}$  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**

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

Consent 6497-1

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

**Lapse and Review**

23. This consent shall lapse on the expiry of 16 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.
24. 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 7 December 2004

For and on behalf of  
Taranaki Regional Council



---

Director-Resource Management





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

Please quote our file number  
 on all correspondence

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

Name of Consent Holder: Greymouth Petroleum Limited  
 P O Box 3394  
 NEW PLYMOUTH 4341



Change To Conditions Date: 17 March 2008 [Granted: 7 December 2004]

**Conditions of Consent**

Consent Granted: To discharge treated stormwater and treated produced water from hydrocarbon exploration and production operations at the Turangi wellsite onto and into land in the vicinity of the Parahaki Stream at or about 2623930E-6243135N

Expiry Date: 1 June 2021

Review Date(s): June 2009, June 2015

Site Location: Turangi Road wellsite, Turangi Road, Motunui  
 [Property owner: Parininihi Ki Waitotara Inc]

Legal Description: Sec 21 Blk VI Waitara SD

Catchment: Parahaki

### 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

#### Conditions 1 - 8: Additional

1. The consent holder shall ensure that the discharge of treated produced water to land does not result in an observable Hydrocarbon run-off into the perimeter drain.
2. The conductivity of the soil layer containing the discharge shall be maintained at less than  $400 \text{ mSm}^{-1}$ , or alternatively, if the background soil conductivity exceeds  $400 \text{ mSm}^{-1}$ , the application of waste shall not increase the soil conductivity by more than  $100 \text{ mSm}^{-1}$  over the background concentrations established prior to the exercise of this consent.
3. The sodium absorption ratio [SAR] of the soil layer containing the discharge shall be maintained at less than 18.0, or alternatively if the background soil SAR exceeds 18.0, the application of waste shall not increase the SAR by more than 1.0 over the background concentrations established prior to the exercise of this consent.
4. Prior to the expiry, cancellation, or surrender of this consent soil parameters shall not exceed the following limits: conductivity,  $290 \text{ mSm}^{-1}$ ; total dissolved salts,  $2500 \text{ gm}^{-3}$ ; sodium,  $460 \text{ gm}^{-3}$ ; and chloride,  $700 \text{ gm}^{-3}$ .
5. At all times the levels of hydrocarbons in the soil within the discharge area shall comply with the guideline values for sandy soil type in the surface layer 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], appended to this consent.
6. Any discharge of treated produced water directly to land shall occur within the area enclosed by the perimeter drain

7. The consent holder shall keep records of the following:
- a) The results of analysis of a monthly representative sample of the composition of the treated produced water, which is being or will be discharged on the site [including pH level, electro-conductivity, Salinity, and concentration of total hydrocarbons]
  - b) volumes of treated produced water discharged directly to land
  - c) dates and times of commencement and completion of discharge events
  - d) sampling, analysis and results of monitoring undertaken by the consent holder

and shall forward these records to the Chief Executive, Taranaki Regional Council, on a quarterly basis, or as requested by the Council.

8. Prior to the exercise of this consent, the consent holder shall provide, to the written satisfaction of the Chief Executive, Taranaki Regional Council, a management plan to confirm that the activity will be conducted to comply with all of the conditions of this consent. The management plan shall be reviewed annually and shall include as a minimum:

- a. sampling regime
- b. a representative analysis of the quality of soil within the proposed discharge area;
- c. procedures for notification to Council of disposal activities;
- d. contingency procedures;
- e. site reinstatement and monitoring; and
- f. control of site access.

**Conditions 9 - 12 [previously conditions 1 - 4]: unchanged**

9. 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 the environment.
10. The maximum stormwater catchment area shall be no more than 9750 m<sup>2</sup>.
11. 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.
12. 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.

**Conditions 13 - 14 [previously condition 5 - 6]: changed**

13. All stormwater 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.

14. The design, management and maintenance of the stormwater system shall be generally undertaken in accordance with the information submitted in support of the application. In the case of any contradiction between the documentation submitted in support of applications 3409 and 4922 and the conditions of this consent, the conditions of this consent shall prevail.

**Condition 15 [previously condition 7]: unchanged**

15. Any above ground hazardous substances storage areas shall be bunded with drainage to sumps, or other appropriate recovery systems, and not to the stormwater catchment.

**Condition 16 [previously condition 8]: changed**

16. The following concentrations shall not be exceeded in the discharge from the perimeter drain through the interceptor pit:

Component	Concentration
pH (range)	6.5 - 8.5
suspended solids	100 gm <sup>-3</sup>
total recoverable hydrocarbons [infrared spectroscopic technique]	15 gm <sup>-3</sup>
chloride	50 gm <sup>-3</sup>

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.

**Conditions 17 - 22 [previously conditions 9 - 14]: changed**

17. 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 an increase in temperature of more than 2 degrees Celsius.
18. 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.
19. The discharge onto and into land shall occur a minimum of 20 metres from any surface water body. Discharge shall be onto and into land and there shall be no direct discharge to surface water.

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20. 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.
21. 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.
22. 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 17 March 2008

For and on behalf of  
Taranaki Regional Council



Director-Resource Management

**Appendix 1**

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].

**Table 4.12 Tier 1 soil acceptance criteria *Agricultural use* <sup>(1,3,6)</sup> ALL PATHWAYS**  
(all values mg/kg)

Soil Type/ Contaminant	Depth of contamination		
	Surface (<1m)	1m - 4m	> 4m
<b>SAND</b>			
MAHs			
Benzene	1.1 <sup>(v)</sup>	1.9 <sup>(7,v)</sup>	2.4 <sup>(7,v)</sup>
Toluene	(58) <sup>(4,v)</sup>	(94) <sup>(4,m)</sup>	(230) <sup>(4,v)</sup>
Ethylbenzene	(53) <sup>(4,v)</sup>	(92) <sup>(4,7,v)</sup>	(120) <sup>(4,v)</sup>
Xylenes	(48) <sup>(4,v)</sup>	(130) <sup>(4,7,v)</sup>	(180) <sup>(4,v)</sup>
PAHs			
Naphthalene	7.2 <sup>(p)</sup>	70 <sup>(v)</sup>	80 <sup>(v)</sup>
Non-carc. (Pyrene)	(160) <sup>(4,p)</sup>	NA <sup>(2)</sup>	NA <sup>(2)</sup>
Benzo(a)pyrene eq. <sup>(5)</sup>	0.027 <sup>(p)</sup>	(25) <sup>(4,m)</sup>	NA <sup>(2)</sup>
<b>SANDY SILT</b>			
MAHs			
Benzene	1.1 <sup>(v)</sup>	1.9 <sup>(v)</sup>	2.4 <sup>(v)</sup>
Toluene	(82) <sup>(4,v)</sup>	(170) <sup>(4,v)</sup>	(240) <sup>(4,v)</sup>
Ethylbenzene	(59) <sup>(4,v)</sup>	(92) <sup>(4,v)</sup>	(140) <sup>(4,v)</sup>
Xylenes	(59) <sup>(4,v)</sup>	(130) <sup>(4,v)</sup>	(180) <sup>(4,v)</sup>
PAHs			
Naphthalene	7.2 <sup>(p)</sup>	83 <sup>(v)</sup>	(130) <sup>(4,v)</sup>
Non-carc. (Pyrene)	(160) <sup>(4,p)</sup>	NA <sup>(2)</sup>	NA <sup>(2)</sup>
Benzo(a)pyrene eq. <sup>(5)</sup>	0.027 <sup>(p)</sup>	(25) <sup>(4,m)</sup>	NA <sup>(2)</sup>
<b>SILTY CLAY</b>			
MAHs			
Benzene	1.7 <sup>(v)</sup>	4.6 <sup>(v)</sup>	12 <sup>(v)</sup>
Toluene	(210) <sup>(4,v)</sup>	(950) <sup>(4,v)</sup>	(3,000) <sup>(4,v)</sup>
Ethylbenzene	(110) <sup>(4,v)</sup>	(800) <sup>(4,v)</sup>	(2,800) <sup>(4,v)</sup>
Xylenes	(160) <sup>(4,v)</sup>	(710) <sup>(4,v)</sup>	(2,200) <sup>(4,v)</sup>
PAHs			
Naphthalene	7.2 <sup>(p)</sup>	(330) <sup>(4,v)</sup>	(1,100) <sup>(4,v)</sup>
Non-carc. (Pyrene)	(160) <sup>(4,p)</sup>	NA <sup>(2)</sup>	NA <sup>(2)</sup>
Benzo(a)pyrene eq. <sup>(5)</sup>	0.027 <sup>(p)</sup>	(25) <sup>(4,m)</sup>	NA <sup>(2)</sup>

## NOTES:

1. Based on protection of human health. Refer to Table 4.20 for protection of groundwater. Site-specific consideration of aesthetic and ecological impacts is required.
2. NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.
3. Surface soil acceptance criteria are based on the lower value of volatilisation criteria (Table 4.16), other pathway criteria (Table 4.18) and criteria for the protection of maintenance workers (Table 4.19). Criteria for soils at 1 m are based on the lower value of those arising from volatilisation and maintenance criteria. Criteria for soils at 4 m are based on volatilisation only.
4. Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons. For further explanation refer to Appendix 4M.
5. Risk associated with mixture of carcinogenic PAHs assessed by comparison with criteria based on benzo(a)pyrene equivalent concentration. Refer to Section 4.4.3 for details of the calculation of Benzo(a)pyrene equivalent concentrations.
6. The following notes indicate the limiting pathway for each criterion: v - Volatilisation, s - Soil Ingestion, d - Dermal, p - Produce, m - Maintenance/Excavation
7. Due to the nature of boundary conditions in volatilisation model, calculated criteria for sandy soils are higher than that for silt soil type. Therefore, the criteria for sand are set equal to the criteria for silt. Refer Appendix 4D for details.

**Table 4.12 (CONTINUED)**  
**Tier 1 soil acceptance criteria Agricultural use<sup>(1,3,6)</sup> ALL PATHWAYS**  
**(all values mg/kg)**

Soil Type/ Contaminant	Depth of contamination		
	Surface (<1m)	1m - 4m	> 4m
<b>CLAY</b>			
<b>MAHs</b>			
Benzene	2.7 <sup>(v)</sup>	8.8 <sup>(v)</sup>	(25) <sup>(4,v)</sup>
Toluene	(320) <sup>(4,v)</sup>	(2,400) <sup>(4,v)</sup>	(8,500) <sup>(4,v)</sup>
Ethylbenzene	(160) <sup>(4,v)</sup>	NA <sup>(2)</sup>	NA <sup>(2)</sup>
Xylenes	(250) <sup>(4,v)</sup>	(1,800) <sup>(4,v)</sup>	(6,500) <sup>(4,v)</sup>
<b>PAHs</b>			
Naphthalene	7.2 <sup>(p)</sup>	(360) <sup>(4,v)</sup>	(1,200) <sup>(4,v)</sup>
Non-carc. (Pyrene) <sup>(5)</sup>	(160) <sup>(4,p)</sup>	NA <sup>(2)</sup>	NA <sup>(2)</sup>
Benzo(a)pyrene eq. <sup>(5)</sup>	0.027 <sup>(p)</sup>	(25) <sup>(4,m)</sup>	NA <sup>(2)</sup>
<b>PUMICE</b>			
<b>MAHs</b>			
Benzene	1.2 <sup>(v)</sup>	2.4 <sup>(v)</sup>	3.1 <sup>(v)</sup>
Toluene	(73) <sup>(4,v)</sup>	(240) <sup>(4,v)</sup>	(350) <sup>(4,v)</sup>
Ethylbenzene	(48) <sup>(4,v)</sup>	(140) <sup>(4,v)</sup>	(220) <sup>(4,v)</sup>
Xylenes	(53) <sup>(4,v)</sup>	(180) <sup>(4,v)</sup>	(260) <sup>(4,v)</sup>
<b>PAHs</b>			
Naphthalene	7.2 <sup>(p)</sup>	140 <sup>(v)</sup>	(220) <sup>(4,v)</sup>
Non-carc. (Pyrene) <sup>(5)</sup>	(160) <sup>(4,p)</sup>	NA <sup>(2)</sup>	NA <sup>(2)</sup>
Benzo(a)pyrene eq. <sup>(5)</sup>	0.027 <sup>(p)</sup>	(25) <sup>(4,m)</sup>	NA <sup>(2)</sup>
<b>PEATS AND HIGHLY ORGANIC SOILS</b>			
<b>MAHs</b>			
Benzene	5.7 <sup>(v)</sup>	10 <sup>(v)</sup>	13 <sup>(v)</sup>
Toluene	(2,500) <sup>(4,v)</sup>	(2,900) <sup>(4,v)</sup>	(3,800) <sup>(4,v)</sup>
Ethylbenzene	(2,200) <sup>(4,v)</sup>	(2,500) <sup>(4,v)</sup>	(3,200) <sup>(4,v)</sup>
Xylenes	(1,700) <sup>(4,v)</sup>	(2,000) <sup>(4,v)</sup>	(2,600) <sup>(4,v)</sup>
<b>PAHs</b>			
Naphthalene	7.2 <sup>(p)</sup>	(2,700) <sup>(4,v)</sup>	(3,500) <sup>(4,v)</sup>
Non-carc. (Pyrene) <sup>(5)</sup>	(160) <sup>(4,p)</sup>	NA <sup>(2)</sup>	NA <sup>(2)</sup>
Benzo(a)pyrene eq. <sup>(5)</sup>	0.027 <sup>(p)</sup>	(25) <sup>(4,m)</sup>	NA <sup>(2)</sup>

## NOTES:

1. Based on protection of human health. Refer to Table 4.20 for protection of groundwater. Site-specific consideration of aesthetic and ecological impacts is required.
2. NA indicates contaminant not limiting as estimated health-based criterion is significantly higher than that likely to be encountered on site.
3. Surface soil acceptance criteria are based on the lower value of volatilisation criteria (Table 4.16), other pathway criteria (Table 4.18) and criteria for the protection of maintenance workers (Table 4.19). Criteria for soils at 1 m are based on the lower value of those arising from volatilisation and maintenance criteria. Criteria for soils at 4 m are based on volatilisation only.
4. Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons. For further explanation refer to Appendix 4M.
5. Risk associated with mixture of carcinogenic PAHs assessed by comparison with criteria based on benzo(a)pyrene equivalent concentration. Refer to Section 4.4.3 for details of the calculation of Benzo(a)pyrene equivalent concentrations.
6. The following notes indicate the limiting pathway for each criterion: v - Volatilisation, s - Soil Ingestion, d - Dermal, p - Produce, m - Maintenance/Excavation

**Table 4.15 Tier 1 soil acceptance criteria for TPH<sup>(1,3,5,6)</sup> Agricultural use ALL PATHWAYS**  
(all values in mg/kg)

Soil Type/ Contaminant	Depth of contamination		
	Surface (<1m)	1m - 4m	> 4m
<b>SAND</b> C7-C9 <sup>(4)</sup> C10-C14 C15-C36	120 <sup>(m)</sup> 58 <sup>(x)</sup> (4,000) <sup>(7,x)</sup>	120 <sup>(m)</sup> (560) <sup>(7,x)</sup> NA <sup>(2)</sup>	(3,800) <sup>(7,s,v)</sup> (650) <sup>(7,x)</sup> NA <sup>(2)</sup>
<b>SANDY SILT</b> C7-C9 <sup>(4)</sup> C10-C14 C15-C36	(500) <sup>(7,m)</sup> 58 <sup>(x)</sup> (4,000) <sup>(7,x)</sup>	(500) <sup>(7,m)</sup> (670) <sup>(7,x)</sup> NA <sup>(2)</sup>	(3,800) <sup>(7,v)</sup> (4,900) <sup>(7,v)</sup> NA <sup>(2)</sup>
<b>SILTY CLAY</b> C7-C9 <sup>(4)</sup> C10-C14 C15-C36	(2,700) <sup>(7,v)</sup> 58 <sup>(x)</sup> (4,000) <sup>(7,x)</sup>	(7,300) <sup>(7,v)</sup> (2,700) <sup>(7,x)</sup> NA <sup>(2)</sup>	(19,000) <sup>(7,v)</sup> (8,900) <sup>(7,x)</sup> NA <sup>(2)</sup>
<b>CLAY</b> C7-C9 <sup>(4)</sup> C10-C14 C15-C36	(15,000) <sup>(7,v)</sup> 58 <sup>(x)</sup> (4,000) <sup>(7,x)</sup>	NA <sup>(2)</sup> (2,900) <sup>(7,x)</sup> NA <sup>(2)</sup>	NA <sup>(2)</sup> (9,700) <sup>(7,x)</sup> NA <sup>(2)</sup>
<b>PUMICE</b> C7-C9 <sup>(4)</sup> C10-C14 C15-C36	(810) <sup>(7,m)</sup> 58 <sup>(x)</sup> (4,000) <sup>(7,x)</sup>	(810) <sup>(7,m)</sup> (1,100) <sup>(7,x)</sup> NA <sup>(2)</sup>	(4,600) <sup>(7,v)</sup> (1,600) <sup>(7,x)</sup> NA <sup>(2)</sup>
<b>PEATS AND HIGHLY ORGANIC SOILS</b> C7-C9 <sup>(4)</sup> C10-C14 C15-C36	(6,700) <sup>(7,m)</sup> 58 <sup>(x)</sup> (4,000) <sup>(7,x)</sup>	(6,700) <sup>(7,m)</sup> NA <sup>(2)</sup> NA <sup>(2)</sup>	NA <sup>(2)</sup> NA <sup>(2)</sup> NA <sup>(2)</sup>

## NOTES:

- Criteria for C10 - C14 and C15 - C36 are based on consideration of aliphatic component of TPH measurement and consideration of TPH as a surrogate measure for PAH, consideration of PAHs completed by extrapolation of PAH content of diesel and PAH criteria (refer Table 4.10)
- NA Indicates estimated criterion exceeds 20,000 mg/kg. At 20,000 mg/kg residual separate phase is expected to have formed in soil matrix. Some aesthetic impact may be noted.
- Based on protection of human health only. Site specific consideration of aesthetic and ecological impact is required.
- Based on health effects associated with aliphatic component only. Separate consideration of the health effects associated with the aromatic component (i.e. BTEX) is required.
- Soil acceptance criteria are based on the lower value of criteria based on volatilisation (Table 4.16), other pathways (Table 4.18), criteria for the protection of maintenance workers (Table 4.19) and TPH criteria developed as surrogates for PAHs (Table 4.22). Surface soils criteria are based on all three pathways, criteria for soils at 1 m are based on volatilisation and maintenance workers, and criteria for soils at 4 m are based on volatilisation only. PAH surrogate considerations apply at all depths.
- The following notes indicate the limiting pathway for each criterion: v - Volatilisation, s - Soil Ingestion, d - Dermal, p - Produce, m - Maintenance/Excavation, x - PAH surrogate
- Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons. For further explanation refer to Appendix 4M.
- Due to the nature of boundary conditions in volatilisation model, calculated criteria for sandy soils are higher than that for silt soil type. Therefore, the criteria for sand are set equal to the criteria for silt. Refer Appendix 4D for details.

## **Appendix II**

### **Ambient air monitoring report**



# Memorandum

To Job Manager, Shane Reynolds  
From Air Quality Officer, Brian Cheyne  
File 6497-1, FRODO-#662937  
Date September 21, 2009

## Ambient gas monitoring and Flaring Inventory for the Turangi-A wellsite.

### 1. Multiple Gas Detector

During the monitoring year, a multi-gas meter was deployed on one occasion in the vicinity of the plant. The deployment lasted approximately twenty-four hours, with the instrument placed in a down-wind position at the start of the deployment. Monitoring consisted of continual measurements of gas concentrations for the gases of interest (carbon monoxide, combustible gases, and volatile organic compounds). The location of the multi-gas meter for the sampling run and summarised details of the sample are shown in Figure 1.

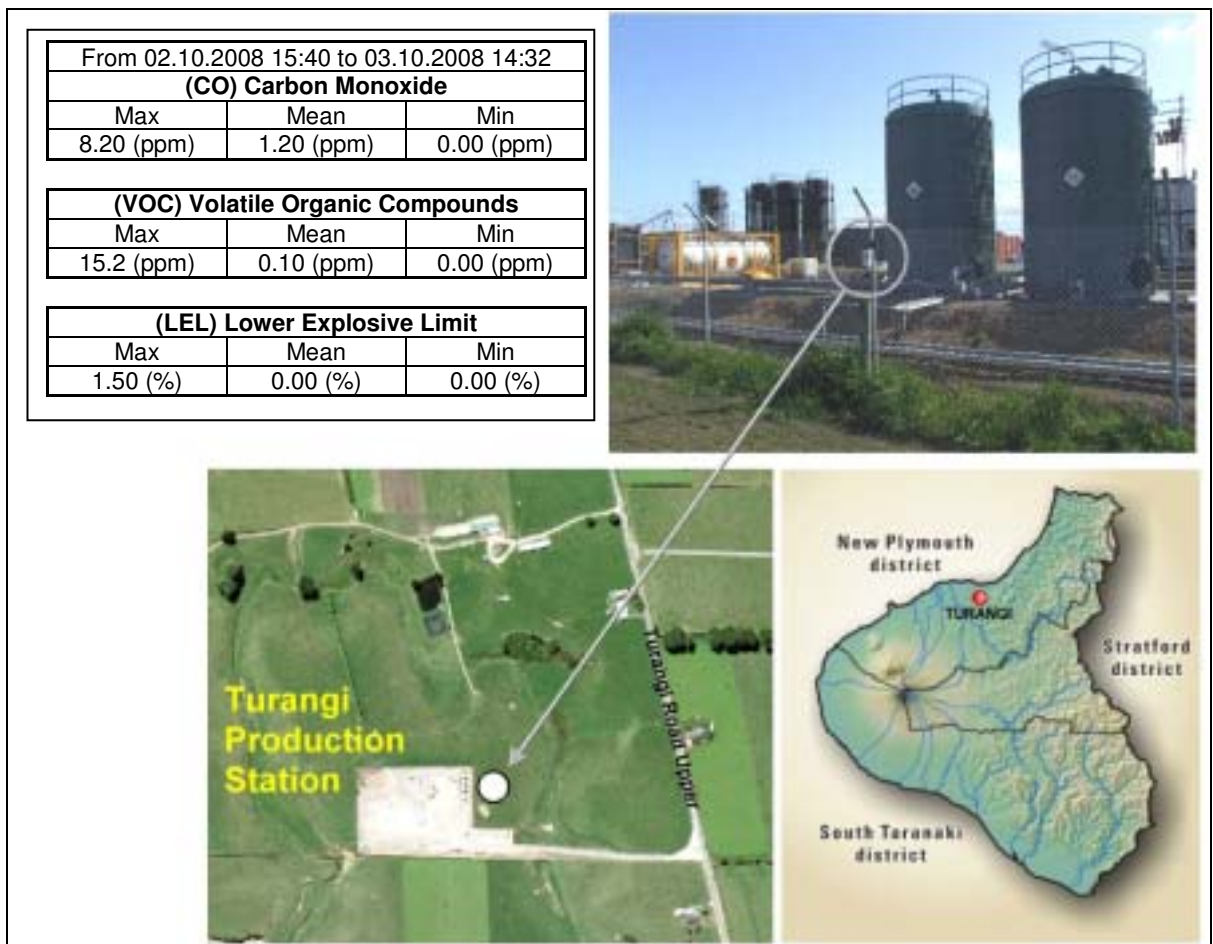


Figure 1: Air monitoring sites (CO, VOC and LEL) at Turangi-A wellsite (2008-09)

Note: (1) the instrument records in units of ppm. At 15°C  
1ppm CO = 0.85 mg m<sup>-3</sup>  
1ppm VOC = 0.4 mg m<sup>-3</sup> (expressed as isobutylene)  
(2) See text for explanation of LEL. Because the LEL of methane is equivalent to a mixture of approximately 5% methane in air, then the actual concentration of methane in air can be obtained by dividing the % LEL by 20.

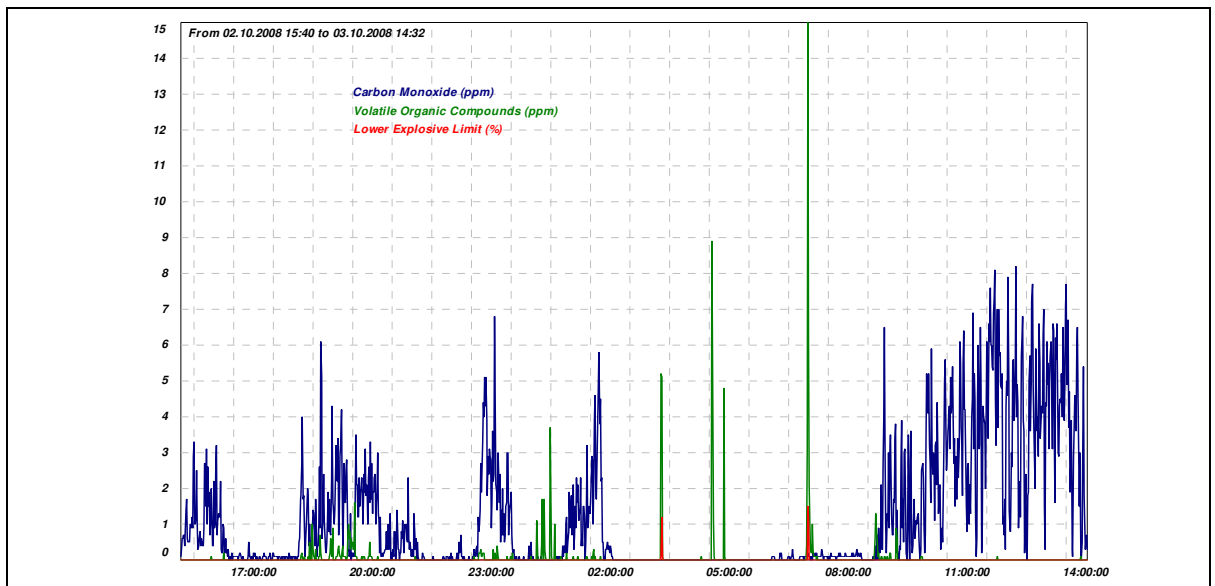
Because of the nature of the activities on the site, it was considered that the primary information of interest in respect of gases potentially emitted from the site was the average downwind concentration, rather than any instantaneous peak value. That is, the long-term exposure levels, rather than short-term maxima, are of most interest. The gas meter was therefore set up to create a data set based on recording the average concentration measured during each minute as raw data.

The details of each sample run are graphically presented in Figure 2.

The consent covering air discharges from the Turangi-A wellsite has specific limits related to particular gases. Special condition 15 of consent 6497 sets a limit on the carbon monoxide concentration at or beyond the production station's boundary. The limit is expressed as 10 mg/m<sup>3</sup> for an eight hour average or 30 mg/m<sup>3</sup> for a 1 hour average exposure. The maximum concentration of carbon monoxide found during the monitoring run was only 6.97 mg/m<sup>3</sup> which complies with the consent condition. This continues the pattern found in previous years.

The volatile organic compound sensor on the instrument used reacts to a range of organic chemicals (both aromatics, and linear chain carbon compounds), together with some inorganic compounds. It is intended for use as a screening device, to assist in determining whether further, more specific investigations are justified. The levels detected are well below levels of concern for the likely compounds that could be emitted from the site, and based on these results no additional investigations are warranted.

LEL% gives the percentage of the lower explosive limit, expressed as methane, that is detected in the air sampled. The sensor on the instrument reacts to gases and vapours such as acetone, benzene, butane, methane, propane, carbon monoxide, ethanol, and higher alkanes and alkenes, with varying degrees of sensitivity. The Council's Regional Air Quality Plan has a typical requirement that no discharge shall result in a dangerous level of airborne contaminants, including any risk of explosion. At no time did the level of explosive gases downwind of the Turangi-A wellsite reach any more than a trivial level. The maximum concentration of LEL found during the monitoring run was only 1.50%.



**Figure 2:** Graphs of ambient gas levels in the vicinity of the Turangi-A wellsite

Additional notes on deployment are as follows:

02-Oct-2008 15:40

“Multi Rae” is located; GPS 1713921/5681435

Weather: Fine, fresh wind from SW

On retrieval a strong petrochemical odour was noticed.

## Flaring volumes

In December 2004 the New Zealand Parliament passed the Resource Management (Energy and Climate Change) Amendment Act, which relieved Regional Councils from the obligation to consider the effects on climate change of discharges into air of greenhouse gases.

Holders of resource consents to discharge emissions to air were no longer required to provide any information on green house gas emissions, and consents were amended accordingly. However, some consent holders are still required to provide reports on emissions from gas combustion, including Greymouth Petroleum Limited.

There are a number of products of flaring that are of interest because of their potential effects upon local air quality. Combustion processes that are well controlled release nitrogen oxides, while incomplete combustion will emit carbon monoxide and volatile or semi-volatile organic compounds that cause smoke and odour, and can be highly injurious to health. Information on volumes of gas combusted in the Taranaki region assists the Council and consent holders in determining whether this is a significant issue in the region.

Special condition 20 of the consent 6497 requires:

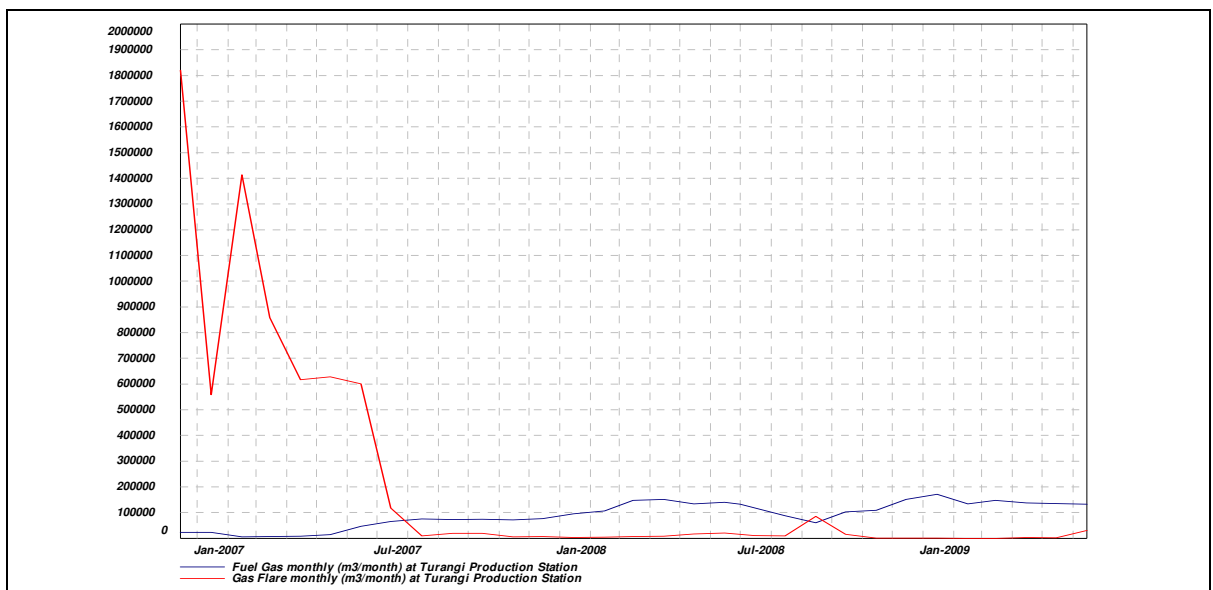
*“That the consent holder shall supply to the Taranaki Regional Council each month a copy of flaring information comprising: the type and amount of material flared [including any gas used to maintain a pilot flame], the date this was flared, the reason why flaring was*

undertaken, the measures undertaken to notify neighbours at the time, and an indication of whether smoke was produced from such flaring events.”

Emission data for the Turangi-A wellsite were provided to the Council by Greymouth Petroleum Limited on a monthly basis, expressed as total gas flared, total fuel gas and calculated carbon dioxide emission (tonnes) over a one month period. These data are graphically presented in Figure 5, shown as monthly totals for the 2008-2009 monitoring year.

In 2008-2009 reporting year, the total amount of gas combusted (flared plus fuel) was 1.67 Mm<sup>3</sup>.

The graph shows that the amount of gas flared decreased dramatically in July 2007, when the JGK-2 gas compressor began to circulate gas instead of flaring.



**Figure 5:** Monthly totals for gas combusted (flared plus fuel) at Turangi Production Station (entire dataset)