Greymouth Petroleum Limited
Turangi Production Station
Monitoring Programme
Annual Report
2015-2016

Technical Report 2016-19

ISSN: 1178-1467 (Online)
Document: 1695227 (Word)
Document: 1774287 (Pdf)

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January 2017

Executive summary

Greymouth Petroleum Limited (the Company) operates a petrochemical production station located on Turangi Road at Motunui, in the Parahaki catchment. The Turangi Production Station processes oil and gas from from the Company's northern Taranaki operations, including the Turangi and Kowhai groups of wellsites. This report for the period July 2015 to June 2016 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess the Company's environmental performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of the Company's activities.

The Company holds three resource consents in relation to the Turangi Production Station, which include a total of 68 conditions setting out the requirements that the Company must satisfy. The Company holds two consents to discharge stormwater and treated produced water onto land, in circumstances where it may subsequently enter an unnamed tributary of the Parahaki Stream, and one consent to discharge emissions related to production activities into the air at this site.

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

The Council's monitoring programme for the year under review included six inspections, four water samples collected for physicochemical analysis, two biomonitoring surveys of receiving waters, and two ambient air quality surveys.

The monitoring showed that the site was well managed. All consent conditions relating to site operations and management were complied with. Levels of contaminants in samples collected from the site and receiving waters were within limits prescribed by consent conditions. Biomonitoring in the receiving waters did not show any effect from discharges on the communities in the stream.

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, combustible gases, PM10 particulates and nitrogen oxides 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 air emissions from the site.

During the year, the Company demonstrated a high level of environmental and administrative performance with the resource consents. There were no Unauthorised Incidents recording non-compliance in respect of this consent holder during the period under review.

For reference, in the 2015-2016 year, 71% 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 24% demonstrated a good level of environmental performance and compliance with their consents.

In terms of overall environmental and compliance performance by the consent holder over the last several years, this report shows that the consent holder's performance is remains at a high level.

This report includes a recommendation for the 2016-2017 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 for the period July 2015 to June 2016 by the Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by Greymouth Petroleum Limited (GPL). GPL operates a petrochemical production station situated on Turangi Road at Motunui, in the Parahaki catchment.

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

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 the Company's use of water, land and air, and is the eighth combined annual report by the 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:

- consent compliance monitoring under the RMA and the Council's obligations;
- the Council's approach to monitoring sites though annual programmes;
- the resource consents held by the Company/companies 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 Turangi Production Station and associated sites.

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

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

Section 4 presents recommendations to be implemented in the 2016-2017 monitoring year.

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

1.1.3 The Resource Management Act 1991 and monitoring

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

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

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Council is recognising the comprehensive meaning of 'effects' inasmuch as is appropriate for each activity. Monitoring programmes are not only based on existing permit conditions, but also on the obligations of the RMA to assess the effects of the exercise of consents. In accordance with Section 35 of the RMA, the Council undertakes compliance monitoring for consents and rules in regional plans, and maintains an overview of the performance of resource users and consent holders. Compliance monitoring, including both activity and impact monitoring, enables the Council to continually re-evaluate its approach and that of consent holders to resource management and, ultimately, through the refinement of methods and considered responsible resource utilisation, to move closer to achieving sustainable development of the region's resources.

1.1.4 Evaluation of environmental and administrative performance

Besides discussing the various details of the performance and extent of compliance by the Company, this report also assigns them a rating for their environmental and administrative performance during the period under review.

Environmental performance is concerned with actual or likely effects on the receiving environment from the activities during the monitoring year. **Administrative performance** is concerned with the Company's approach to demonstrating consent compliance in site operations and management including the timely provision of information to Council (such as contingency plans and water take data) in accordance with consent conditions.

Events that were beyond the control of the consent holder and unforeseeable (that is a defence under the provisions of the RMA can be established) may be excluded with regard to the performance rating applied. For example loss of data due to a flood destroying deployed field equipment.

The categories used by the Council for this monitoring period, and their interpretation, are as follows:

Environmental Performance

- **High:** No or inconsequential (short-term duration, less than minor in severity) breaches of consent or regional plan parameters resulting from the activity; no adverse effects of significance noted or likely in the receiving environment. The Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices or infringement notices in relation to such impacts.

- **Good:** Likely or actual adverse effects of activities on the receiving environment were negligible or minor at most. There were some such issues noted during monitoring, from self reports, or in response to unauthorised incident reports, but these items were not critical, and follow-up inspections showed they have been dealt with. These minor issues were resolved positively, co-operatively, and quickly. The Council was not obliged to issue any abatement notices or infringement notices in relation to the minor non-compliant effects; however abatement notices may have been issued to mitigate an identified potential for an environmental effect to occur.

  For example:

  - High suspended solid values recorded in discharge samples, however the discharge was to land or to receiving waters that were in high flow at the time;
  - Strong odour beyond boundary but no residential properties or other recipient nearby.

- **Improvement required**: Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent minor non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.

- **Poor:** Likely or actual adverse effects of activities on the receiving environment were significant. There were some items noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent moderate non-compliant activity could elevate an 'improvement required' issue to this level. Typically there were grounds for either a prosecution or an infringement notice in respect of effects.

Administrative performance

- **High:** The administrative requirements of the resource consents were met, or any failure to do this had trivial consequences and were addressed promptly and co-operatively.

- **Good:** Perhaps some administrative requirements of the resource consents were not met at a particular time, however this was addressed without repeated interventions from the Council staff. Alternatively adequate reason was provided

for matters such as the no or late provision of information, interpretation of 'best practical option' for avoiding potential effects, etc.

- **Improvement required:** Repeated interventions to meet the administrative requirements of the resource consents were made by Council staff. These matters took some time to resolve, or remained unresolved at the end of the period under review. The Council may have issued an abatement notice to attain compliance.

- **Poor**: Material failings to meet the administrative requirements of the resource consents. Significant intervention by the Council was required. Typically there were grounds for an infringement notice.

For reference, in the 2015-2016 year, 71% 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 24% demonstrated a good level of environmental performance and compliance with their consents.

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 site was expanded to the south during the 2013-2014 year. The production facilities currently treat condensate and gas from GPL's northern Taranaki operations, including the Turangi and Kowhai groups of wellsites.

The primary facilities at the Turangi Production Station 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 load-out facility.

Gas is compressed, metered and exported to the national gas network. Condensate storage is located on the wellsite and currently consists of six above ground tanks and a truck load-out facility. Condensate is pumped via pipeline to the Omata tank farm, along with up to two truckloads going to the Waihapa Production Station per day. Produced formation water is stored on the site in bunded tanks prior to being pumped down the Turangi-5 well 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 capture and drain general surface water run-off from the site and some surrounding farmland. Stormwater from the site passes through two sets of lined skimmer pits before discharging to land and into a tributary of the Parahaki Stream at points north and south of the access road. The separate 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.

Photo 1 Turangi Production Station

1.3 Resource consents

1.3.1 Water discharge permit

Section 15(1)(a) of the 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.

GPL holds water discharge permit **6498-1** for the northern section of the site, to discharge treated stormwater and treated produced water from hydrocarbon exploration and production operations at the Turangi Production Station onto land, where it may enter into an unnamed tributary of the Parahaki Stream. This permit was issued by the Taranaki Regional Council on 7 December 2004 under Section 87(e) of the RMA. On 17 March 2008 the consent was varied in relation to the method of discharging produced water and it was also transferred from Greymouth Petroleum Acquisition Company Limited to Greymouth Petroleum Limited. On 10 September 2013 further variations were made to allow for an increase in the size of the catchment area and alterations to the stormwater system. It is due to expire on 1 June 2021.

There are 25 special conditions attached to this consent.

Conditions 1 and 6 relate to the discharge of treated water and the perimeter drain.

Conditions 2 to 5 set out contaminant concentrations that must not be exceeded in the soil layer.

Conditions 7, 8 and 12 require records to be kept, and the provision of management and contingency plans.

Conditions 9 to 11 relate to the best practicable option, catchment area and works notifications.

Conditions 13 to 18 relate to the stormwater system design and bunding of hazardous substance storage areas.

Conditions 19 to 22 specify limits in the discharge, effects on receiving waters and no direct discharge to surface water.

Conditions 23 to 25 relate to site reinstatement, lapse and review.

GPL also holds water discharge permit **9674-1** for the southern section of the site, to discharge treated stormwater and produced water from hydrocarbon exploration and production operations at the Turangi Production Station, onto land where it may enter an unnamed tributary of the Parahaki Stream. This permit was issued by the Taranaki Regional Council on 6 September 2013 under Section 87(e) of the RMA. On 13 February 2014 variations were made to allow for an increase in the size of the catchment area and alterations to the stormwater system. It is due to expire on 1 June 2027.

There are 16 special conditions attached to this consent.

Condition 1 requires the consent holder to exercise the best practicable option to prevent or minimise effects.

Conditions 3 and 14 require notification to the Council prior to the commencement of site works, drilling and reinstatement.

Condition 4 requires maintenance of a contingency plan for spillages or accidental discharges.

Conditions 2 and 5 to 10 relate to stormwater system design, management and maintenance.

Conditions 11 to 13 place limits on constituents in the discharge and effects in the receiving waters.

Conditions 15 and 16 are lapse and review provisions.

These permits are attached to this report in Appendix I.

1.3.2 Air discharge pemit

GPL holds air discharge permit **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. This permit was issued by the Taranaki Regional Council on 7 December 2004 under Section 87(e) of the

RMA. On 10 September 2013 the consent was varied to allow for relocation of the flare pit. It is due to expire on 1 June 2021.
There are 27 special conditions attached to this consent.

Conditions 1 to 3 specify design and reinstatement requirements.

Conditions 4 to 7 relate to notifications.

Conditions 8 and 9 require consideration of the wind and effective separation, prior to flaring.

Conditions 10 to 12 state that no liquid or solid hydrocarbons shall be flared, and only substances from the well stream will be combusted.

Conditions 13 to 15 relate to the best practicable option and prohibit effects beyond the boundary.

Condition 16 requires vapour recovery on storage vessels.

Condition 17 specifies the maximum opacity of smoke emissions.

Conditions 18 to 20 place limits on contaminant concentrations due to air emissions.

Conditions 21 to 25 specify records to be kept and reporting requirements.

Conditions 26 and 27 are lapse and review provisions.

The permit is attached to this report in Appendix I.

1.3.3 Wellsite consents

GPL also holds consents for production activities at wellsites associated with the Turangi Production Station. A summary of these consents is provided in Table 1.

Table 1 Consents for production activities at wellsites associated with Turangi Production Station

Wellsite	Consent number	Purpose	Issue date	Expiry
Epiha	7722-1	To discharge treated stormwater, produced water and surplus drilling water from hydrocarbon exploration and production operations at the Epiha wellsite onto and into land	30/11/2010	2027
	7725-1	To discharge emissions to air associated with production activities at the Epiha wellsite, including flaring from well workovers, and in emergency situations, and other miscellaneous activities	30/11/2010	2027
Kowhai-A	6719-1	To discharge emissions to air during flaring from well workovers and in emergency situations and miscellaneous emissions associated with production activities at the Kowhai-A wellsite	1/11/2005	2021
	6720-1	To discharge treated stormwater and treated production water from hydrocarbon exploration and production operations at the Kowhai-A wellsite onto and into land in the vicinity of an unnamed tributary of the Waiau Stream	26/10/2005	2021
Kowhai-B	9203-1	To discharge treated stormwater and produced water from hydrocarbon exploration and production operations at the Kowhai-B wellsite onto and into land	23/2/2012	2027

Wellsite	Consent number	Purpose	Issue date	Expiry
	9204-1	To discharge emissions to air associated with production activities at the Kowhai-B wellsite, including: flaring associated with emergencies and maintenance; and minor emissions from other miscellaneous activities	28/2/2012	2027
Kowhai-C	9474-1	To discharge emissions to air associated with hydrocarbon producing wells at the Kowhai-C wellsite	13/2/2013	2027
	9478-1	To discharge treated stormwater, treated produced water and surplus drilling water from hydrocarbon exploration and production operations at the Kowhai-C wellsite onto and into land where it may enter an unnamed tributary of the Waiau Stream	29/10/2013	2027
Ohanga-A	7024-1	To discharge treated stormwater and treated produced water from hydrocarbon exploration and production operations at the Ohanga-A wellsite onto and into land and into an unnamed tributary of the Onaero River	22/11/2006	2021
	7025-1	To discharge emissions to air from: flaring of hydrocarbons; and miscellaneous activities associated with well clean-up, well testing, and production testing, associated with up to eight wells at the Ohanga-A wellsite	22/11/2006	2021
Onaero	7555-1	To discharge treated stormwater, treated produced water and treated surplus drilling water from hydrocarbon exploration and production operations onto and into land in circumstances where the discharge may enter an unnamed tributary of the Onaero River at the Onaero wellsite	10/12/2009	2027
	7558-1	To discharge emissions to air during flaring from well workovers and in emergency situations associated with production activities at the Onaero wellsite	10/12/2009	2027
Turangi-B	7853-1	To discharge treated stormwater and produced water from hydrocarbon exploration and production operations at the Turangi-B wellsite onto and into land	16/6/2011	2027
	7854-1	To discharge emissions to air associated with production activities at the Turangi-B wellsite, including: flaring from well workovers; flaring in emergency situations; and emissions from other miscellaneous activities	5/12/2011	2027
Turangi-C	9415-1	To discharge treated stormwater and produced water from hydrocarbon exploration and production operations at the Turangi-C wellsite onto land	5/2/2013	2027
	9420-1	To discharge emissions to air associated with hydrocarbon producing wells at the Turangi-C wellsite	5/2/2013	2027
Turangi Metering Station	6807-1	To discharge emissions into the air from flaring of petroleum products in emergency situations, commissioning, and plant shutdowns, together with miscellaneous emissions at the Turangi Metering Station	20/9/2006	2021
	6808-1	To discharge treated stormwater from the Turangi Metering Station onto and into land in the vicinity of the Waiau Stream	30/3/2006	2021
Urenui-1	7532-1	To discharge treated stormwater, treated surplus drilling water and treated produced water from hydrocarbon exploration and production operations at the Urenui-1 wellsite, onto land where it may enter an unnamed tributary of the Onaero River	7/8/2013	2027
	9631-1	To discharge emissions to air associated with hydrocarbon producing wells at the Urenui-1 wellsite	20/8/2013	2027

1.4 Monitoring programme

1.4.1 Introduction

Section 35 of the RMA sets obligations upon the Council to gather information, monitor and conduct research on the exercise of resource consents within the Taranaki region. The Council is also required to assess the effects arising from the exercising of these consents and report upon them.

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 the Turangi Production Station consisted of four primary components.

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;
- new consents;
- advice on the Council's environmental management strategies and content of regional plans; and
- consultation on associated matters.

1.4.3 Site inspections

The Turangi Production Station was visited six times during the monitoring period. With regard to consents for the abstraction of or 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 Company 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 Council undertook sampling of both the discharges from the site and the water quality upstream and downstream of the discharge points and mixing zone.

The production station discharges were sampled on one occasion, and the samples analysed for chlorides, conductivity, hydrocarbons, pH, temperature, turbidity and suspended solids. The receiving waters of the unnamed tributary of the Parahaki

Stream were sampled concurrently, and the samples analysed for the same constituents.

The Council also undertook sampling of the ambient air quality outside the boundary of the site. A multi-gas meter was deployed on one occasion in the vicinity of the plant, with monitoring consisting of continuous measurements of gas concentrations for the gases of interest (carbon monoxide and combustible gases). A PM10 particulate monitor was deployed concurrently with the multi-gas meter. Two nitrogen oxide measuring devices were also deployed in the vicinity of the plant on one occasion during the year under review. The Company supplied data on flaring causes and flare and fuel gas volumes throughout the period.

1.4.5 Biomonitoring surveys

A biological survey was performed on two occasions in an unnamed tributary of the Parahaki Stream to determine whether or not the discharge of stormwater has had a detrimental effect upon the communities of the stream.

2. Results

2.1 Water

2.1.1 Inspections

Six inspections were carried out at the Turangi Production Station and associated wellsites in the 2015-2016 year. The following was found during the inspections:

31 July 2015
The Turangi Production Station and Kowhai-A sites were found to be secure, with ring drains and bunds clear of contaminants. The skimmer pits were clear and stormwater was not discharging offsite. No flaring was observed or odours noted at either site during the inspections.

16 August 2015
An inspection of both the Turangi Production Station and Kowhai-A wellsite found both sites were neat and tidy. The stormwater systems, including skimmer pits were clear of contaminants. No odours or other off-site effects were noted. No flaring was evident at either site.

17 November 2015
The stormwater systems at both sites were observed to be operating effectively. The contents of the skimmer pits were clear, with no discharge occurring from either site. Coconut matting had been installed at the Turangi Production Station site as a silt and sediment reduction agent. This should be effective in reducing discharge of sediments to skimmer pits in the event of high rainfall. No flaring was being undertaken at either site.

16 February 2016
There was no discharge of stormwater off site at the Turangi Production Station. The skimmer pits contained tadpoles and frogs, indicating good water quality bought about by a reduction in suspended solids by vegetation retained in ring drains, silt cloth and the use of coconut core matting and a concreted truck load out area. No flaring was observed during the inspection and no smoke or odours noted.

Some recent flaring had been undertaken at the Kowhai-A site. The flare pit was clear of contaminants and notifications to neighbours and Council had been received for this activity as per consent conditions. There was no stormwater discharge off site and the skimmer pit was clear.

31 May 2016
The Turangi Production Station site was observed to be neat and tidy. There was some additional activity on site due to preparation for drilling the Turangi-C wellsite. Ring drains, bunds, and skimmer pits were all clear of contaminants.

New skimmer pits (a two-pond system) had been constructed at the Kowhai-A wellsite. The area had been hydro seeded along with associated silt containment methods installed to minimise any offsite effects. The contents of the skimmer pits were discoloured due to silt runoff, but this was expected to settle out once the works were completed.

8 June 2016

The annual site inspection of the Turangi Production Station and associated sites was undertaken with a GPL representative to assess what, if any, works are required to maintain full compliance with resource consents held for these sites. Stormwater systems, silt control measures, flare pit design and location and general maintenance (weed control) of the sites were assessed.

The sites were generally very good with little or no works required. Ring drains and bunds were all in place and working effectively. Flare pits were well situated to minimise off site effects and no flaring was in progress. Some silt controls required a tidy up to maintain efficiency.

2.1.2 Results of discharge monitoring

Chemical water quality sampling of the discharges from the Turangi Production Station was undertaken once during the 2015-2016 period. The samples were collected on 23 June 2016. Table 2 presents the results. The locations of the sampling sites (IND002035 and IND002052) are shown in Figure 1.

Table 2 Results for discharge monitoring from the Turangi Production Station

Parameter	Units	23 June 2016		Consents limits
		Northern discharge IND002035	Southern discharge IND002052	
Chloride	g/m^3	6.5	7.5	50
Conductivity	mS/m @ 20°C	3.6	4.1	-
Hydrocarbons	g/m^3	< 0.5	< 0.5	15
Suspended solids	g/m^3	51	83	100
Temperature	Deg. C	14.7	13.8	-
pH		6.9	7.1	6.0 – 9.0
Turbidity	NTU	42	87	-

The results are indicative of uncontaminated discharges, with hydrocarbon and chloride concentrations well within the consent limits, and neutral pH levels.

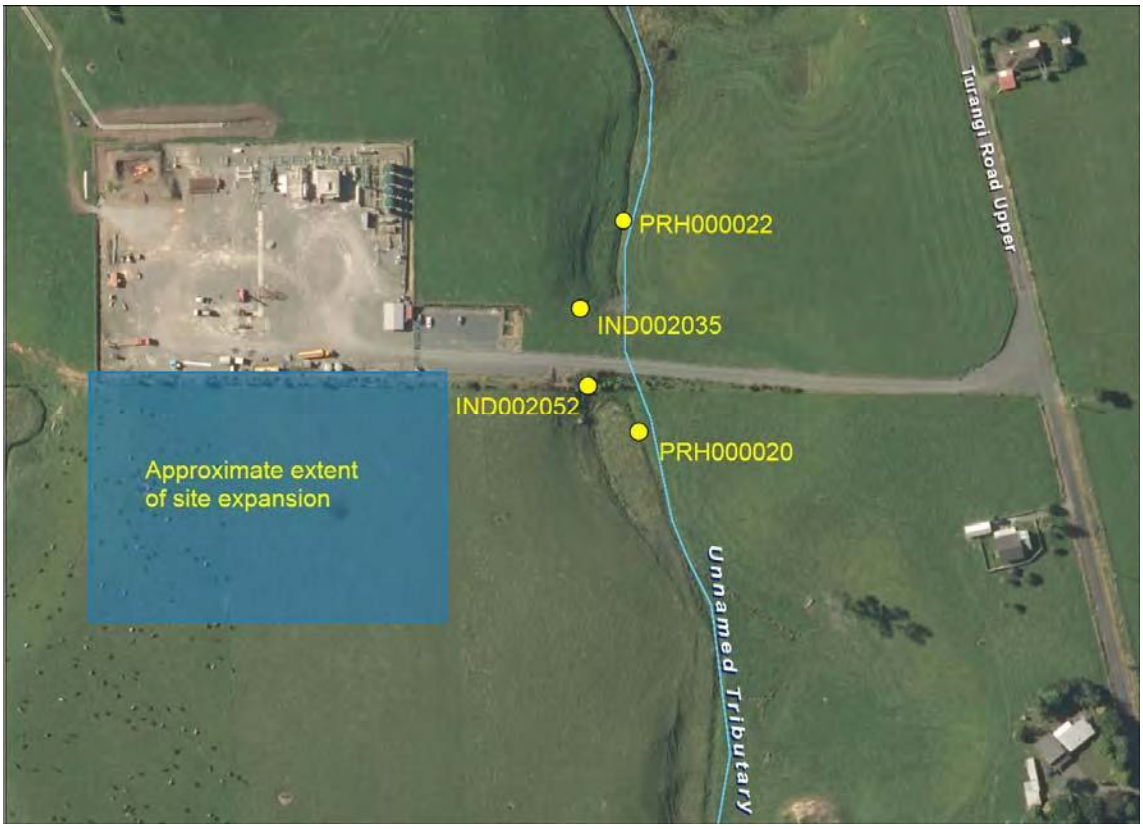

Figure 1 Turangi Production Station and associated sampling sites

2.1.3 Results of receiving environment monitoring

Chemical

Chemical water quality sampling of the unnamed tributary of the Parahaki Stream was undertaken in conjunction with discharge monitoring on 23 June 2016. The results are presented in Table 3 and the sampling sites are shown in Figure 1.

Table 3 Results of receiving environment monitoring in relation to the Turangi Production Station

Parameter	Units	23 June 2016		Consents limits
		Upstream site PRH000020	Downstream site PRH000022	
Chloride	g/m^3	16.5	15.1	-
Conductivity	mS/m @ 20°C	12.4	11.3	-
Hydrocarbons	g/m^3	< 0.5	< 0.5	No conspicuous oil films
Suspended solids	g/m^3	36	48	No conspicuous change
Temperature	Deg. C	14.9	14.7	< 2 Deg C increase
pH		6.6	6.6	-
Turbidity	NTU	35	46	No conspicuous change

The results indicate that the discharges were causing a small elevation in the suspended solids and turbidity of the receiving waters. However, the change was not conspicuous when viewing the waters in the tributary and any effect would have been no more than minor. The other parameters were unaltered by the discharges.

Biomonitoring

The Councils 'vegetation sweep' technique was used at three sites on 13 October 2015 and 7 March 2016 to collect macroinvertebrates from an unnamed tributary of the Parahaki Stream for the spring survey at the Turangi Production Station. This has provided data to assess whether discharges to nearby land had had an affect on the macroinvertebrate communities of the unnamed tributary. Samples were processed to provide number of taxa (richness), MCI, and $SQMCI_S$ scores for each site.

Taxa richness is the most robust index when ascertaining whether a macroinvertebrate community has been exposed to toxic discharges. Macroinvertebrates exposed to toxic chemicals may die or deliberately drift downstream thus potentially lowering taxa richness at a site. The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The $SQMCI_S$ takes into account taxa abundances as well as sensitivity to pollution. Significant differences in either the taxa richness, MCI or the $SQMCI_S$ between sites may indicate the degree of adverse effects (if any) of the discharge being monitored.

Taxa richnesses, MCI and $SQMCI_S$ scores were all similar among the three sites during both surveys, indicating that any discharges were not having an effect on the macroinvertebrate communities. During the spring survey all three indices were generally higher at all three sites than what had previously been reported indicating a generally improvement in conditions for macroinvertebrates at the time of the survey but this would be unrelated to any activities from the production station. During summer the taxa richness was slightly lower but this would be attributable to summer low flow conditions. The generally state of the macroinvertebrate communities present in the unnamed tributary remained 'poor' which is typical of small, lowland streams in pastoral catchments in the Taranaki Region.

Overall, there was no evidence that discharges from the Turangi Production Station for the current monitoring period were having an impact on the macroinvertebrate communities present in the unnamed tributary of the Parahaki Stream.

2.2 Air

2.2.1 Inspections

Air inspections were carried out in conjunction with site inspections as discussed in Section 2.1.1 above. No issues regarding air quality were noted during the monitoring year.

2.2.2 Results of abstraction and discharge monitoring

2.2.2.1 Carbon monoxide and combustible gases

During the monitoring year, a multi-gas meter was deployed on one occasion in the vicinity of the plant. The deployment lasted approximately 48 hours, with the instrument placed in a down-wind position at the start of the deployment. Monitoring consisted of continuous measurements of gas concentrations for the gases of interest (carbon monoxide and combustible gases). The monitoring sites used in the year under review are shown in Figure 2.

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.

Figure 2 Air monitoring sites at Turangi Production Station for 2015-2016

The details of the sample run are summarised in Table 4 and the data from the sample run are presented graphically in Figure 3.

The consent covering air discharges from the Turangi Production Station has specific limits related to particular gases. Special condition 18 of consent 6497-1 sets a limit on the carbon monoxide concentration at or beyond the production station's boundary. The limit is expressed as 10 mg/m^3 for an eight hour average or 30 mg/m^3 for a one hour average exposure. The maximum concentration of carbon monoxide found during the monitoring run was 2.2 mg/m^3 while the average concentration for the entire dataset was only 0.23 mg/m^3 which comply with consent conditions. This is in line with the pattern found in previous years.

Table 4 Results of carbon monoxide and LEL monitoring at Turangi Production Station

Period		14 to 16 April 2016 (48 hours)
Max	CO(ppm)	1.90
	LEL(%)	0.20
Mean	CO(ppm)	0.20
	LEL(%)	0.00
Min	CO(ppm)	0.00
	LEL(%)	0.00

Notes: (1) the instrument records in units of ppm. At 25°C and 1 atm, 1ppm CO = 1.145 mg/m3
(2) 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 percentage LEL by 20.

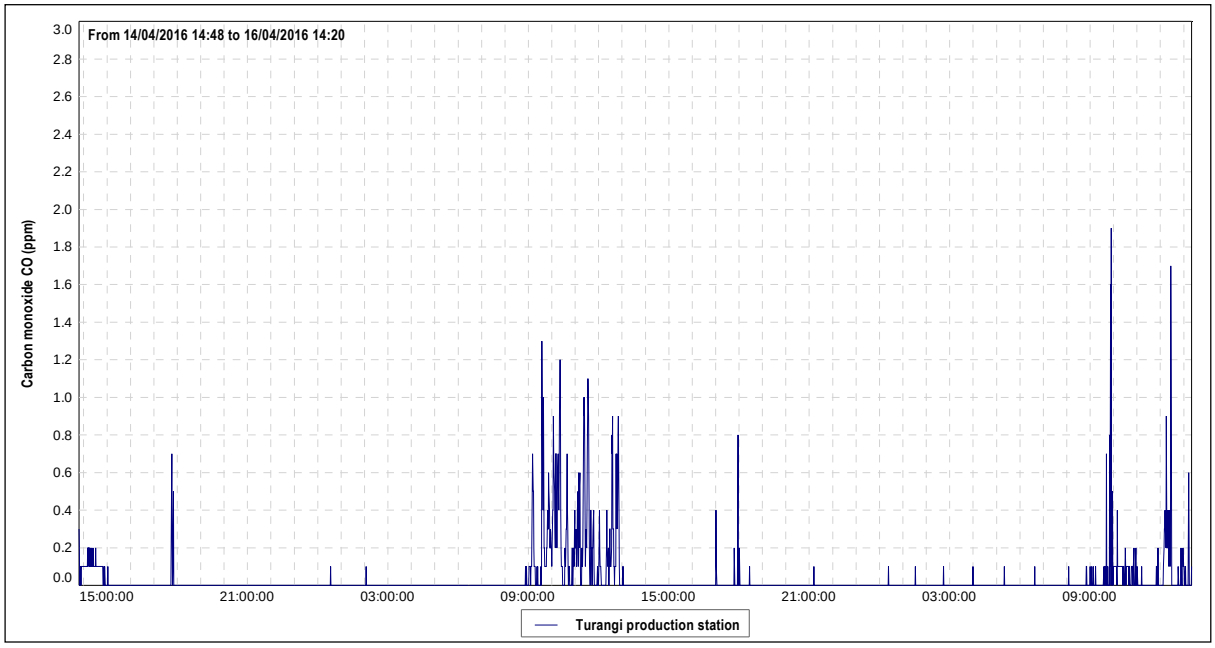

Figure 3 Ambient CO levels in the vicinity of Turangi Production Station

Lower Explosive Limit (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 dangerous levels of airborne contaminants, including any risk of explosion. At no time did the level of explosive gases downwind of the Turangi Production Station reach any more than a trivial level.

2.2.2.2 PM10 particulates

In September 2004 the Ministry for the Environment enacted National Environmental Standards (NESs) relating to certain air pollutants. The NES for PM10 particulates is 50 $\mu g/m^3$ (24-hour average).

Particulates can be derived from many sources, including motor vehicles (particularly diesel), solid and oil-burning processes for industry and power generation, incineration and waste burning, photochemical processes, and natural sources such as pollen, abrasion, and sea spray.

PM10 particles are linked to adverse health effects that arise primarily from the ability of particles of this size to penetrate the defences of the human body and enter deep into the lungs, significantly reducing the exchange of gases across the lung walls. Health effects from inhaling PM10 include increased mortality and the aggravation of existing respiratory and cardiovascular conditions such as asthma and chronic pulmonary diseases.

During the reporting period, a DustTrak PM10 monitor was deployed on one occasion in the vicinity of Turangi Production Station. The deployment lasted approximately 68 hours, with the instrument placed in a down-wind position at the start of the deployment. Monitoring consisted of continual measurements of PM10 concentrations.

The location of the DustTrak monitor during the sampling run is shown in Figure 2. The results of the sample run are presented in Figure 4 and Table 5.

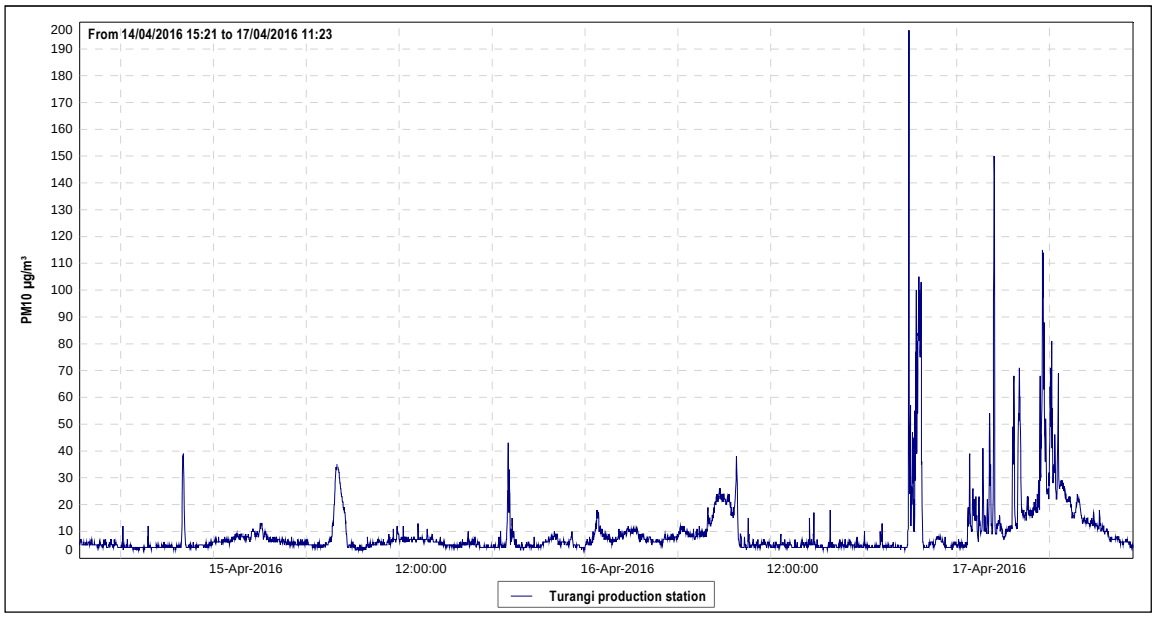

Figure 4 PM10 concentrations (µg/m³) at Turangi Production Station

Table 5 Daily averages of PM10 results from monitoring at Turangi Production Station

	14 to 17 April 2016 (68 hours)	
24 hr. set	Day 1	Day 2
Daily average	6.5 µg/m³	13.5 µg/m³
NES limit (24 hour average)	50 µg/m³	

During the 68 hour run, from 14 April to 17 April 2016, the average recorded PM10 concentration was 6.5 µg/m³ for the first 24 hour period and 13.5 µg/m³ for the second 24 hour period. These daily averages equate to 13.1% and 26.9%, respectively, of the 50 µg/m³ value that is set by the NES. Background levels of PM10 in the region have been found to be typically around 11 µg/m³.

2.2.2.3 Nitrogen oxides

From 2014 onwards, the Council implemented a coordinated region-wide compliance monitoring programme to measure nitrogen oxides (NOx). The programme involves deploying measuring devices at 24 NOx monitoring sites (including two sites in the vicinity of Turangi Production Station) on the same day, with retrieval three weeks later. This approach assists the Council in further evaluating the effects of local and regional emission sources and ambient air quality in the region.

The consent covering air discharges from the Turangi Production Station has specific limits related to particular gases. Special condition 19 of consent 6497-1 sets a limit on the nitrogen dioxide concentration at or beyond the production station's boundary. The limit is expressed as 200 µg/m³ for a 1-hour average or 100 µg/m³ for a 24-hour average exposure.

NOx passive adsorption discs were placed at two locations in the vicinity of the Turangi Production Station on one occasion during the year under review. The discs were left in place for a period of 21 days. The calculated 1-hour and 24-hour theoretical maximum NOx concentrations found at Turangi Production Station during the year under review equate to 12.2 µg/m³ and 6.5 µg/m³, respectively. The results show that the ambient ground level concentration of NOx is well below the limits set out by consent 6497-1.

The full air monitoring reports are attached to this report in Appendix III.

2.2.3 Summary of flaring volumes reported by GPL

A summary of flaring volumes at Turangi Production Station is provided in Figure 5.

Flaring occurred each month during the year with no smoke emissions or complaints recorded. The quantities of gas flared at the production station relate to things like the frequency of equipment trips and plant servicing. The facilities upgrade completed in the previous monitoring period has reduced flaring frequency, reduced smoke and improved processing. Flaring in May, August and November 2015 was related to planned maintenance, while flaring was necessary in September 2015 due to increased back pressure in the pipeline. Flaring was also undertaken at the Kowhai sites, Urenui-1 and Ohanga-A, mainly relating to planned maintenance, well testing, de-pressurising pipework and equipment for repairs and servicing.

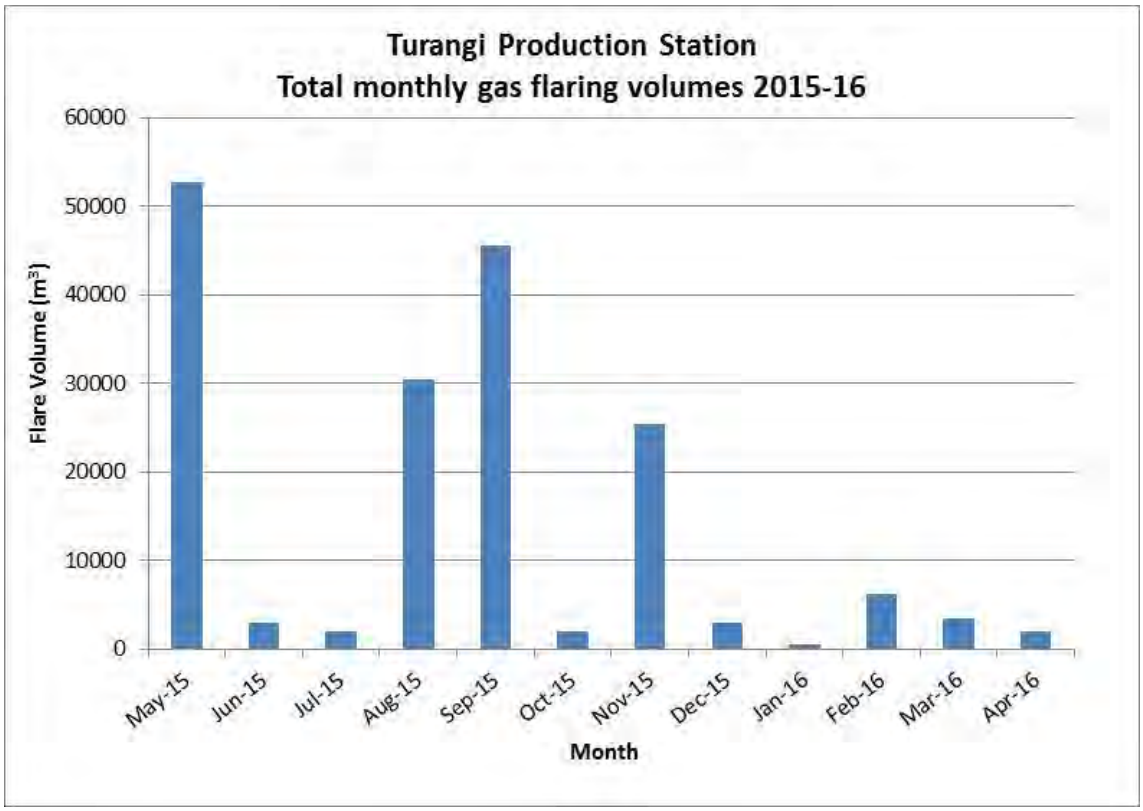

Figure 5 Summary of monthly gas flaring volumes at Turangi Production Station

2.3 Investigations, interventions, and incidents

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

The Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The incident register includes events where the Company concerned has itself notified the Council. The register contains details of any investigation and corrective action taken.

Complaints may be alleged to be associated with a particular site. If there is potentially an issue of legal liability, the Council must be able to prove by investigation that the identified company is indeed the source of the incident (or that the allegation cannot be proven).

In the 2015-2016 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans.

3. Discussion

3.1 Discussion of site performance

Monitoring of the Turangi Production Station during the 2015-2016 year found that the site was well managed. All consent conditions relating to site operations and management were complied with.

3.2 Environmental effects of exercise of consents

Site inspections found that the stormwater systems were constructed and maintained in accordance with consent conditions. Levels of contaminants in samples collected from the site and receiving waters were within limits prescribed by consent conditions. Biomonitoring in the receiving waters did not show any effect from discharges on the communities in the stream.

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, combustible gases, PM10 particulates and nitrogen oxides 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 air emissions from the site.

3.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Tables 6-8.

Table 6 Summary of performance for Consent 6497-1

Purpose: ***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. Flare pit to be lined	Inspection	Yes
2. Flaring shall occur at the designated location	Inspection	Yes
3. Temporary flare pit to be removed upon completion of the new flare pit	Inspection	Yes
4. Notification to Council one month prior to production operations	Production operations commenced early 2006	N/A
5. Notification to neighbours 24 hrs prior to flaring & record of complaints	Inspection and liaison with consent holder	Yes
6. Notification to Council 24 hrs prior to flaring	Notifications received	Yes
7. No alterations without approval	Inspection and liaison with consent holder	Yes

Purpose: ***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?**
8. Take into account wind speed & direction when flaring	Inspection and Company records	Yes
9. Effective separation to minimise smoke	Inspection and Company records	Yes
10. Notification to Council of ineffective separation	No incidents during year under review	N/A
11. No liquid or solid hydrocarbons flared	Inspection and liaison with consent holder	Yes
12. Only substances from well stream to be flared	Inspection and Company records	Yes
13. Adoption of the best practicable option	Inspection and liaison with consent holder	Yes
14. No hazardous/toxic/noxious contaminants beyond boundary	Inspection and air monitoring	Yes
15. No offensive odour or smoke beyond boundary	Inspection	Yes
16. Hydrocarbon storage vessels to have vapour recovery systems	Inspection	Yes
17. Specified opacity for smoke emissions	Air monitoring	Yes
18. Control of carbon monoxide emissions	Air monitoring	Yes
19. Control of nitrogen oxide emissions	Air monitoring	Yes
20. Control of emissions to achieve specified contaminant concentrations	Not assessed	N/A
21. Keep & maintain record of smoke emitting incidents	Inspection and annual flaring report	Yes
22. Keep & maintain flaring log	Inspection and annual flaring report	Yes
23. Monthly flaring information supplied	Information received	Yes
24. Provision of annual flaring & air emissions report during May	Latest report received June 2016	Yes
25. Analysis of typical gas and crude oil stream	Analysis not requested	N/A
26. Lapse provision	Consent exercised	N/A
27. Optional review provision	Next option for review in June 2021	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

Table 7 Summary of performance for Consent 6498-1

Purpose: ***To discharge treated stormwater and treated produced water from hydrocarbon exploration and production operations at the Turangi Production Station onto land, where it may enter into an unnamed tributary 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 limits	Not assessed	N/A
3. Soil sodium absorption ratio limits	Not assessed	N/A
4. Concentrations in soil not to be exceed prior to expiry/cancellation/ surrender	Consent still current	N/A
5. Hydrocarbons in soil to comply with MfE guidelines	Not assessed	N/A
6. Treated produced water discharged to land shall be within perimeter drain	All produced water re-injected	Yes
7. Records to be kept and forwarded to Council quarterly	Inspection and company records	Yes
8. Approved management plan	Received and approved	Yes
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	No site works or drilling undertaken	Yes
12. Approved contingency plan	Latest update received 14 August 2013	Yes
13. All stormwater & produced water discharged through treatment system	Inspection	Yes
14. Consent exercised in accordance with application documentation	Inspection and liaison with consent holder	Yes
15. Design of skimmer pits to meet minimum size and hydrocarbon capture requirements	Inspection and sampling	Yes
16. Stormwater retention areas to be lined	Inspection	Yes
17. Stormwater system to be installed prior to any site works	Inspection	Yes
18. Bunding and drainage of hazardous substances	Inspection	Yes
19. Concentrations not to be exceeded in the discharge	Sampling	Yes

Purpose: ***To discharge treated stormwater and treated produced water from hydrocarbon exploration and production operations at the Turangi Production Station onto land, where it may enter into an unnamed tributary of the Parahaki Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
20. Temperature increase of not more than 2 degrees Celsius in receiving waters	Sampling	Yes
21. No effects upon surface water bodies	Inspection and sampling	Yes
22. No direct discharge to surface water	Inspection	Yes
23. 48 hrs notice prior to reinstatement	Site still active	N/A
24. Lapse provision	Consent exercised	N/A
25. Optional review provision	Next option for review in June 2021	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

Table 8 Summary of performance for Consent 9674-1

Purpose: ***To discharge treated stormwater and produced water from hydrocarbon exploration and production operations at the Turangi Production Station, onto land where it may enter an unnamed tributary of the Parahaki Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Adoption of the best practicable option	Inspection and liaison with consent holder	Yes
2. Maximum stormwater catchment area	Inspection and company records	Yes
3. Notification to Council 7 days prior to site works and well drilling	No site works or well drilling during the monitoring period	Yes
4. Approved contingency plan	Latest update received 14 Aug 2013	Yes
5. Consent exercised in accordance with application documentation	Inspection and liaison with consent holder	Yes
6. All stormwater and produced water discharged through treatment system	Inspection	Yes
7. Design of skimmer pits to meet minimum size and hydrocarbon capture requirements	Inspection and sampling	Yes
8. Minimum skimmer pit storage volume	Inspection	Yes
9. Stormwater retention areas to be lined	Inspection	Yes
10. Stormwater system to be installed prior to any site works	Inspection	Yes
11. Concentrations not to be exceeded in the discharge	Sampling	Yes

Purpose: ***To discharge treated stormwater and produced water from hydrocarbon exploration and production operations at the Turangi Production Station, onto land where it may enter an unnamed tributary of the Parahaki Stream***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
12. Temperature increase of not more than 2 degrees Celsius in receiving waters	Sampling	Yes
13. No effects upon surface water bodies	Inspection, sampling and biomonitoring	Yes
14. 48 hrs notice prior to reinstatement	Site still active	N/A
15. Lapse provision	Consent exercised	N/A
16. Optional review provision	Next option for review in June 2021	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent		**High**
Overall assessment of administrative performance in respect of this consent		**High**

During the year, the Company demonstrated a high level of environmental and a high level of administrative performance with the resource consents as defined in Section 1.1.4. The Turangi Production Station and associated wellsites were well managed and maintained.

3.4 Recommendations from the 2014-2015 Annual Report

In the 2014-2015 Annual Report, it was recommended:

1. THAT monitoring of consented activities at the Turangi Production Station and associated facilities in the 2015-2016 year is amended from that undertaken in 2014-2015 to align with programmes for other petrochemical production stations by including biomonitoring of the tributary of the Parahaki Stream.

Biomonitoring was carried out in a tributary of the Parahaki Stream.

3.5 Alterations to monitoring programmes for 2016-2017

In designing and implementing the monitoring programmes for air/water discharges in the region, the Council has taken into account:

- the extent of information made available by previous authorities;
- its relevance under the RMA;
- its obligations to monitor emissions/discharges and effects under the RMA; and
- to report to the regional community.

The Council also takes into account the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki emitting to the atmosphere/discharging to the environment.

It is proposed that for 2016-2017 that the monitoring programme remains unchanged from 2015-2016.

4. Recommendation

1. THAT monitoring of consented activities at Turangi Production Station and associated facilities in the 2016-2017 year continue at the same level as in 2015-2016.

Glossary of common terms and abbreviations

The following abbreviations and terms may be used within this report:

Biomonitoring	Assessing the health of the environment using aquatic organisms.
Bund	A wall around a tank to contain its contents in the case of a leak.
CO	Carbon monoxide
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 20°C and expressed in mS/m.
g/m^2/day	grams/metre^2/day.
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.
Incident Register	The 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.
LEL	Lower Explosive Limit (LEL) gives the percentage of the lower explosive limit, expressed as methane, that is detected in the air sampled.
m^2	Square Metres.
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.
NOx	Nitrogen oxides
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).
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 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 including all subsequent amendments.
SS	Suspended solids.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.

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

Bibliography and references

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Appendix I

Resource consents held by Greymouth Petroleum Limited

(For a copy of the signed resource consent please contact the TRC consent department)

Discharge Permit

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

Name of Consent Holder:	Greymouth Petroleum Limited P O Box 3394 NEW PLYMOUTH 4341
Decision Date (Change):	10 September 2013
Commencement Date (Change):	10 September 2013 (Granted: 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
Expiry Date:	1 June 2021
Review Date(s):	June 2015
Site Location:	Turangi Production Station, Turangi Road, Motunui (Property owner: BA & JM McKenzie)
Legal Description:	Sec 21 Blk VI Waitara SD (Discharge source & site)
Grid Reference (NZTM)	1713792E-5681411N (temporary flare pit) 1713756E-5681440N

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. Flaring shall only occur over a pit, or similar containment area, lined with impermeable material that prevents any liquid from leaking through its base or sidewalls and discharging to land.

2. Flaring shall only occur within 20 metres of the location defined by NZTM:

- 1713792E-5681411N (temporary flare pit); and
- 1713756E-5681440N.

3. The temporary flare pit shall be removed and site reinstated following the completion of the permanent flare pit.

4. 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.

5. 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.

6. 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.

7. 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

8. 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.

9. 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.

10. 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.

11. Subject to special conditions 9 and 10, no liquid or solid hydrocarbons shall be combusted through the gas flare system other than in an emergency.

12. Only substances originating from the well stream and treated as outlined by conditions 9, 10, 11 & 13 are to be combusted within the flare pit.

13. 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.

14. 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.

15. 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.

16. All hydrocarbon storage vessels shall be fitted with vapour recovery systems.

17. 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.

18. 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.

19. 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.

20. 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 1/30th 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

21. 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.

22. 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.

23. 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.

24. 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 21;
    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.

25. 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.

Lapse and Review

26. This consent shall lapse on the expiry of 16 years after the date of first 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.

Signed at Stratford on 10 September 2013

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Discharge Permit

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

Name of Consent Holder:	Greymouth Petroleum Limited P O Box 3394 NEW PLYMOUTH 4341
Decision Date (Change):	10 September 2013
Commencement Date (Change):	10 September 2013 (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 Production Station onto land, where it may enter into an unnamed tributary of the Parahaki Stream
Expiry Date:	1 June 2021
Review Date(s):	June 2015
Site Location:	Turangi Production Station, Turangi Road, Motunui (Property owner: BA & JM McKenzie)
Legal Description:	Sec 21 Blk VI Waitara SD (Discharge source & site)
Grid Reference (NZTM)	1713982E-5681378N
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

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 mSm^{-1}, or alternatively, if the background soil conductivity exceeds 400 mSm^{-1}, the application of waste shall not increase the soil conductivity by more than 100 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 mSm^{-1}; total dissolved salts, 2500 gm^{-3}; sodium, 460 gm^{-3}; and chloride, 700 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.

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 1.8 hectares.

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.

13. All discharges from the site, including from any containment pit or hydrocarbon combustion facility (e.g. flare pit, thermal oxidiser), shall flow to a perimeter drain and skimmer pit. Perimeter drains shall be designed, including by having a positive grade and low permeability, to ensure that runoff flows directly to a skimmer pit without ponding.

14. Subject the other conditions of this consent the design, management and maintenance of the stormwater system shall be undertaken in accordance with the information submitted in support of the consent application 7570, and in particular:

    - Drawing 12364-02, Sheet 1, prepared by BTW Company Limited and dated June 2013;
    - Drawing 12364-02, Sheet 5, prepared by BTW Company Limited and dated June 2013; and
    - Stormwater design report for Turangi Production Station, prepared by BTW Company Limited, referenced 12364-8/2013 and dated 14 August 2013.

15. Skimmer pits shall have a combined capacity of no less than 340 m^3, and be designed to retain any hydrocarbons that enter them.

16. All skimmer pits and any other stormwater retention areas shall be lined with an impervious material to prevent seepage through the bed and sidewalls, and all skimmer pits shall have a valve that can be shut off to prevent any discharge from the site.

17. Perimeter drains and skimmer pits necessary to comply with the conditions of this consent shall be installed before any site works commences. Site works includes the introduction of a drilling rig, drilling equipment or any other associated equipment or facilities to the site for any purpose other than for the construction of the site.

18. 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.

19. 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^{-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.

20. 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.

21. 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.

22. 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.

23. 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.

24. This consent shall lapse on the expiry of five years after the date of first 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.

25. 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 10 September 2013

For and on behalf of
Taranaki Regional Council

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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* [1,3,6] ALL PATHWAYS (all values mg/kg)

Soil Type/ Contaminant	Depth of contamination		
	Surface (<1m)	1m - 4m	> 4m
SAND			
MAHs			
Benzene	1.1 [v]	1.9 [7,v]	2.4 [7,v]
Toluene	(68) [4,v]	(94) [4,m]	(230) [4,v]
Ethylbenzene	(53) [4,v]	(92) [4,7,v]	(120) [4,v]
Xylenes	(48) [4,v]	(130) [4,7,v]	(180) [4,v]
PAHs			
Naphthalene	7.2 [p]	70 [v]	80 [v]
Non-carc. (Pyrene)	(160) [4,p]	NA [2]	NA [2]
Benzo(a)pyrene eq. [5]	0.027 [p]	(25) [4,m]	NA [2]
SANDY SILT			
MAHs			
Benzene	1.1 [v]	1.9 [v]	2.4 [v]
Toluene	(82) [4,v]	(170) [4,v]	(240) [4,v]
Ethylbenzene	(59) [4,v]	(92) [4,v]	(140) [4,v]
Xylenes	(59) [4,v]	(130) [4,v]	(180) [4,v]
PAHs			
Naphthalene	7.2 [p]	83 [v]	(130) [4,v]
Non-carc. (Pyrene)	(160) [4,p]	NA [2]	NA [2]
Benzo(a)pyrene eq. [5]	0.027 [p]	(25) [4,m]	NA [2]
SILTY CLAY			
MAHs			
Benzene	1.7 [v]	4.6 [v]	12 [v]
Toluene	(210) [4,v]	(950) [4,v]	(3,000) [4,v]
Ethylbenzene	(110) [4,v]	(800) [4,v]	(2,800) [4,v]
Xylenes	(160) [4,v]	(710) [4,v]	(2,200) [4,v]
PAHs			
Naphthalene	7.2 [p]	(330) [4,v]	(1,100) [4,v]
Non-carc. (Pyrene)	(160) [4,p]	NA [2]	NA [2]
Benzo(a)pyrene eq. [5]	0.027 [p]	(25) [4,m]	NA [2]

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* [1,3,6] ALL PATHWAYS
(all values mg/kg)

Soil Type/ Contaminant	Depth of contamination		
	Surface (<1m)	1m - 4m	> 4m
CLAY			
MAHs			
Benzene	2.7 [v]	8.8 [v]	(26) [4,v]
Toluene	(320) [4,v]	(2,400) [4,v]	(8,500) [4,v]
Ethylbenzene	(160) [4,v]	NA [2]	NA [2]
Xylenes	(250) [4,v]	(1,800) [4,v]	(6,500) [4,v]
PAHs			
Naphthalene	7.2 [p]	(360) [4,v]	(1,200) [4,v]
Non-carc. (Pyrene)	(160) [4,p]	NA [2]	NA [2]
Benzo(a)pyrene eq. [5]	0.027 [p]	(25) [4,m]	NA [2]
PUMICE			
MAHs			
Benzene	1.2 [v]	2.4 [v]	3.1 [v]
Toluene	(73) [4,v]	(240) [4,v]	(350) [4,v]
Ethylbenzene	(48) [4,v]	(140) [4,v]	(220) [4,v]
Xylenes	(53) [4,v]	(180) [4,v]	(260) [4,v]
PAHs			
Naphthalene	7.2 [p]	140 [v]	(220) [4,v]
Non-carc. (Pyrene)	(160) [4,p]	NA [2]	NA [2]
Benzo(a)pyrene eq. [5]	0.027 [p]	(25) [4,m]	NA [2]
PEATS AND HIGHLY ORGANIC SOILS			
MAHs			
Benzene	5.7 [v]	10 [v]	13 [v]
Toluene	(2,500) [4,v]	(2,900) [4,v]	(3,800) [4,v]
Ethylbenzene	(2,200) [4,v]	(2,500) [4,v]	(3,200) [4,v]
Xylenes	(1,700) [4,v]	(2,000) [4,v]	(2,600) [4,v]
PAHs			
Naphthalene	7.2 [p]	(2,700) [4,v]	(3,500) [4,v]
Non-carc. (Pyrene)	(160) [4,p]	NA [2]	NA [2]
Benzo(a)pyrene eq. [5]	0.027 [p]	(25) [4,m]	NA [2]

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[1,3,5,6] *Agricultural use* ALL PATHWAYS
(all values in mg/kg)

Soil Type/ Contaminant	Depth of contamination		
	Surface (<1m)	1m - 4m	> 4m
SAND			
C_7-C_9 [4]	120 [m]	120 [m]	(3,800) [7,8,v]
C_{10}-C_{14}	58 [x]	(560) [7,x]	(650) [7,x]
C_{15}-C_{36}	(4,000) [7,x]	NA [2]	NA [2]
SANDY SILT			
C_7-C_9 [4]	(500) [7,m]	(500) [7,m]	(3,800) [7,v]
C_{10}-C_{14}	58 [x]	(670) [7,x]	(4,900) [7,v]
C_{15}-C_{36}	(4,000) [7,x]	NA [2]	NA [2]
SILTY CLAY			
C_7-C_9 [4]	(2,700) [7,v]	(7,300) [7,v]	(19,000) [7,v]
C_{10}-C_{14}	58 [x]	(2,700) [7,x]	(8,900) [7,x]
C_{15}-C_{36}	(4,000) [7,x]	NA [2]	NA [2]
CLAY			
C_7-C_9 [4]	(15,000) [7,v]	NA [2]	NA [2]
C_{10}-C_{14}	58 [x]	(2,900) [7,x]	(9,700) [7,x]
C_{15}-C_{36}	(4,000) [7,x]	NA [2]	NA [2]
PUMICE			
C_7-C_9 [4]	(810) [7,m]	(810) [7,m]	(4,800) [7,v]
C_{10}-C_{14}	58 [x]	(1,100) [7,x]	(1,800) [7,x]
C_{15}-C_{36}	(4,000) [7,x]	NA [2]	NA [2]
PEATS AND HIGHLY ORGANIC SOILS			
C_7-C_9 [4]	(6,700) [7,m]	(6,700) [7,m]	NA [2]
C_{10}-C_{14}	58 [x]	NA [2]	NA [2]
C_{15}-C_{36}	(4,000) [7,x]	NA [2]	NA [2]

NOTES:

1. 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)
2. 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.
3. Based on protection of human health only. Site specific consideration of aesthetic and ecological impact is required.
4. 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.
5. 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.
6. 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
7. Brackets denote values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons. For further explanation refer to Appendix 4M.
8. 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.

Discharge Permit

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

Name of Consent Holder:	Greymouth Petroleum Limited P O Box 3394 NEW PLYMOUTH 4341
Decision Date (Change):	13 February 2014
Commencement Date (Change):	13 February 2014 (Granted: 6 September 2013)

Conditions of Consent

Consent Granted:	To discharge treated stormwater and produced water from hydrocarbon exploration and production operations at the Turangi Production Station, onto land where it may enter an unnamed tributary of the Parahaki Stream
Expiry Date:	1 June 2027
Review Date(s):	June 2015, June 2021
Site Location:	Turangi Production Station, Turangi Road, Motunui (Property owner: Ducal Products Limited)
Legal Description:	Sec 21 & Lot 1 DP 19476 Blk VI Waitara SD (Discharge source & site)
Grid Reference (NZTM)	1713988E-5681344N
Catchment:	Parahaki

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

General condition

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

Special conditions

1. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or likely adverse effect on the environment associated with the discharge of contaminants from the site.

2. Stormwater discharged shall be collected from a catchment area of no more than 1.8 Ha.

3. At least 5 working days prior, the consent holder shall advise the Chief Executive, Taranaki Regional Council of the date of each of the following events:

   a) commencement of any site works (site works includes the introduction of a drilling rig, drilling equipment or any other associated equipment or facilities to the site for any purpose other than for the construction of the site);
   b) commencement of any well drilling operation; and
   c) recommencement of any site works or drilling operations following a period of inactivity exceeding 30 days.

   If any of these events is rescheduled or delayed, the consent holder shall immediately provide further notice advising of the new date.

   Any advice given in accordance with this condition shall include the consent number and the wellsite name and be emailed to worknotification@trc.govt.nz.

4. The consent holder shall maintain a contingency plan that details measures and procedures to be undertaken to prevent spillage or accidental discharge of contaminants not authorised by this consent and measures to avoid, remedy or mitigate the environmental effects of such a spillage or discharge. The contingency plan shall be certified by the Chief Executive, Taranaki Regional Council prior to discharging from the site, and after any change to the Plan.

5. Subject the other conditions of this consent the design, management and maintenance of the stormwater system shall be undertaken in accordance with the information submitted in support of the consent application 9674 and in particular, the following drawings prepared by BTW Company Limited:

   a) Drawing 12364-103-GIS, Sheet 1 and dated March 2013;
   b) Drawing 12364-02, Sheet 1, Revision 2 and dated December 2013;
   c) Drawing 12364-02, Sheet 2, Revision 3 and dated December 2013;
   d) Drawing 12364-02, Sheet 3, Revision 2 and dated December 2013;
   e) Drawing 12364-02, Sheet 4, Revision 3 and dated December 2013;
   f) Drawing 12364-02, Sheet 5, Revision 3 and dated December 2013;
   g) Drawing 12364-02, Sheet 6, Revision 3 and dated December 2013;
   h) Stormwater design report for Turangi-A Production Station, referenced 12364-8/2013, Revision 2 and dated December 2013.

6. All discharges from the site, including from any containment pit or hydrocarbon combustion facility (e.g. flare pit, thermal oxidiser), shall flow to a perimeter drain and skimmer pit. Perimeter drains shall be designed, including by having a positive grade and low permeability, to ensure that runoff flows directly to a skimmer pit without ponding.

7. Skimmer pits shall have a combined capacity of no less than 370 m^3, and be designed to retain any hydrocarbons that enter them.

8. Skimmer pits shall have a combined capacity of no less than 370 m^3 including a 'dead storage' of no less than 106 m^3, and be designed to retain any hydrocarbons that enter them.

9. All skimmer pits and any other stormwater retention areas shall be lined with an impervious material to prevent seepage through the bed and sidewalls, and all skimmer pits shall have a valve that can be shut off to prevent any discharge from the site.

10. Perimeter drains and skimmer pits necessary to comply with the conditions of this consent shall be installed before any site works commences. Site works includes the introduction of a drilling rig, drilling equipment or any other associated equipment or facilities to the site for any purpose other than for the construction of the site.

11. Constituents in the discharge shall meet the standards shown in the following table.

Constituent	Standard
pH	Within the range 6.0 to 9.0
suspended solids	Concentration not greater than 100 gm-3
total recoverable hydrocarbons	Concentration not greater than 15 gm-3 [as determined by infrared spectroscopic technique]
chloride	Concentration not greater than 50 gm-3

12. 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.

13. After allowing for a mixing zone of 25 metres, the discharge shall not give rise to any of the following effects in the receiving water:

    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.

14. The consent holder shall advise the Chief Executive, Taranaki Regional Council, in writing at least 48 hours prior to the reinstatement of the site and the reinstatement shall be carried out so as to minimise adverse effects on stormwater quality. Notification shall include the consent number and a brief description of the activity consented and be emailed to worknotification@trc.govt.nz.

15. This consent shall lapse on 30 September 2018, 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.

16. 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 and/or June 2021, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 13 February 2014

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director-Resource Management

Appendix II

Biomonitoring reports

To Job Manager, Callum MacKenzie
From Technical Officer, Katie Blakemore
Document 1691268
Report No KB008
Date 27 May 2016

Biomonitoring of an unnamed tributary of the Parahaki Stream in relation to the Turangi Production Station, Greymouth Petroleum Ltd, March 2016

Introduction

This was the second of two biomonitoring surveys scheduled to be undertaken in the 2015-2016 monitoring year for the Turangi Production Station of Greymouth Petroleum. The Production Station discharges stormwater and treated production water to land where they may enter the Parahaki Stream. The Taranaki Regional Council has undertaken four previous surveys at the site in relation to petrochemical activities, three in relation to the Turangi-1 wellsite (two in 2005 (Hope 2005a and Hope 2005b) and one in 2014), as well as one previous survey in relation to the Turangi Production Station (Sutherland 2016). This macroinvertebrate survey was performed at the Turangi Production Station to determine whether discharges to land had had a detrimental effect on macroinvertebrate communities of an unnamed tributary of the Parahaki Stream.

Methods

The survey was undertaken on 7 March 2016 at three established sites (Table1, Figure 1). Site 1 was the control site, while site 2 was the primary impact site and site 3 is the secondary impact site.

Table 1 Biomonitoring sites in an unnamed tributary of the Parahaki Stream in relation to the Turangi Production Station

Site number	Site code	Grid reference (NZTM)	Location	Altitude (masl)
1	PRH000020	E1714011 N5681332	Upstream of Turangi Production Station discharge	40
2	PRH000022	E1713999 N5681410	25m downstream of Turangi Production Station discharge	40
3	PRH000024	E17140124 N5681446	100m downstream of Turangi Production Station discharge	40

The Council's standard 'vegetation sweep' technique was used to collect streambed macroinvertebrates in the unnamed tributary of the Parahaki Stream. The 'vegetation sweep' technique is very similar to C2 (soft-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark *et al*, 2001).

Figure 1 Biomonitoring sites in an unnamed tributary of the Parahaki Stream in relation to the Turangi Production Station

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology using protocol P1 of NZMWG protocols for sampling macroinvertebrates in wadeable streams (Stark et al. 2001). Macroinvertebrate taxa found in each sample were recorded based on the abundance categories in Table 2.

Table 2 Macroinvertebrate abundance categories

Abundance category	Number of individuals
R (rare)	1-4
C (common)	5-19
A (abundant)	20-99
VA (very abundant)	100-499
XA (extremely abundant)	>499

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams. Highly 'sensitive' taxa were assigned the highest scores of 9 or 10, while the most 'tolerant' forms scored 1. Sensitivity scores for certain taxa have been modified in accordance with Taranaki experience. By averaging the scores obtained from a list of taxa taken from one site and multiplying by a

scaling factor of 20, a Macroinvertebrate Community Index (MCI) value was obtained. The MCI is a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. However, other physical variables such as sedimentation, temperatures, water velocity, and dissolved oxygen levels may also affect the MCI values because the taxa that are able to tolerate extremes in these variables generally have lower sensitivity scores. More 'sensitive' communities inhabit less polluted waterways. A gradation of biological water quality conditions based upon MCI ranges which has been adapted for Taranaki streams and rivers (TRC, 2013) from Stark's classification (Stark, 1985; Boothroyd and Stark, 2000) (Table 3).

Table 3 Macroinvertebrate community health based on MCI ranges which has been adapted for Taranaki streams and rivers (TRC, 2013) from Stark's classification (Stark, 1985 and Boothroyd and Stark, 2000)

Grading	MCI
Excellent	>140
Very Good	120-140
Good	100-119
Fair	80-99
Poor	60-79
Very Poor	<60

A semi-quantitative MCI value (SQMCIs) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling these products, and dividing by the sum of the loading factors (Stark, 1998 and 1999). The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA). Unlike the MCI, the SQMCIs is not multiplied by a scaling factor of 20, so that its corresponding range of values is 20x lower.

Results

Site habitat characteristics and hydrology

The survey was carried out under summer low flow conditions and was 18 days following a river fresh of both 3x and 7x median flow. At the time of the survey, site 1 had a very low, very slow/still, cloudy brown flow while sites 2 and 3 had a low, slow clear brown flow. It was noted that site 1 had a trickle flow connecting a series of pools. Water temperatures were 21.7 °C, 19.0°C and 19.2°C at the three sites respectively. The substrate at site 1 comprised silt, while sites 2 and 3 had a mixture of silt and hard clay, with a minor amount of coarse gravel also present at site 2. Banks were stable, with no stock damage at sites 2 and 3, while site 1 had banks that were mostly stable with a minor amount of stock damage.

Macrophytes were present on the streambed at all three sites, while moss, leaves and wood were absent from the streambed at all three sites. No periphyton mats were present at any site, while periphyton filaments were absent at site 1, patchy at site 2 and widespread at site 3. Sites 2 and 3 had partial shading provided by rank pasture grasses.

Macroinvertebrate communities

Table 4 provides a summary of the results from previous surveys sampled at the site, together with results from the current survey. Macroinvertebrate fauna recorded in the current survey are provided in Table 5.

Table 4 Number of taxa, MCI and $SQMCI_s$ values for an unnamed tributary of the Parahaki Stream, sampled in relation to the Turangi Production Station on 13 October 2015 and a summary of historical data for these sites

Site No	N	No of taxa		MCI score		$SQMCI_s$ score	
		Range	Mar 2016	Range	Mar 2016	Range	Mar 2016
1	4	15-25	9	60-78	71	1.3-2.6	1.4
2	4	14-25	15	59-76	79	1.3-2.5	1.1
3	4	15-21	9	55-75	67	1.2-3.3	1.3

Table 5 Macroinvertebrate fauna of the Parahaki Stream in relation to the Turangi Production Station, sampled on 7 March 2016

Taxa List	Site Number	MCI score	1	2	3
	Site Code		PRH000020	PRH000022	PRH000024
	Sample Number		FWB16141	FWB16142	FWB16143
COELENTERATA	Coelenterata	3	-	-	R
PLATYHELMINTHES (FLATWORMS)	*Cura*	3	-	C	R
NEMERTEA	Nemertea	3	R	-	-
ANNELIDA (WORMS)	Oligochaeta	1	A	XA	A
HIRUDINEA (LEECHES)	Hirudinea	3	R	R	-
MOLLUSCA	*Physa*	3	-	R	C
	Potamopyrgus	4	C	R	R
CRUSTACEA	Ostracoda	1	VA	XA	VA
	Isopoda	5	-	R	-
	Paracalliope	5	-	R	-
	Talitridae	5	-	R	-
ODONATA (DRAGONFLIES)	*Xanthocnemis*	4	-	-	R
HEMIPTERA (BUGS)	*Microvelia*	3	-	R	-
COLEOPTERA (BEETLES)	Dytiscidae	5	C	C	-
	Hydrophilidae	5	R	R	-
TRICHOPTERA (CADDISFLIES)	*Polyplectropus*	6	-	-	R
	Triplectides	5	-	R	-
DIPTERA (TRUE FLIES)	*Zelandotipula*	6	-	R	-
	Stratiomyidae	5	R	-	-
ACARINA (MITES)	Acarina	5	R	A	C
		No of taxa	9	15	9
		MCI	71	79	67
		SQMCIs	1.4	1.1	1.3
		EPT (taxa)	0	1	1
		%EPT (taxa)	0	7	11

'Tolerant' taxa | 'Moderately sensitive' taxa | 'Highly sensitive' taxa

R = Rare C = Common A = Abundant VA = Very Abundant XA = Extremely Abundant

Site 1 – upstream of Production Station discharge

A low taxa richness of nine taxa was recorded by this survey (Table 5). This is the six taxa less than the previously recorded lowest taxa richness for this site (Table 4) and a substantial sixteen taxa less than the taxa richness recorded by the previous (October 2015) survey. The macroinvertebrate community was characterised by two 'tolerant' taxa, the 'abundant' ostracod seed shrimps and 'very abundant' oligochaete worms. Tolerant taxa accounted for over half (56%) of all taxa recorded at this site.

A MCI score of 71 was recorded (Table 5), categorising the site as having 'poor' macroinvertebrate community. This is not significantly different (Stark 1998) to the previously recorded MCI score of 78 and is within the range of scores previously recorded at this site (Table 4). A low $SQMCI_s$ score of 1.4 units was recorded (Table 5). This is not significantly different (Stark 1998) to the previously recorded $SQMCI_s$ score of 1.6 units and is within the range previously recorded at this site (Table 4).

Site 2 – 25m downstream of Production Station discharge

A moderately low taxa richness of fifteen taxa was recorded (Table 5).This within the previously recorded range for this site (Table 4) and a substantial ten taxa less than the previously recorded taxa richness for this site. The macroinvertebrate community was characterised by two 'extremely abundant' 'tolerant' taxa (ostracod seed shrimps and oligochaete worms), as well as one 'abundant' 'moderately sensitive' taxon (Acarini/mites). Tolerant taxa accounted for almost half (47%) of all taxa recorded at this site.

The recorded MCI score of 79 units (Table 5) categorised the site as having 'poor' macroinvertebrate community health (Table 3). This is the highest recorded score for this site, but was not significantly different (Stark 1998) from the previously recorded score of 76 units. A low $SQMCI_s$ score of 1.1 was recorded at this site (Table 5). This is the lowest recorded score for this site but is not significantly different (Stark 1998) from the previously recorded $SQMCI_s$ score of 1.7 units.

Site 3 – 100m downstream of Production Station discharge

A low taxa richness of nine taxa was recorded at this site (Table 5). This is a substantial eleven taxa fewer than was recorded in the previous survey and six taxa less than the previously recorded minimum taxa richness for this site (Table 4). The macroinvertebrate community was characterised by two 'tolerant' taxa, the 'abundant' ostracod seed shrimps and 'very abundant' oligochaete worms. Tolerant taxa accounted for a high proportion (78%) of all taxa found at this site.

A MCI score of 67 units was recorded (Table 5), categorising the site as having 'poor' macroinvertebrate community health. This is within the range of MCI scores previously recorded at this site and is not significantly different (Stark 1998) from the previously recorded MCI score of 75 units. A low $SQMCI_s$ score of 1.3 units was recorded in this survey (Table 5). This is within the range previously recorded at this site (Table 4) and is not significantly different (Stark 1998) from the $SQMCI_s$ score of 1.2 units recorded in the preceding survey.

Discussion and conclusions

The Councils 'vegetation sweep' technique was used at three sites to collect macroinvertebrates from an unnamed tributary of the Parahaki Stream for the summer survey at the Turangi Production Station. This has provided data to assess whether discharges to nearby land had had any affect on the macroinvertebrate communities of the unnamed tributary. Samples were processed to provide number of taxa (richness), MCI, and $SQMCI_S$ scores for each site.

Taxa richness is the most robust index when determining whether a macroinvertebrate community has been exposed to toxic discharges. When exposed to toxic discharges, macroinvertebrates may die and be swept downstream or may deliberately drift downstream as an avoidance mechanism (catastrophic drift). The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The $SQMCI_S$ takes into account taxa abundances as well as sensitivity to pollution. It may indicate subtle changes in communities, and therefore be the more relevant index if non-organic impacts are occurring. Significant differences in either the MCI or the $SQMCI_S$ scores between sites may indicate the degree of adverse effects (if any) of the discharge being monitored.

The current surveys were undertaken during a period of extremely low flow conditions. Under these conditions, organisms are more likely to experience extremes of variables such as water temperature, conductivity and dissolved oxygen levels. There is also less dilution of any discharges that may occur. Therefore organisms which cannot tolerate these conditions may die or deliberately drift downstream to avoid the unfavourable conditions (catastrophic drift), thus reducing taxa richness. The low flow conditions may also reduce the area of habitat available, directly impacting the organisms present. These low flow conditions are likely to be the main factor contributing to the lower than previously recorded taxa richnesses and $SQMCI_s$ scores. Taxa which are classed as 'tolerant' are less likely to be affected by the environmental conditions experienced under low flow conditions.

MCI scores at all three sites categorised the sites as having 'poor' macroinvertebrate community health, but were within the range of previously recorded scores and were similar to the MCI scores recorded in the preceding survey, for each site respectively. The MCI scores were typical of those recorded in lowland coastal streams in the Taranaki region (TRC 2015). Site 1 (the 'control' site) had an MCI score similar to those of both sites 2 and 3, but site 2 had a MCI score a significant twelve units higher than that of site 3. This reflects the lower proportion of tolerant taxa at site 2 compared to sites 1 and 3. $SQMCI_s$ scores were very low, but were similar to those recorded in the preceding survey for each site respectively. These scores were generally lower than is typical for lowland coastal streams in the Taranaki region (TRC 2015), reflecting the high abundances of tolerant taxa found at these sites. Low taxa richnesses were recorded at all three sites, and sites 1 and 3 recorded their lowest taxa richnesses to date. All three sites recorded taxa richnesses that were substantially lower than those recorded at the same site in the preceding survey.

Taken together, the low taxa richnesses, low $SQMCI_s$ scores and relatively high proportions of tolerant taxa found indicate that the macroinvertebrate communities had been affected primarily by the low flow conditions experienced over the summer months. Site 1, the upstream 'control' site, which is upstream of discharges from the Production Station, recorded

the largest drop in taxa richness since the preceding survey. Further, the highest taxa richness and MCI score were recorded at site 2, the 'primary impact' site. This site would be expected to have the poorest macroinvertebrate community metric scores of any of the three sites, if discharges from the Production Station had caused any detrimental effects on the macroinvertebrate communities of the unnamed tributary of the Parahaki Stream, which is the opposite of the results recorded in the current survey. These results indicate that macroinvertebrate communities have been influenced primarily by summer low flow conditions. Overall, there is no evidence that discharges of stormwater and treated production water have had any significant detrimental effects on the macroinvertebrate communities of this unnamed tributary of the Parahaki Stream.

Summary

A macroinvertebrate survey was carried out at three sites in an unnamed tributary of the Parahaki Stream near the Turangi Production Station, to determine if discharges from the Production Station had detrimental effects on the stream macroinvertebrate communities.

The unnamed tributary of the Parahaki Stream recorded low taxa richnesses and $SQMCI_s$ scores. MCI scores categorised all sites as having 'poor' macroinvertebrate community health, but the MCI scores were generally similar to those recorded in Taranaki lowland coastal stream. MCI scores and $SQMCI_s$ scores were similar to those recorded in the preceding survey, while taxa richnesses were lower. This change is attributable to summer low flow conditions at the time of the survey.

Overall, the results of this survey provide no evidence that discharges from the Turangi Production Station have had any significant detrimental impacts on the stream macroinvertebrate communities.

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To Job Manager; Callum MacKenzie
From Freshwater Biologist; Darin Sutherland
Report No DS038
Document 1646693
Date 26 February 2016

Biomonitoring of an unnamed tributary of the Parahaki Stream in relation to the Turangi Production Station, Greymouth Petroleum Ltd, October 2015

Introduction

This was the first of two biomonitoring surveys scheduled to be undertaken in the 2015-2016 monitoring year for the Turangi Production Station of Greymouth Petroleum. The Production Station discharges stormwater and treated production water to land where they may enter the Parahaki Stream. The Taranaki Regional Council has undertaken three previous surveys at the site in relation to petrochemical activities (Turangi-1 wellsite), two in 2005 (Hope, 2005a and Hope, 2005b) and one in 2014. A macroinvertebrate survey was performed at the Turangi Production Station to determine whether discharges to land had had a detrimental effect upon macroinvertebrate communities of an unnamed tributary of the Parahaki Stream (Figure 1).

Methods

The survey was undertaken on 13 October 2015 at three sites (Table 1). Site 1 was the control site while site 2 was the primary impacted site and site 3 was the secondary impacted site. The altitude of the three sites was approximately 40 m asl.

The Council's standard 'vegetation sweep' technique was used to collect streambed macroinvertebrates in the unnamed tributary of the Parahaki Stream (Table 1; Figure 1). The 'vegetation sweep' technique is very similar to C2 (soft-bottomed, semi-quantitative) of the New Zealand Macroinvertebrate Working Group (NZMWG) protocols for macroinvertebrate samples in wadeable streams (Stark *et al*, 2001).

Table 1 Biomonitoring sites in an unnamed tributary of the Parahaki Stream in relation to the Turangi Production Station

Site No.	Site code	GPS reference (NZTM)	Location
1	PRH000020	E1714011 N5681332	Upstream of Turangi Production Station discharge
2	PRH000022	E1713999 N5681410	25 m downstream of Turangi Production Station discharge
3	PRH000024	E1714012 N5681446	100 m downstream of Turangi Production Station discharge

Figure 1 Biomonitoring sites in an unnamed tributary of the Parahaki Stream in relation to the Turangi Production Station

Samples were preserved with Kahle's Fluid for later sorting and identification under a stereomicroscope according to Taranaki Regional Council methodology which uses Protocol P1 of NZMWG protocols of sampling macroinvertebrates in wadeable streams (Stark et al, 2001). Macroinvertebrate taxa found in each sample were recorded as:

R (rare)	= less than 5 individuals;
C (common)	= 5-19 individuals;
A (abundant)	= estimated 20-99 individuals;
VA (very abundant)	= estimated 100-499 individuals;
XA (extremely abundant)	= estimated 500 individuals or more.

Stark (1985) developed a scoring system for macroinvertebrate taxa according to their sensitivity to organic pollution in stony New Zealand streams. Highly 'sensitive' taxa were assigned the highest scores of 9 or 10, while the most 'tolerant' forms scored 1. Sensitivity scores for certain taxa have been modified in accordance with Taranaki experience.

By averaging the scores obtained from a list of taxa taken from one site and multiplying by a scaling factor of 20, a Macroinvertebrate Community Index (MCI) value was obtained. The MCI is a measure of the overall sensitivity of macroinvertebrate communities to the effects of organic pollution. More 'sensitive' communities inhabit less polluted waterways. A difference of 11 units or more in MCI values is considered significantly different (Stark 1998).

A semi-quantitative MCI value ($SQMCI_s$) has also been calculated for the taxa present at each site by multiplying each taxon score by a loading factor (related to its abundance), totalling

these products, and dividing by the sum of the loading factors (Stark, 1998 and 1999). The loading factors were 1 for rare (R), 5 for common (C), 20 for abundant (A), 100 for very abundant (VA) and 500 for extremely abundant (XA). Unlike the MCI, the $SQMCI_s$ is not multiplied by a scaling factor of 20, so that its corresponding range of values is 20x lower.

Results

Site habitat characteristics and hydrology

This October 2015 survey followed a period of 12 days since a fresh in excess of three times and seven times median flow. In the month prior to this survey, there had been four fresh events, one of which exceeded three times median flow and one which exceeded seven times median flow.

The water temperatures during the survey were in the range 15.5-15.8 °C. Water levels were low and water speed was slow. The water was uncoloured and clear. Sites 1 and 2 had substrates comprised of silt and hard clay while site 3 had a substrate comprised entirely of silt.

No algal mats and filamentous algae were present. Moss, leaves and wood were absent from all sites and macrophytes were present on the stream edges at sites 1 and 2 and on the bed at site 3. All sites had partial shading from overhanging tall grasses.

Macroinvertebrate communities

Table 2 provides a summary of the results from previous surveys sampled at the site along with current survey results.

Table 2 Number of taxa, MCI and $SQMCI_s$ values for an unnamed tributary of the Parahaki Stream, sampled in relation to the Turangi Production Station on 13 October 2015 and a summary of historical data for these sites

Site No.	N	No of taxa			MCI value			$SQMCI_s$ value		
			Range	Oct 2015		Range	Oct 2015		Range	Oct 2015
1	3		15-24	25		60-77	78		1.3-2.6	1.6
2	3		14-20	25		59-74	76		1.3-2.5	1.7
3	3		15-21	20		55-69	75		1.3-3.3	1.2

Results of the current survey macroinvertebrate faunal data are summarised in Table 3.

Table 3 Macroinvertebrate fauna of an unnamed tributary of the Parahaki Stream in relation to the Turangi Production Station survey sampled October 13 2015

Taxa List	Site Number	MCI score	1	2	3
	Site Code		PRH000020	PRH000022	PRH000024
	Sample Number		FWB15282	FWB15283	FWB15284
PLATYHELMINTHES (FLATWORMS)	*Cura*	3	C	C	C
NEMERTEA	Nemertea	3	-	R	-
NEMATODA	Nematoda	3	R	-	R
ANNELIDA (WORMS)	Oligochaeta	1	XA	XA	XA
	Lumbricidae	5	R	R	-
HIRUDINEA (LEECHES)	Hirudinea	3	C	R	C
MOLLUSCA	Lymnaeidae	3	R	-	-
	Physa	3	-	R	R
	Potamopyrgus	4	-	R	-
CRUSTACEA	Ostracoda	1	A	R	A
	Paraleptamphopidae	5	C	-	-
	Talitridae	5	R	C	-
EPHEMEROPTERA (MAYFLIES)	*Austroclima*	7	C	A	R
	Zephlebia group	7	R	-	R
ODONATA (DRAGONFLIES)	*Xanthocnemis*	4	C	R	-
HEMIPTERA (BUGS)	*Microvelia*	3	-	R	-
COLEOPTERA (BEETLES)	Dytiscidae	5	C	R	R
	Hydrophilidae	5	C	R	-
TRICHOPTERA (CADDISFLIES)	*Hydrobiosis*	5	-	A	R
	Polyplectropus	6	C	R	R
	Psilochorema	6	-	R	R
	Oxyethira	2	R	C	R
DIPTERA (TRUE FLIES)	*Aphrophila*	5	-	R	-
	Paralimnophila	6	C	-	-
	Zelandotipula	6	R	R	R
	Chironomus	1	A	VA	A
	Orthocladiinae	2	A	A	A
	Polypedilum	3	A	A	C
	Paradixa	4	C	C	-
	Empididae	3	R	-	R
	Austrosimulium	3	VA	VA	A
	Stratiomyidae	5	R	-	-
ACARINA (MITES)	Acarina	5	-	-	C
		No of taxa	25	25	20
		MCI	78	76	75
		SQMCIs	1.6	1.7	1.2
		EPT (taxa)	3	4	5
		%EPT (taxa)	12	16	25

'Tolerant' taxa | 'Moderately sensitive' taxa | 'Highly sensitive' taxa

R = Rare C = Common A = Abundant VA = Very Abundant XA = Extremely Abundant

Site 1- Upstream of Turangi Production Station discharge

A moderate macroinvertebrate community richness of 25 taxa was found at site 1 ('control' site) at the time of the spring survey (Table 3).

The MCI score of 78 units indicated a community of 'poor' biological health but this was the highest score recorded at the site. The $SQMCI_S$ score of 1.6 units was within the range previously recorded (Table 2).
The community was characterised by one extremely abundant 'tolerant' taxon (oligochaete worms) (Table 3).

Site 2- 25 m downstream of Turangi Production Station discharge

A moderate macroinvertebrate community richness of 25 taxa was found at site 2 ('primary impacted' site) at the time of the spring survey (Table 3).

The MCI score of 76 units indicated a community of 'poor' biological health which was the highest score ever recorded at the site. The $SQMCI_S$ score of 1.7 units was within the range previously recorded at this site (Table 2).

The community was characterised by one extremely abundant 'tolerant' taxon (oligochaete worms) (Table 3).

Site 3- 100 m downstream of Turangi Production Station discharge

A moderate macroinvertebrate community richness of 20 taxa was found at site 3 ('secondary impacted' site) at the time of the spring survey (Table 3).

The MCI score of 75 units indicated a community of 'poor' biological health but this was the highest score recorded at the site. The $SQMCI_S$ score of 1.2 units was 0.1 units lower than the minimum previously recorded score at this site (Table 2).

The community was characterised by one extremely abundant 'tolerant' taxon (oligochaete worms) (Table 3).

Summary and Conclusions

The Councils 'vegetation sweep' technique was used at three sites to collect macroinvertebrates from an unnamed tributary of the Parahaki Stream for the spring survey at the Turangi Production Station. This has provided data to assess whether discharges to nearby land had had an affect on the macroinvertebrate communities of the unnamed tributary. Samples were processed to provide number of taxa (richness), MCI, and $SQMCI_S$ scores for each site.

Taxa richness is the most robust index when ascertaining whether a macroinvertebrate community has been exposed to toxic discharges. Macroinvertebrates when exposed to toxic chemicals may die or deliberately drift downstream thus potentially lowering taxa richness at a site. The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The $SQMCI_S$ takes into account taxa abundances as well as sensitivity to pollution. Significant differences in either the

taxa richness, MCI or the $SQMCI_S$ between sites may indicate the degree of adverse effects (if any) of the discharge being monitored.

Taxa richnesses at all three sites were very similar and there was no indication that discharges had had any effect on the number of taxa present in the unnamed tributary. MCI and $SQMCI_S$ scores were also very similar among the three sites which further indicated that any discharges were not having an effect on the macroinvertebrate communities. All three indices were generally higher at all three sites than what had previously been reported indicating a generally improvement in conditions for macroinvertebrates at the time of the survey but this would be unrelated to any activities from the production station. However, the generally state of the macroinvertebrate communities present in the unnamed tributary remained 'poor' which is typical of small, lowland streams in pastoral catchments in the Taranaki Region.

Overall, there was no evidence that discharges from the Turangi Production Station for the current monitoring period were having an impact on the macroinvertebrate communities present in the unnamed tributary of the Parahaki Stream.

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Appendix III

Air monitoring reports

Memorandum

To Job Manager, Callum MacKenzie
From Scientific Officer - Air Quality, Brian Cheyne
File 1719413
Date July 25, 2016

Ambient Gas (PM10, NOx, CO and LEL) Monitoring at Turangi Production Stations during 2015-2016 monitoring year

Introduction

In January and April 2016 as part of the compliance monitoring programme for the Turangi production station, a survey of ambient air quality sampling was carried out by the Taranaki Regional Council (the Council) in the vicinity of the plant. The main objectives were to measure:

- The concentrations of PM10 using a portable data logging TSI 'DustTrak';
- To measure the concentrations of the nitrogen oxides (NOx) using a passive sampling method, that gives a result for average exposure;
- And to measure carbon monoxide (CO) using a portable multi gas meter that provides instantaneous data throughout the monitoring period.

The findings of this study are presented in this memorandum, together with the locations of the monitoring sites which are provided in Figure 1.

Carbon monoxide (CO) and Lower explosive limit (LEL)

During the monitoring year, a multi-gas meter was deployed on one occasion in the vicinity of the plant. The deployment lasted approximately 48 hours, with the instrument placed in a down-wind position at the start of the deployment. Monitoring consisted of continuous measurements of gas concentrations for the gases of interest (carbon monoxide and combustible gases).

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.

Figure 1 Air monitoring sites at Turangi production station (2015-2016)

The details of the sample run are summarised in Table 1 and the data from the sample run are presented graphically in Figure 2**.**

The consents covering air discharges from the Turangi production station have specific limits related to particular gases. Special condition 18 of consent 6497-1 set a limit on the carbon monoxide concentration at or beyond the production station's boundary. The limit is expressed as 10 mg/m³ for an eight hour average or 30 mg/m³ for a one hour average exposure. The maximum concentration of carbon monoxide found during the monitoring run was 2.2 mg/m³ with average concentration for the entire dataset was only 0.23 mg/m³ which comply with consent conditions. This is in line with the pattern found in previous years.

Table 1 Results of carbon monoxide and LEL monitoring at Turangi production station

Period (from-to)		14/04/2016 14:48 to 16/04/2016 14:20
Max	CO(ppm)	1.90
	LEL(%)	0.20
Mean	CO(ppm)	0.20
	LEL(%)	0.00
Min	CO(ppm)	0.00
	LEL(%)	0.00

Note: (1) the instrument records in units of ppm. At 25°C, 1 atm.
1ppm CO = 1.145 mg/m^3

(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 percentage LEL by 20.

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 dangerous levels of airborne contaminants, including any risk of explosion. At no time did the level of explosive gases downwind of the Turangi production station reach any more than a trivial level.

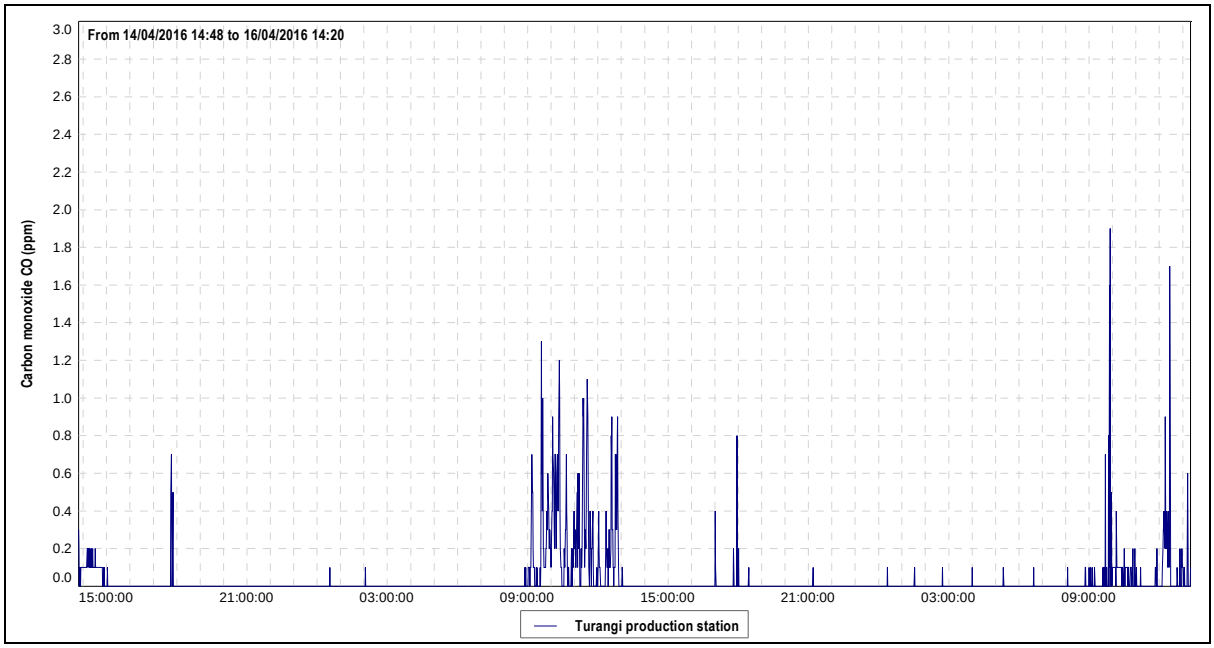

Figure 2 Graph of ambient CO levels in the vicinity of the Turangi Production Station

PM10

In September 2004 the Ministry for the Environment made public National Environmental Standards (NESs) relating to certain air pollutants. The NES for PM10 is 50 µg/m^3 (24-hour average).

Particulates can be derived from many sources, including motor vehicles (particularly diesel), solid and oil-burning processes for industry and power generation, incineration and waste burning, photochemical processes, and natural sources such as pollen, abrasion, and sea spray.

PM10 particles are linked to adverse health effects that arise primarily from the ability of particles of this size to penetrate the defences of the human body and enter deep into the lungs significantly reducing the exchange of gases across the lung walls. Health effects from inhaling PM10 include increased mortality and the aggravation of existing respiratory and cardiovascular conditions such as asthma and chronic pulmonary diseases.

During the reporting period, a "DustTrak" PM10 monitor was deployed on one occasion in the vicinity of the Turangi production station. The deployment lasted approximately 68 hours, with the instrument placed in a down-wind position at the start of the deployment. Monitoring consisted of continual measurements of PM10 concentrations. The location of the "DustTrak" monitor during the sampling run is shown in Figure 1.

The details of the sample run are presented in Figure 3 and Table 2.

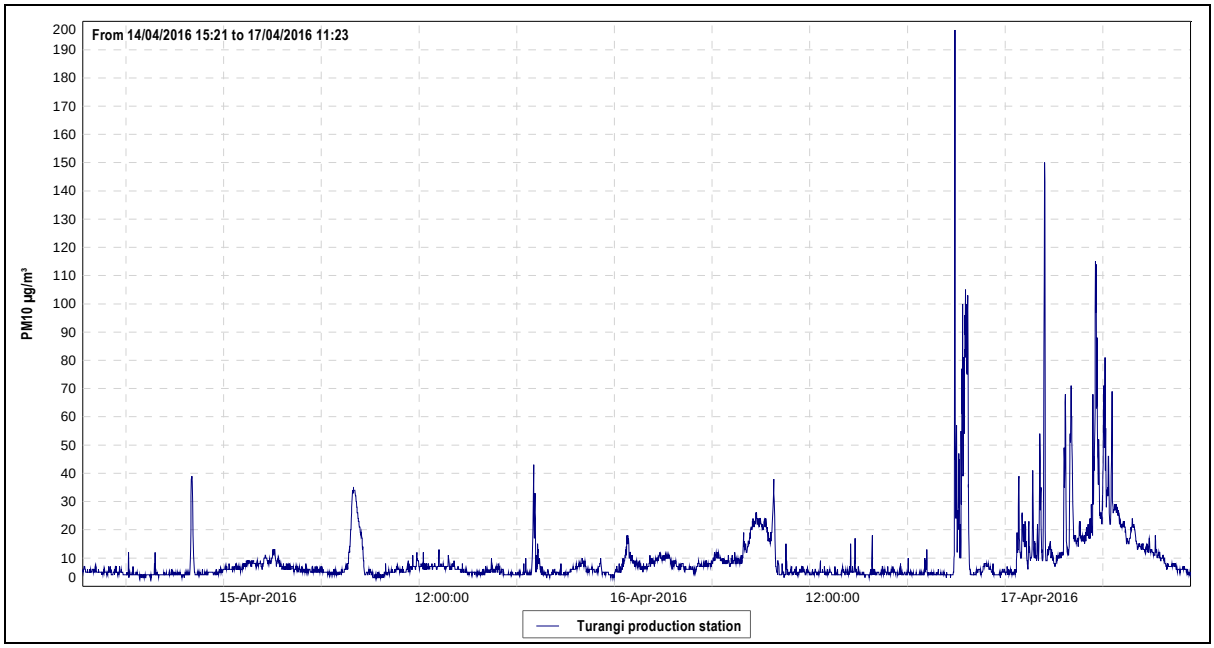

Figure 2 PM10 concentrations (µg/m³) at the Turangi production station (2015-16)

	(68 hours) (14-17/04/2016)	
24 hr. set	Day 1	Day 2
Daily average	6.5 µg/m³	13.5 µg/m³
NES	50µg/m³	

Table 1 Daily mean of PM10 results during two days' monitoring at Turangi production station

During the 68-hour run, from 14th of April to 17th of April 2016, the average recorded PM_{10} concentration for the first 24 hour period was 6.54µg/m³ and 13.47µg/m³ for the second 24 hour period. These daily means equate to 13.1% and 26.9%, respectively, of the 50 µg/m³ value that is set by the National Environmental Standard.

Background levels of PM_{10} in the region have been found to be typically around 11 µg/m³.

Nitrogen oxides (NOx)

From 2014 onwards, the Council has implemented a coordinated region-wide compliance monitoring programme to measure NOx. The programme involves deploying all measuring devices at 24 NOx monitoring sites (including two sites in the vicinity of the Turangi production station) on the same day, with retrieval three weeks later. This approach assists the Council in further evaluating the effects of local and regional emission sources and ambient air quality in the region.

The complete report covering region-wide NOx monitoring is attached in the Appendix to this memorandum.

The consents covering air discharges from the Turangi production station have specific limits related to particular gases. Special condition 19 of consent 6497-1 set a limit on the nitrogen dioxide concentration at or beyond the production station's boundary. The limit is expressed as 100 µg/m³ for a 24 hour average or 200 µg/m³ for a one hour average exposure.

NOx passive adsorption discs were placed at two locations in the vicinity of the Turangi production station on one occasion during the year under review. The discs were left in place for a period of 21 days.

The calculated 1-hour and 24-hour theoretical maximum NOx concentrations found at the Turangi production station during the year under review equates to 12.2 µg/m³ and 6.5 µg/m³ respectively. The results show that the ambient ground level concentration of NO_x is well below the limits set out by consent 6497-1.

Memorandum

To	Fiza Hafiz, Scientific Officer – State of the Environment Job Managers - Callum MacKenzie, Emily Roberts, James Kitto
From	Brian Cheyne, Scientific Officer – Air Quality
File	Frodo # 1718841
Date	22 July 2016

Monitoring of nitrogen oxides (NOx) levels in Taranaki near the NOx emitting sites, year 2015-2016

From 2014 onwards, the Taranaki Regional Council (TRC) has implemented a coordinated region-wide monitoring programme to measure NOx, not only at individual compliance monitoring sites near industries that emit NOx, but simultaneously at the urban sites (the Council regional state of the environment programme) to determine exposure levels for the general population. The programme involves deploying all measuring devices on the same day, with retrieval three weeks later. This approach will assist the Council to further evaluate the effects of local and regional emission sources and ambient air quality in the region.

Nitrogen oxides

Nitrogen oxides (NOx), a mixture of nitrous oxide (N2O), nitric oxide (NO) and nitrogen dioxide (NO2), are produced from natural sources, motor vehicles and other fuel combustion processes. Indoor domestic appliances (gas stoves, gas or wood heaters) can also be significant sources of nitrogen oxides, particularly in areas that are poorly ventilated. NO and NO2 are of interest because of potential effects on human health.

Nitric oxide is colourless and odourless and is oxidised in the atmosphere to form nitrogen dioxide. Nitrogen dioxide is an odorous, brown, acidic, highly corrosive gas that can affect our health and environment. Nitrogen oxides are critical components of photochemical smog – nitrogen dioxide produces the brown colour of the smog.

Environmental and health effects of nitrogen oxides

Nitrogen dioxide is harmful to vegetation, can fade and discolour fabrics, reduce visibility, and react with surfaces and furnishings. Vegetation exposure to high levels of nitrogen dioxide can be identified by damage to foliage, decreased growth or reduced crop yield.

Nitric oxide does not significantly affect human health. On the other hand, elevated levels of nitrogen dioxide cause damage to the mechanisms that protect the human respiratory tract and can increase a person's susceptibility to, and the severity of, respiratory infections and asthma. Long-term exposure to high levels of nitrogen dioxide can cause chronic lung disease. It may also affect sensory perception, for example, by reducing a person's ability to smell an odour.

National environmental standards and guidelines

In 2004, national environmental standards (NES) for ambient (outdoor) air quality were introduced in New Zealand to provide a guaranteed level of protection for the health of New Zealanders. The national standard for nitrogen dioxide (NO2) is set out below.

In any 1-hour period, the average concentration of nitrogen dioxide in the air should not be more than 200 µg/m³.

Before the introduction of the national environmental standards, air quality was measured against the national air quality guidelines. The national guidelines were developed in 1994 and revised in 2002 following a comprehensive review of international and national research and remain relevant. The national guideline for nitrogen dioxide (NO2) is set out below.

In any 24-hour period, the average concentration of nitrogen dioxide in the air should not be more than 100 µg/m³.

Nitrogen dioxide limits are also set in the special conditions of the resource consents. The consents limits are the same as those imposed under the NES and MfE's guideline.

Measurement of nitrogen oxides

The Taranaki Regional Council has been monitoring nitrogen oxides (NOx) in the Taranaki region since 1993 using passive absorption discs. Research to date indicates that this is an accurate method, with benefits of simplicity of use and relatively low cost. To date more then 660 samplers of nitrogen oxides have been collected in Taranaki region. Discs are sent to EUROFINS ELS Ltd. Lower Hutt for analysis. Passive absorption discs are placed at the nominated sites. The gases diffuse into the discs and any target gases (nitrogen dioxide or others) are captured.

In the 2015-16 year, passive absorption discs were placed on one occasion at twenty four sites, staked about two metres off the ground for a period of 21 days, for the purpose of Compliance Monitoring.

Conversion of exposure result to standardised exposure time period

From the average concentration measured, it is possible to calculate a theoretical maximum daily or one hour concentrations that may have occurred during the exposure period. Council data on NOx is gathered over a time period other than exactly 24 hours or one hour. There are mathematical equations used by air quality scientists to predict the maximum concentrations over varying time periods. These are somewhat empirical, in that they take little account of local topography, micro-climates, diurnal variation, etc. Nevertheless, they are applied conservatively and have some recognition of validity.
One formula in general use is of the form:

$$C(t_2) = C(t_1) \times \left(\frac{t_1}{t_2}\right)^P$$

where C(t) = the average concentration during the time interval t, and p = a factor lying between 0.17 and 0.20. When converting from longer time periods to shorter time periods, using p = 0.20 gives the most conservative estimate (i.e. the highest calculated result for time period t_2 given a measured concentration for time period t_1). Using the 'worst case' factor of p = 0.20, the monitoring data reported above has been converted to equivalent 'maximum' 1-hour and 'maximum'24-hour exposure levels.

Results

The location of the NOx monitoring sites are shown in Figure 1 and the details of the NOx results are presented in Table 1 and Figure 2.

Table 1 Actual (laboratory) and recalculated ambient NOx results, NES and MfE guideline.

	Survey at	Site code	NOx(µg/m³) Lab. results	NOx 1/hr (µg/m³) Theoretical max.	NOx 24/hr (µg/m³) Theoretical max.
Petrochemical	McKee PS	AIR007901	1.9	6.5	3.5
		AIR007902	8.1	27.8	14.8
	Turangi PS	AIR007922	3.8	13.1	6.9
		AIR007824	3.3	11.3	6.0
	Kaimiro PS	AIR007817	1.2	4.1	2.2
		AIR007818	4.0	13.8	7.3
	Sidewinder PS	AIR007831	0.8	2.8	1.5
		AIR007832	0.8	2.8	1.5
	Maui PS	AIR008201	1.3	4.5	2.4
		AIR008214	2.4	8.3	4.4
	Kupe PS	AIR007827	2.1	7.2	3.8
		AIR007830	1.4	4.9	2.6
	Kapuni PS	AIR003410	5.9	20.3	10.7
		AIR003411	7.0	24.1	12.7
	Cheal PS	AIR007841	1.5	5.2	2.7
		AIR007842	2.0	6.9	3.6
	Waihapa PS	AIR007815	1.5	5.2	2.7
		AIR007816	2.6	8.9	4.7
	Ballance AUP	AIR003401	4.2	14.4	7.7
		AIR003404	6.9	23.8	12.6
Dairy factory	Fonterra	AIR002410	3.4	11.7	6.2
		AIR002711	4.8	16.5	8.7
		AIR002412	4.3	14.8	7.8
		AIR002413	4.1	14.1	7.5
National Environmental Standard (NES) and MfE guideline				**200 (NES)**	**100 (guideline)**

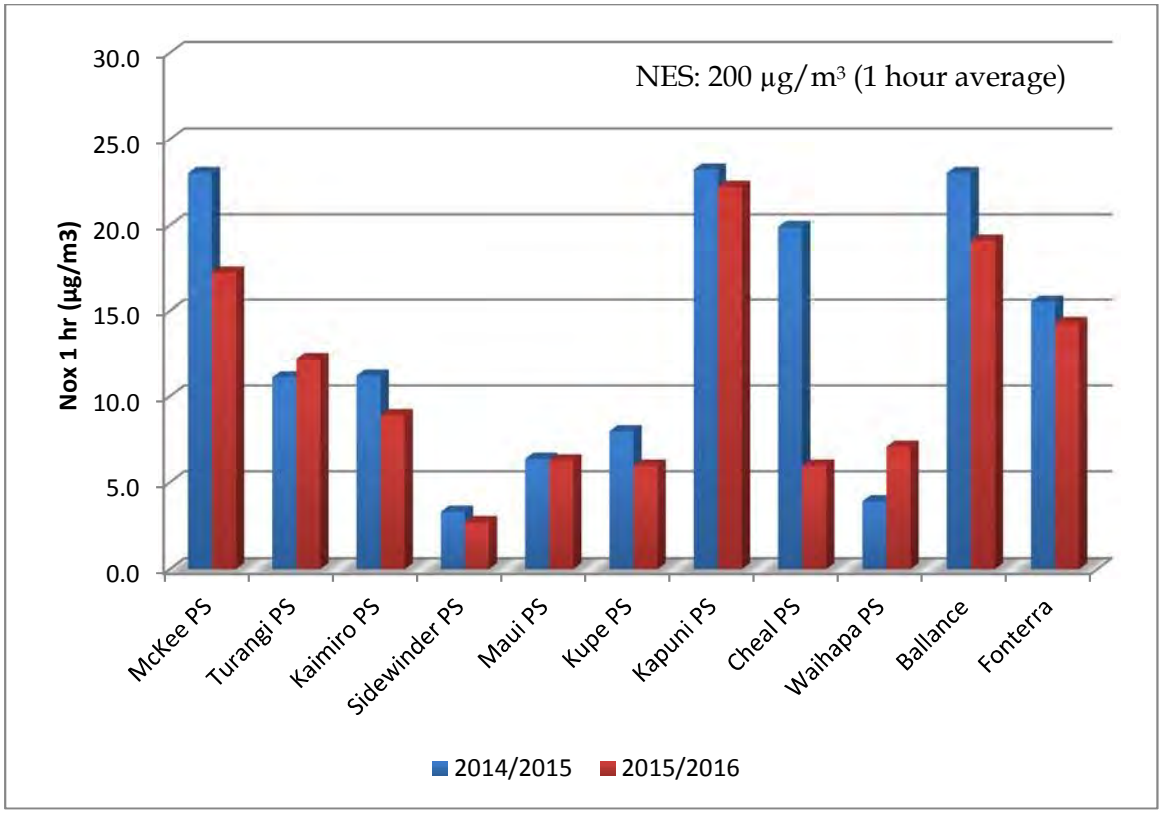

Figure 2 Average NOx levels at 11 surveyed locations throughout the region (year 2014-2016).

Discussion

The calculated 1-hour and 24-hour theoretical maximum concentrations (using a power law exponent of 0.2) ranged from 2.8 µg/m³ to 27.8 µg/m³ and 1.5 µg/m³ to 14.8 µg/m³ respectively. The highest results in 2015-16 monitoring year were obtained from the NOx emitting sites at four different locations:

1. Around the Fonterra's Whareroa co-generation plant.
2. In Kapuni heavy industrial area around the STOS production station and
3. Ballance ammonia/urea plant.
4. And from the sites at McKee production station and power generation plant.

All values were within the National Environmental Standards, Ministry for the Environment Ambient Air Quality Guidelines and the respective resource consents limits. This continues the pattern found in previous years.

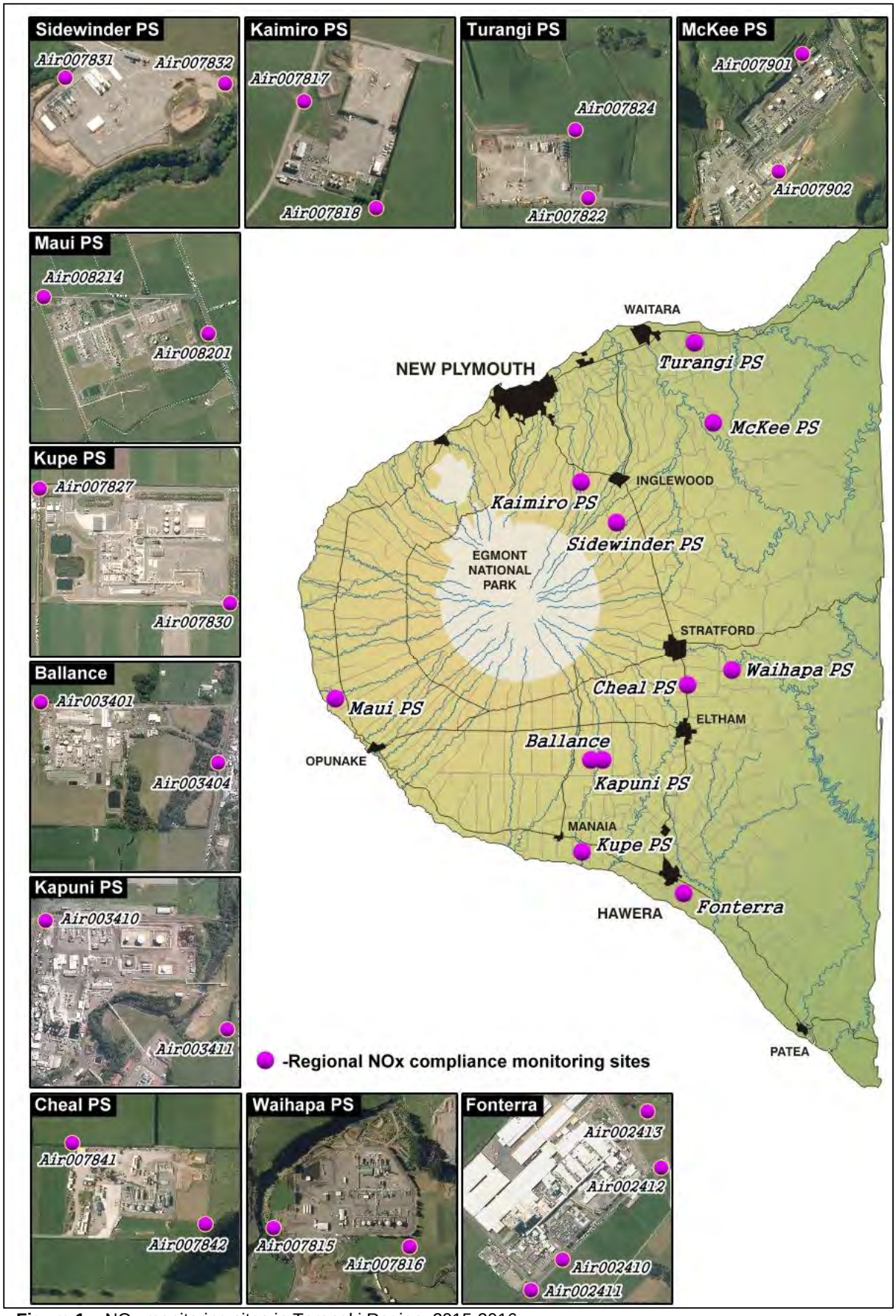

Figure 1 NOx monitoring sites in Taranaki Region, 2015-2016

Ministry for the Environment environmental performance indicator

Ministry for the Environment uses an environmental performance indicator to categorise air quality. These categories are set out in Table 2 and further details of the entire NOx results are set out in Table 3.

Table 2 Environmental Performance Indicator air quality categories

Measured value	Less than 10% of NES	10-33% of NES	33-66% of NES	66-100% of NES	More than 100% of NES
Category	*excellent*	*good*	*acceptable*	*alert*	*action*

Table 3 Categorisation of results (2015-16 monitoring year)

National Environmental Standard for NO2 = 200 µg/m³- 1 hour average.		
Category	**Measured values**	
Excellent	<10% of the NES, (0-20µg/m³)	**20** (83%)
Good	10-33% of the NES, (20-66µg/m³)	**4** (17 %)
Acceptable	33-66% of the NES, (66-132 µg/m³)	**0** (0%)
Alert	66-100% of the NES, (132-200 µg/m³)	**0** (0%)
Total number of samples		**24** (100%)

Conclusion

The monitoring showed that 83% of the 1-hour average results fell into Ministry's 'excellent' categories and 17% of the results lay within Ministry's 'good' category. No results ever entered the 'acceptable' or 'alert' categories, i.e., no results ever exceeded the National Environmental Standard of 200µg/m³.

These results, and all regional monitoring to date, have shown that Taranaki has very clean air, and on a regional basis there are no significant pressures upon the quality of the air resource.