Shell Todd Oil Services Ltd
Deep Well Injection
Monitoring Programme
Annual Report
2016-2017

Technical Report 2017-24

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Executive summary

Shell Todd Oil Services Limited (the Company) operates a number of wellsites within the Taranaki Region, most notably the Kapuni wellsites. Each wellsite contains varying numbers of producing wells and associated production infrastructure. Two of the Kapuni wellsites, KA9 and KA1/7/19/20, were consented for deep well injection (DWI) activities during the review period. This report for the period July 2016 to June 2017 describes the monitoring programme implemented by the Taranaki Regional Council (the Council) in relation to the Company's DWI activities. The report details the results of the monitoring undertaken, assesses the Company's environmental performance during the period under review and the environmental effects of their DWI activities.

The Company held one resource consent for DWI during the review period, which included a total of 21 conditions setting out the requirements that the Company must satisfy.

During the monitoring period the Company demonstrated an overall high level of environmental performance.

The Council's monitoring programme for the year under review included two inspections, two injectate samples, and ten groundwater samples collected for physicochemical analysis. The monitoring programme also included a significant data review component, with all injection data submitted by the company assessed for compliance on receipt.

The monitoring showed that the Company's DWI activities were being carried out in compliance with the conditions of the applicable resource consent. There is no evidence of any issues with any injection well currently in use, or the ability of the receiving formation to accept injected fluids. The results of groundwater quality monitoring undertaken show no adverse effects of the activity. Inspections undertaken during the monitoring year found sites being operated in a professional manner and there were no Unauthorised Incidents in relation to any of the Company's DWI consents.

During the year, the Company demonstrated a high level of environmental and administrative performance with the resource consent.

For reference, in the 2016-2017 year, consent holders were found to achieve a high level of environmental performance and compliance for 74% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 21% of the consents, a good level of environmental performance and compliance was achieved.

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

This report includes recommendations to be implemented during the 2017–2018 monitoring period.

Table of contents

List of tables

List of figures

1. Introduction

1.1. Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1. Introduction

This report is for the period July 2016 to June 2017 by the Taranaki Regional Council (the Council) on the monitoring programme associated with the resource consent held by Shell Todd Oil Services Limited (the Company) for deep well injection (DWI) activities. During the period under review the Company held one resource consent for the subsurface injection of fluids by DWI. The consent authorises discharge via the KW-2 well, located at the KA9 wellsite Lower Duthie Road, Kapuni and via the KA-01 and KA-07 wells, located at the KA1/7/19/20 wellsite, Palmer Road, Kapuni.

The resource consent permits the discharge of a range of fluids by DWI, including produced water, contaminated stormwater, drilling fluids, hydraulic fracturing (HF) fluids and production sludges. The consent includes a number of special conditions which set out specific requirements the Company must satisfy.

This report covers the results and findings of the monitoring programme implemented by the Council in respect of the DWI consent held by the Company. This is the fourth and last report to be prepared by the Council to cover the Company's DWI discharges and their effects as ownership of the Kapuni wellsites was transferred to Todd Petroleum Mining Company on 1 August 2017.

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 for DWI activities;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted by the Company.

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 2017-2018 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 2016-2017 year, consent holders were found to achieve a high level of environmental performance and compliance for 74% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 21% of the consents, a good level of environmental performance and compliance was achieved.

1.2. Process description

The process of DWI involves injecting fluids deep underground into geological formations which are confined from overlying groundwater aquifers by low permeability strata. Injection wells are also designed and constructed to provide multi barrier protection against contaminant migration to groundwater systems.

The subsurface injection of fluids by DWI is often used as a method for disposing of waste fluids generated during oil and gas exploration and production activities. The greatest volume of waste fluids generated through these activities is saline water (brine) that is drawn to the surface with hydrocarbons through producing wells ('produced water'). The DWI consent currently held by the Company also authorise the injection of fluid types other than produced water. The range of fluid types authorised for injection includes, well workover fluids, well drilling fluids, well servicing and intervention fluids, production chemicals and sludges, contaminated stormwater, HF fluids and HF return fluids.

In addition to providing a means to dispose of waste fluids, the subsurface injection of fluids by DWI is also an established oilfield technique for regulating reservoir pressure as a means of enhancing the rate of hydrocarbon recovery from a reservoir. This process, commonly referred to as water flooding, is often implemented when natural reservoir pressures become reduced due to ongoing production. Fluids can also be heated prior to injection to reduce the viscosity of the oil being produced, improving its flow toward a producing well and upward through the wellbore itself.

The Company does not undertake water flooding at the Kapuni wellsites, discharge is solely for the disposal of fluids.

A schematic representation of injection wells for both waste discharge and enhanced oil recovery is presented in Figure 1.

Further details regarding hydrocarbon exploration and production in Taranaki, the DWI process and its history within region can be found in previous compliance reports published by the Council (see Bibliography).

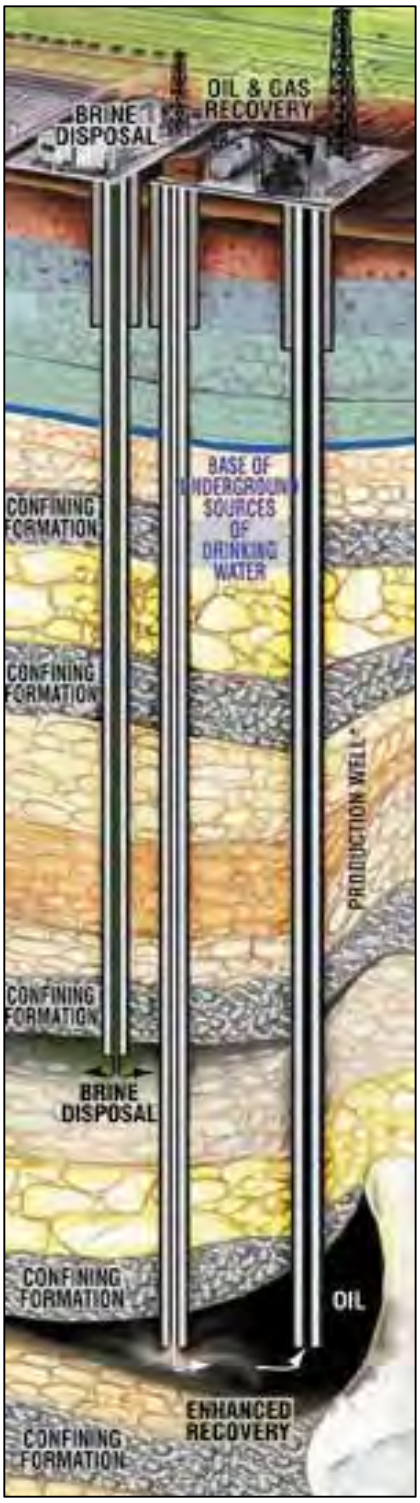

Figure 1 DWI schematic (www.epa.gov/uic)

1.3. Resource consents

1.3.1. Discharges of wastes to land

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

The Company held one discharge consent (9970-1) covering their DWI activities during the review period (Table 1).

Table 1 DWI consents held by the Company during the 2016-2017 monitoring year

Consent Number	Wellsite	Status	Injection Well(s)	Formation	Issued	Expiry
9970-1	KA9	Active	KW-2	Matemateaonga	07/10/2014	01/06/2029
	KA1/7/19/20	Active	KA-01	Mangahewa		
	KA1/7/19/20	Active	KA-07	Mangahewa		

Consent 9970-1 was issued to the Company by the Council on 7 October 2014 under Section 87(e) of the RMA. It is due to expire on 1 June 2029. The consent authorises the discharge of waste fluids by DWI at the KA9 and KA1/7/19/20 wellsites. The company applied for consent 9970-1 because the previous consent 1336-3, which was surrendered in November 2015, required the Company to seek prior approval from the Council for any additives being used in the injection fluid that were not listed in the original application. Consent 9970-1 is less prescriptive and covers a wider range of additives.

The consent has 21 special conditions, as summarised below:

- Condition 1 sets a maximum daily injection volume of 2,000 m^3/day;
- Condition 2 requires to consent holder to submit an "Injection Operation Management Plan" by 1 January 2015;
- Condition 3 requires the consent holder to submit well completion information;
- Condition 4 requires that no injection be made after 1 June 2024;
- Condition 5 requires to BPO requirements;
- Condition 6 sets a minimum injection depth of 1,200 m bgl;
- Condition 7 requires the consent holder to submit an "Injection Operation Management Plan" prior to utilising either contingency back up well;
- Condition 8 prohibits the discharge from resulting in the fracturing of the geological seals confining the injection zone;
- Condition 9 prohibits the discharge from endangering or contaminating any freshwater aquifer;
- Condition 10 limits the type of fluid that may be discharged;
- Condition 11 lists other fluids that may be discharged subject to a number of conditions;
- Conditions 12, 13, 14 and 15 refer to process monitoring and data submission requirements;
- Conditions 16, 17 and 18 relate to the requirement for the consent holder to implement a groundwater monitoring programme;
- Condition 19 requires an annual report summarising data collected and compliance with the consent conditions to be provided before 31 August each year;
- Condition 20 is a lapse clause; and
- Condition 21 is a review provision.

Figure 2 shows the location of the wellsites included in the DWI consent held by the Company during the period under review.

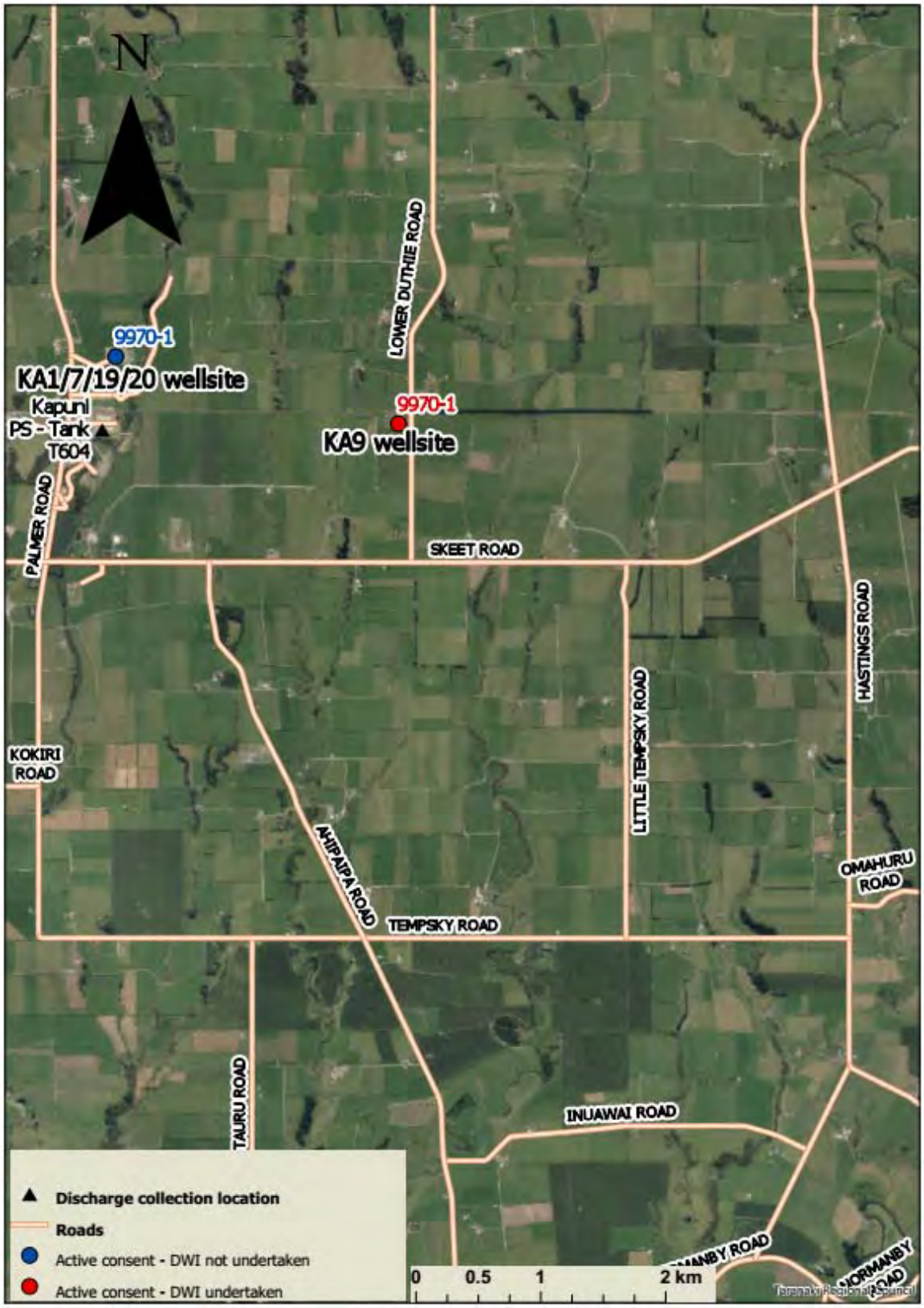

Figure 2 Wellsites and associated consent

This summary of consent conditions may not reflect the full requirements of each condition. The consent conditions in full can be found in the resource consent which is appended to this report (Appendix I).

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 KA9 and KA1/7/19/20 wellsites consisted of five 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 consent reviews, renewals or new consent applications;
- advice on the Council's environmental management strategies and content of regional plans; and
- consultation on associated matters.

1.4.3. Site inspections

The Company's KA9 and KA1/7/19/20 wellsites were visited once 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.

An additional two visits to the Company's Kapuni Production Station were undertaken by Council Officer's for injectate sampling purposes, as outlined in Section 1.4.4.

1.4.4. Injectate sampling

Injectate samples were obtained for analysis in the Council's IANZ accredited laboratory on two occasions during the monitoring period. The sampling of injectate is carried out in order to characterise the general chemical nature of the discharge and also the variation in its chemical composition across the monitoring period.

Injectate samples were collected from the bulk storage tank at the Kapuni Production Station, identified on-site as tank T604 and displayed on Figure 3.

The injectate samples were analysed for the following parameters:

- pH;
- conductivity;
- chlorides; and
- total petroleum hydrocarbons.

1.4.5. Groundwater sampling

The Company contracted AECOM Consulting Services New Zealand Limited (AECOM) to carry out the first round of sampling for the 2016-2017 monitoring period, as it had done for the previous monitoring periods. The Company contracted BTW Company (BTW) to carry out the second round of sampling for the 2016-2017 monitoring period. The contractors obtained samples of groundwater from five existing groundwater monitoring sites during their respective sampling rounds. Details of the sites sampled are included in Table 2. The locations of the groundwater monitoring sites in relation to the injection well being monitored are illustrated in Figure 3.

Table 2 Location of groundwater sites

Reference	Site code	Type	Distance from wellsite (m)	Screened/ open depth (m bmp)	Total depth (m)	High static water level (m bmp)	Aquifer	Sample method
Site 1	GND1143	Bore	948	40	65	18	Volcanic	Tap
Site 2	GND1701	Bore	2,971	92	337	NR*	Matemateaonga	Tap
Site 3	GND2369	Bore	4,643	280	448	NR*	Matemateaonga	Tap
Site 4	GND1659	Bore	4,020	123	432	6	Matemateaonga	Tap
EB bore**	GND2357	Bore	<50	35	Unknown	11.4	Volcanic	Low flow or purging

NR Not Recorded: Design of the bore prevents static water level from being measured from the ground surface. ** The pump was pushed down to 35 m during remediation of the bore however the total depth of bore is unknown. Inferred by URS (2013) to be in between 35-55 m bgl.*

Groundwater samples were sent on behalf of the Company to Hill Laboratories Limited (Hills) and analysed for a range of parameters including the following which are required under Condition 17 of the consent:

- pH;
- conductivity;
- chlorides; and
- total petroleum hydrocarbons.

The parameters above are deemed sufficient to enable identification of any significant changes in groundwater quality related to DWI activities.

In addition, baseline samples have been collected from all monitored sites and analysed by Hills for general ion chemistry, BTEX and dissolved gas concentrations. These more detailed analyses will allow a more in depth assessment of variations in groundwater composition should the need arise in the future.

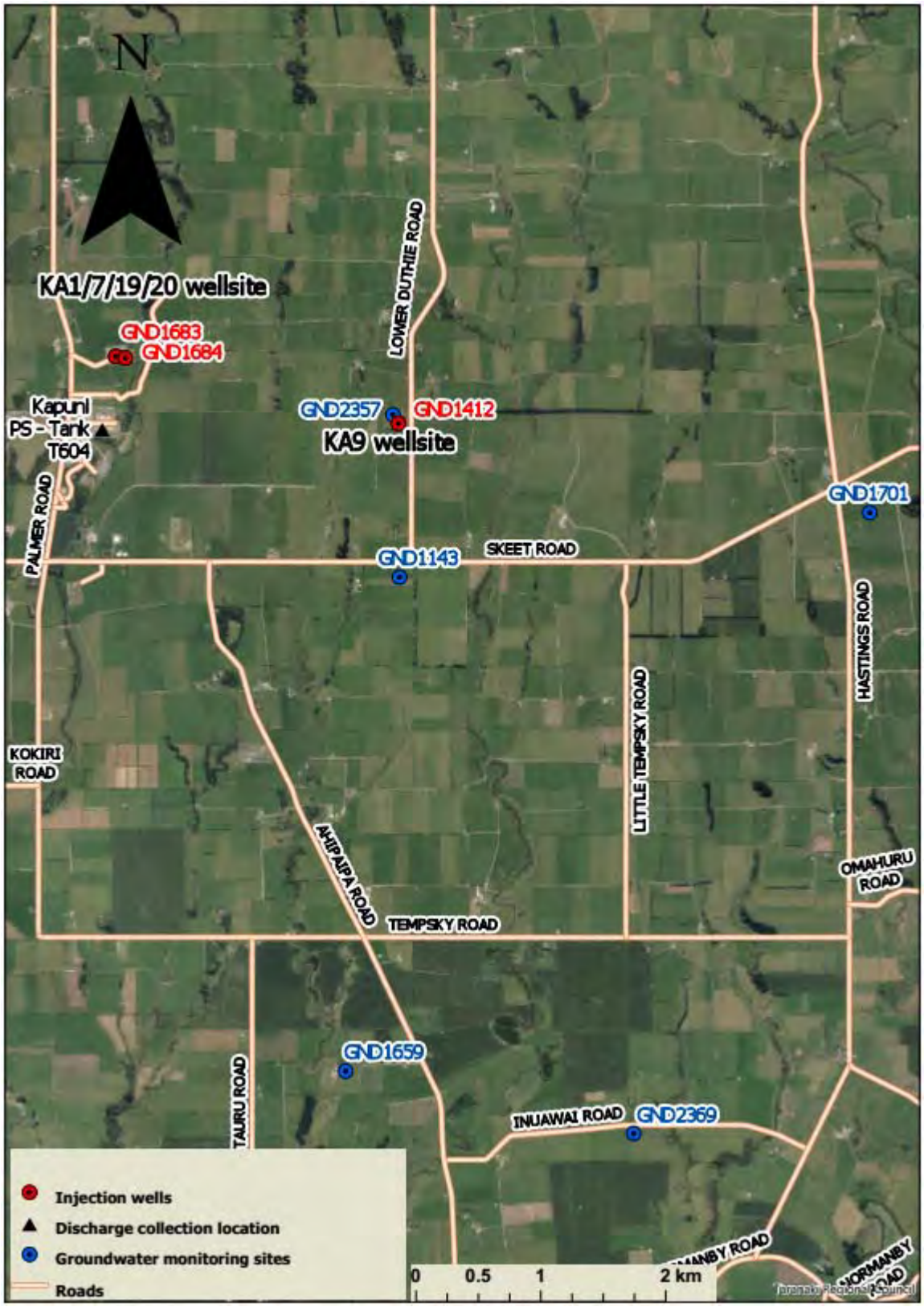

Figure 3 Location of groundwater sampling sites in relation to injection wells being monitored

1.4.6. Assessment of data submitted by the Company

A significant component of the monitoring programme is the assessment of consent holder submitted data. The Company is required to submit a wide range of data under the conditions of their DWI consent.

As required by the conditions of their consent, the Company has submitted an Injection Operation Management Plan for each active injection well. The plans are required to include the operational details of the injection activities and to identify the conditions that would trigger concerns about the integrity of the injection well, the receiving formation or overlying geological seals. The plans are also required to detail the action(s) to be taken by the consent holder if trigger conditions are reached. The Company was also required to submit well construction details, an assessment of the local geological environment, results of well integrity testing and details of the proposed monitoring plan for the injection well.

The Company is also required to maintain continuous records of injection volumes, and average and maximum injection pressures, and to characterise the chemical characteristics of all waste types being discharged. This data is submitted to the Council on a monthly basis where it is assessed for compliance against the relevant consent conditions.

2. Results

2.1. Inspections

Annual routine inspections of the Company's KA9 and KA1/7/19/20 wellsites were undertaken in June 2017. Routine inspections included undertaking a general visual assessment of the operational equipment, storage facilities and associated equipment.

The inspecting officer concluded that the wellsites were in good condition and being well managed. There were no issues noted specific to the Company's DWI consent.

The Kapuni Production Station was also visited by a Council officer on two occasions during the monitoring year for the purpose of injectate sampling. This involved accessing the Company's bulk liquid storage tank at the production station. No issues were noted by staff during these visits.

2.2. Injectate sampling

Samples of injectate were obtained from the Company's storage tank on 4 November 2016 and 27 April 2017. The samples were submitted to the Council's laboratory on the same day for physicochemical analysis. Injectate samples are generally a composite of waste water from the Company's wellsites and other production facilities.

The results of the sample analyses are included below in Table 3. The range of results for each analyte since 2004 is also presented for comparison. The Company also undertakes additional injectate sampling on a monthly basis. A range of the results from the Company's sampling programme are presented in Table 4.

The concentrations of each analyte measured over the 2016-2017 period are within the expected range for produced water samples at this site.

Table 3 Results of injectate sampling undertaken by the Council (2004-2017)

Parameter	Unit	Kapuni Production Station			
		Minimum	Maximum	Tank T604	
Date		2004- to date		04 Nov 2016	27 Apr 2017
Time	NZST			10:20	14:00
TRC sample number	-			TRC163677	TRC171508
pH	pH Units	6.7	9.0	8.0	7.0
Conductivity @ 20°C	mS/m @ 20°C	1,400	3,540	2,640	2,770
Chloride	g/m^3	6,070	12,000	8,090	6,080
Total petroleum hydrocarbons	g/m^3	51	1,300	170	1,200

Table 4 Results of the Company's monthly injectate sampling (2016-2017)

Parameter	Location	June 2016 – June 2017 sampling		
-	Date	Minimum	Maximum	Mean
-	Unit			
pH		6.6	7.5	7.1
Conductivity	mS/m	3.4	34.7	29.9

Parameter	Location	June 2016 – June 2017 sampling		
Suspended Solids	mg/L	14	200	35
Temperature*	Deg°C	1.30	23.46	14.02
Salinity	g/m^3	1,500	22,500	17,958
Chloride	g/m^3	200	10,618	6,795
Hydrocarbons	g/m^3	16.8	256.1	133.8

Note temperature has been calculated using daily injectate temperatures provided by the Company monthly*

2.3. Groundwater sampling

During the period under review, the Company conducted groundwater sampling at five sites in the vicinity of the KA9 wellsite. Sampling was conducted on 16 August 2016 and between 2 and 8 May 2017. The samples were collected by AECOM and BTW following standard groundwater sampling methodologies and were submitted to Hills for analysis. The results of the analyses are included in Appendix II and summarised in Table 5 below.

The samples collected from GND1143 were taken from a tap attached to a secondary storage tank housed in a pump shed close to the well. Samples from GND1701, GND2369 and GND1659 were collected from sampling ports close to the well head. The KA9 emergency bore (GND2357) was sampled by purging the bore using a submersible pump (BTW) or by a low flow sampling technique using a bladder pump (AECOM). An additional tap sample was also taken by the Council at GND1701 on 9 May 2017, for quality assurance and quality control purposes, and was submitted to the Council's lab for analysis. The results from the sample were similar (± 5 %) to those from the sample taken at GND1701 on 8 May 2017 by BTW on behalf of the Company.

The results show there have been no significant changes in groundwater composition over the monitoring period. This is demonstrated by the relatively narrow ranges between analyte concentrations. The subtle variations in some analyte concentrations are a result of natural seasonal fluctuation and sampling variability.

All results are within the ranges expected for Taranaki groundwater and indicate that there has been no contamination by DWI fluids.

Table 5 Results of groundwater sampling undertaken by the Company

Sample details	Units	GND1143 (Site 1)			
Lab sample number	-	Minimum	Maximum	1632819.4	1771630.2
Sample date	-	December 2012-February 2016		16-Aug-16	08-May-17
Sample time	NZST	-	-	-	12:00
pH	pH	6.8	7.3	7.0	7.0
Electrical conductivity	mS/m	30.8	32.6	31.8	31.7
Chloride	mg/L	33.0	35.0	38.0	36.0
Total hydrocarbons	mg/L	<0.7	<0.7	<0.7	<0.7

Sample details	Units	GND1701 (Site 2)			
Lab sample number	-	Minimum	Maximum	1632819.5	1771630.4
Sample date	-	December 2012- February 2016		16-Aug-16	08-May-17
Sample time	NZST	-	-	-	11:00
pH	pH	8.3	8.8	8.8	8.8
Electrical conductivity	mS/m	31.7	34.1	31.7	31.9
Chloride	mg/L	10.7	12.0	11.4	11.6
Total hydrocarbons	mg/L	<0.7	<0.7	<0.7	<0.7
Sample details	**Units**	**GND2369 (Site 3)**			
Lab sample number	-	Minimum	Maximum	1632819.6	176834.1
Sample date	-	December 2012-August 2015		16-Aug-16	02-May-17
Sample time	NZST	-	-	-	11:50
pH	pH	8.1	8.9	8.0	8.1
Electrical conductivity	mS/m	31.4	37.8	37.5	37.5
Chloride	mg/L	10.8	12.3	11.9	12.4
Total hydrocarbons	mg/L	<0.7	<0.7	<0.7	<0.7
Sample details	**Units**	**GND1659 (Site 4)**			
Lab sample number	-	Minimum	Maximum	1632819.7	1771630.3
Sample date	-	December 2012-February 2016		16-Aug-16	08-May-17
Sample time	NZST	-	-	-	12:40
pH	pH	8.0	8.3	8.2	8.4
Electrical conductivity	mS/m	33.3	37.9	33.4	33.6
Chloride	mg/L	10.4	12.9	11.2	11.4
Total hydrocarbons	mg/L	<0.7	<0.7	<0.7	<0.7
Sample details	**Units**	**GND2357 Emergency Bore (Site 5)**			
Lab sample number	-	Minimum	Maximum	1632819.1	1771630.1
Sample date	-	March 2015-February 2016		16-Aug-16	08-May-17
Sample time	NZST				10:30
pH	pH	7.5	7.6	7.5	7.6
Electrical conductivity	mS/m	54.8	62.7	57.2	57.8
Chloride	mg/L	23.0	26.0	26.0	27.0
Total hydrocarbons	mg/L	<0.7	<0.7	<0.7	<0.7

2.4. Provision of consent holder data

The Company provided records of their injection activities during the 2016-2017 monitoring period, including daily injection volumes, pumping duration and maximum and average injection pressures.

Table 6 provides an overview of the Company's injection activities during the monitoring period. Table 7 provides an overview of the Company's historical DWI activities at the KA9 wellsite since 2012.

The volumes of fluid injected by the Company since 2006 is summarised in Table 8

All DWI undertaken by the Company under consent 9970-1 during the monitoring period was via the KW-2 injection well at the KA9 wellsite

Table 6 Summary of injection activity during the 2016-2017 monitoring year

Consent	Wellsite	Injection wells	Total volume discharged (m^3) 01/07/16 – 30/06/17	Discharge period		TRC well ID
				From	To	
9970-1	KA9	KW2	32,499.5	01/07/2016	30/06/2017	GND1412
	KA1/7/19/20	KA1	-	-	-	GND1683
	KA1/7/19/20	KA7	-	-	-	GND1684
Total			32,499.5	-	-	-

Table 7 Summary of historical injection activity 2012-2017

Deep well injection undertaken at the KA9 wellsite via the KW-2 injection well					
Year	Annual volume ($m^{3)}$	Max. injection volume	Maximum injection rate	Max. injection pressure	Avg. injection pressure
Consent limit	-	2,000	-	-	-
2016-2017	32,500	584	-	63	42
2015-2016	35,830	489	73	61	44
2014-2015	43,014	617	-	60	45
2013-2014	62,648	890	164	66	38
2012-2013	62,228	790	147	65	47

Table 8 Summary of historical injection volumes since 2012

Period	Total volume discharged (m^3)	Period	Total volume discharged (m^3)
2015-2016	35,830	**2010-2011**	70,749*
2014-2015	43,014	**2009-2010**	70,749*
2013-2014	62,648	**2008-2009**	206,233
2012-2013	62,228	**2007-2008**	196,376
2011-2012	70,750*	**2006-2007**	169,621

*Note *=volume was reported from 2009-2012 (212,248 m^3) so total has been averaged over the three year period.*

The data presented in Table 7 and Table 8 shows that the maximum and average injection pressures have remained similar to those from previous years and the volume of fluid being injected has decreased significantly since 2006. The injection data for the monitoring period is presented graphically in Figure 4 and Figure 5. The daily volume and maximum daily injection pressures over the entire data record for the KW-2 well are presented in Figure 6 and Figure 7.

The data presented shows that the Company conducted their injection operations well within consented injection limits during the review period. A visual assessment of the historical data suggests that maximum well head pressures and the daily volume injected have remained relatively stable over time indicating the continuing ability of the formation to accept fluids.

The highest maximum injection pressure (62.9 bar) during the monitoring period was recorded on 29 October 2016 and the maximum daily injection volume (584 m^3) was recorded on 29 March 2017.

The highest historical maximum injection pressure (66.1 bar) was recorded on 11 April 2014 and the highest daily volume (890 m^3) was recorded 23 December 2013.

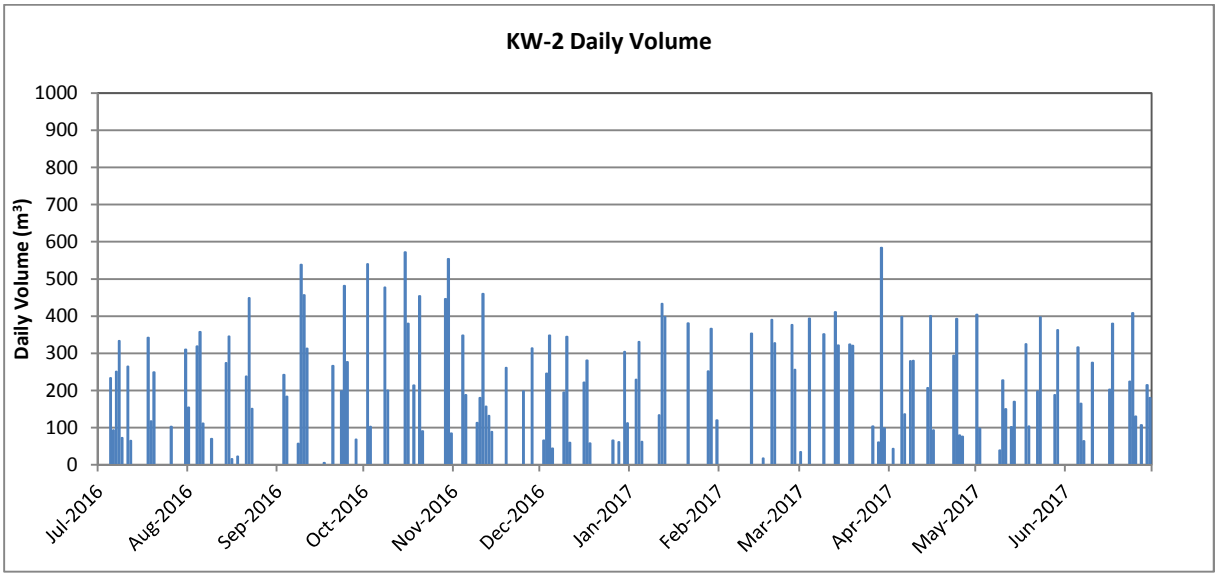

Figure 4 Total daily injection volume KW-2 well (2016-2017)

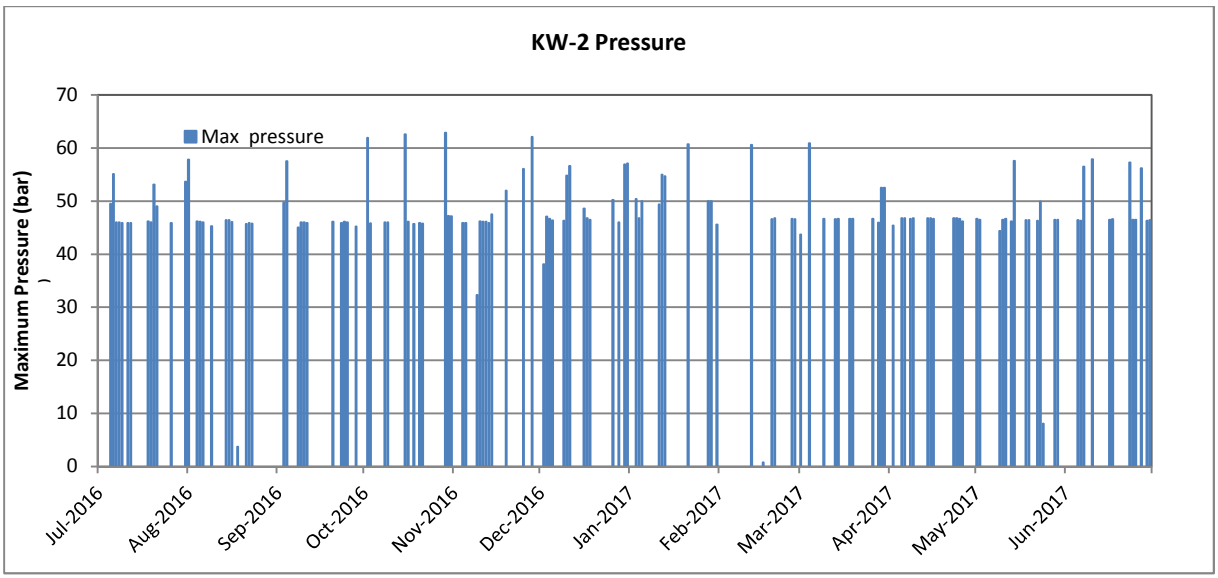

Figure 5 Maximum daily injection pressure KW-2 well (2016-2017)

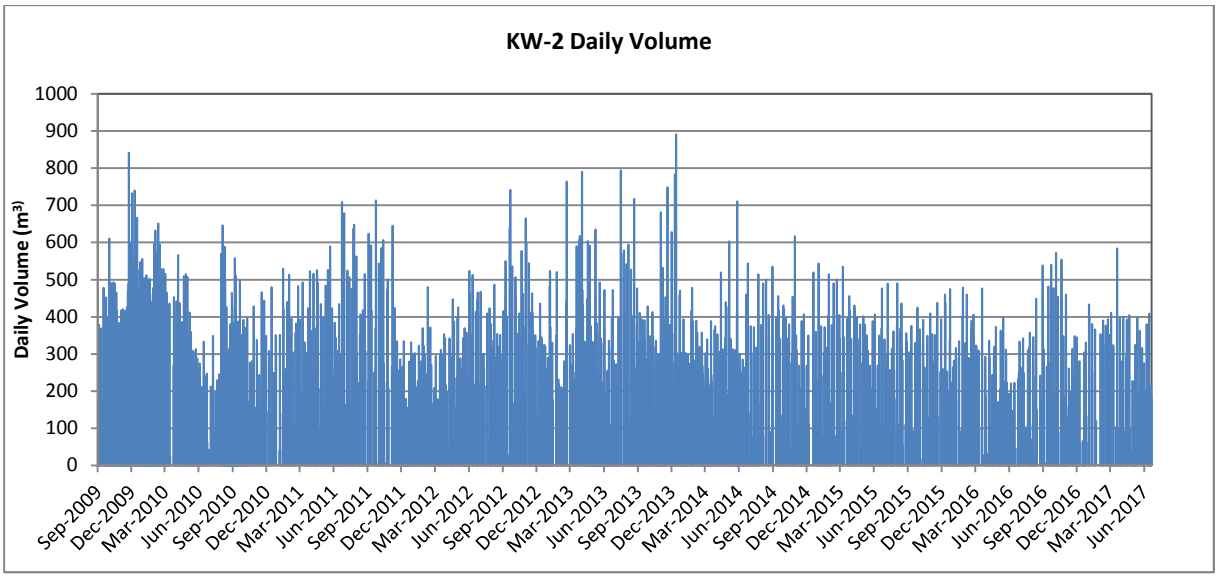

Figure 6 Total daily injection volume KW-2 well (2009-2017)

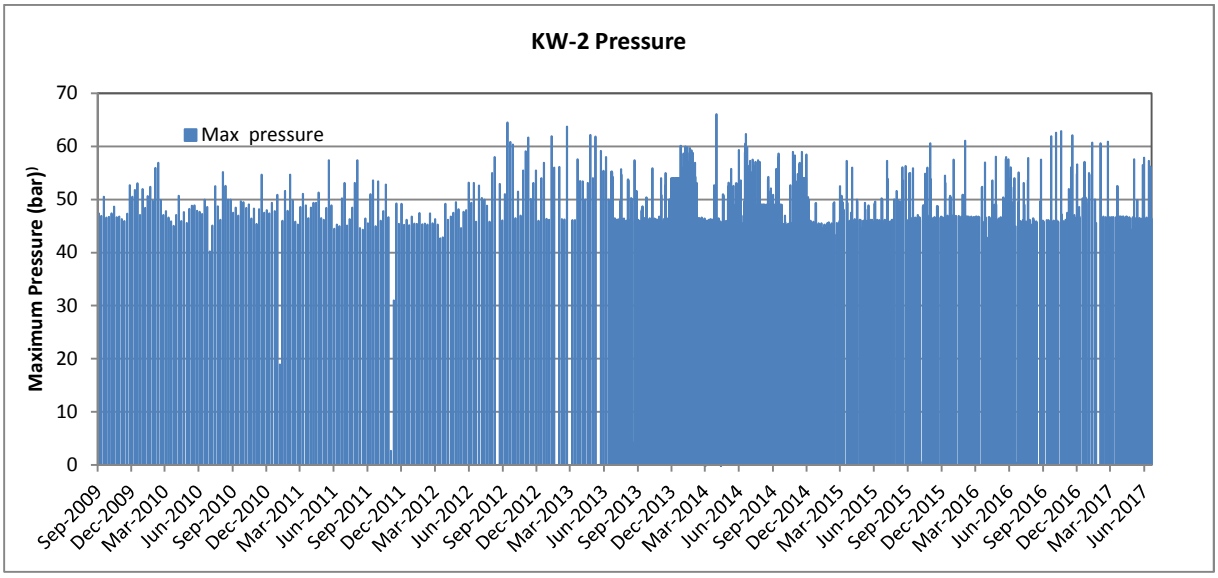

Figure 7 Maximum daily injection pressure KW-2 well (2009-2017)

2.5. 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 causes 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 2016-2017 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

During the period under review, the Company exercised one resource consent for the injection of fluids by DWI (9970-1). Consent 9970-1 authorises the injection of fluids into the Matemateaonga Formation via the KW-2 well and into the Mangahewa Formation via the KA-01 and KA-07 wells. The only well to be utilised during the monitoring period was the KW-2 well, which is located at the KA9 wellsite.

Injection wells are fitted with engineering controls and in built safety systems to protect the wellbore against any process or subsurface related failures. In the event of any sudden pressure losses or increases, safety systems isolate the wellbore and shut down the injectate pumping system.

The operation of the injection well is monitored by Company staff, with automated systems recording the injection data required under the conditions of their consent. Throughout the monitoring period this data was submitted to the Council at the specified frequency.

A review of the 2016-2017 injection data provided by the Company shows that a total of 32,500 m^3 of fluid was injected under consent 9970-1. The data also shows that the maximum daily volume injected was 584 m^3. This occurred on 29 March 2017 and is well below the consented limit of 2,000 m^3/day. The maximum daily injection pressure of 62.9 bar was recorded on 29 October 2016.

Historically, although the annual volume of injection has reduced, daily injection volumes and maximum pressures have remained relatively stable indicating the continued ability of the formation to accept fluids.

Routine inspections of the Company's wellsites conducted during the period under review found them to be in good condition and being well managed. The Council was not required to enter any incidents in relation to the exercising of the Company's DWI consent during the review period, nor were any complaints received from the public in relation to this consent.

3.2. Environmental effects of exercise of consents

No adverse environmental effects have been recorded by the Council in relation to the DWI consent exercised by the Company.

The groundwater monitoring component of this programme continued during the period under review, with two samples being taken from five monitoring sites. The results of the monitoring carried out show that the groundwater composition at each site has remained stable. Some very minor fluctuations in analyte concentrations are attributable to seasonal variations in water composition and standard sampling variability. There is no evidence to suggest that injection activities undertaken by the Company during the review period have had any adverse effect on local groundwater quality.

Compliance with the conditions of the Company's DWI consent exercised during the 2016-2017 monitoring period is summarised below in Section 3.3.

3.3. Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Table 9.

Table 9 Summary of performance for consent 9970-1

Purpose: *To discharge waste fluids, associated with hydrocarbon exploration and production by deep well injection, into the Matemateaonga Formation via the KW-2 well, or into the Mangahewa Formation via wells KA-01 and/or KA-07 as a contingency*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. The volume of fluid injected shall not exceed 200 cubic metres per day	Review and analysis of injection data	Yes
2. By 1 January 2015, the consent holder shall submit an "Injection Operation Management Plan	Receipt of satisfactory "Injection Operation Management Plan," by 1 January 2015	Yes
3. Injection well, geological and operational data submission requirements. This information can be included in the "Injection Operation Management Plan"	Receipt of satisfactory information by 1 January 2015	Yes
4. No injection permitted after 1 June 2024	Assessment of injection records and site inspection notices	N/A
5. The consent holder shall at all times adopt the best practicable option	Assessment of consent holder records and site inspection notices	Yes
6. No injection of fluids above 1,200 m bgl	Review of "Water Flooding Operation Management Plan," well construction log and injection data	Yes
7. Before Contingency wells are utilised, an "Injection Operation Management Plan" specific to the well being utilised must be provided to the Council	Receipt of satisfactory "Injection Operation Management Plan	N/A
8. The consent holder shall ensure that the exercise of this consent does not result in the fracturing of the geological seals confining the injection zone	Assessment of injection records and results of groundwater sampling and analysis programme	Yes

Purpose: *To discharge waste fluids, associated with hydrocarbon exploration and production by deep well injection, into the Matemateaonga Formation via the KW-2 well, or into the Mangahewa Formation via wells KA-01 and/or KA-07 as a contingency*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
9. The consent holder shall ensure that the exercise of this consent does not result in contaminants reaching any useable fresh water (groundwater or surface water)	Assessment of injection records and results of groundwater sampling and analysis programme	Yes
10. Only the listed fluids may be discharged	Receipt and assessment of injection data	Yes
11. These are the only other fluids that may be injected apart from those listed in condition 10	Receipt and assessment of injection data	Yes
12. Consent holder shall keep daily injection records	Receipt and assessment of injection data	Yes
13. Maintain records an undertake analysis to characterise each type of waste arriving on-site for discharge	Receipt and assessment of injection data	Yes
14. If analysis required by condition 13 is not carried out in an IANZ laboratory, it shall be undertaken in accordance with a Quality Assurance Plan certified by the Council	Receipt and assessment of injection data	Yes
15. The data required by conditions 12 & 13 above, for each calendar month, is required to be submitted by the 28th day of the following month	Receipt of satisfactory data by the date specified	Yes
16. The consent holder shall undertake a programme of sampling and testing (the 'Monitoring Programme') that monitors the effects of the exercise of this consent on fresh water resources	Monitoring Programme submitted to the Chief Executive, Taranaki Regional Council, for certification before 1 June 2013,	Yes

Purpose: *To discharge waste fluids, associated with hydrocarbon exploration and production by deep well injection, into the Matemateaonga Formation via the KW-2 well, or into the Mangahewa Formation via wells KA-01 and/or KA-07 as a contingency*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
17. All groundwater samples taken for monitoring purposes shall be taken in accordance with recognised field procedures and analysed for: a. pH; b. conductivity; c. chloride; and d. total petroleum hydrocarbons	Implementation of Groundwater Monitoring Programme and assessment of results	Yes
18. All groundwater sampling and analysis shall be undertaken in accordance with a Sampling and Analysis Plan, which shall be submitted to the Chief Executive, Taranaki Regional Council for review and certification before the first sampling is undertaken	Receipt of Sampling and Analysis Plan prior to first round of sampling being undertaken	Yes
19. The consent holder shall provide to the Council, before 31 August each year, a summary of all data collected and a report detailing compliance with consent conditions over the previous 1 July to 30 June period	Receipt of satisfactory report by 31 August each year	Yes
20. Lapse Clause	Receive notice of exercise of consent	Yes
21. Consent review clause	N/A	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**

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

Table 10 Evaluation of environmental performance over time

Year	Consent number	High	Good	Improvement required	Poor
2015-2016	1336*	-			
	9970	1			
2014-2015	1336	1			
	9970	1			
2013-2014	1336	1			
2012-2013	1336	1			
2009-2012	1336	1			
2006-2009	1336	-	1		
Totals		6	1		

*Note *No injection undertaken*

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

3.4. Recommendations from the 2015-2016 Annual Report

In the 2015-2016 Annual Report, it was recommended:

1. THAT the range of monitoring carried out during the 2015-2016 period be continued during the 2016-2017 monitoring period.
2. THAT the Council notes there is no requirement at this time for a consent review to be pursued or grounds to exercise the review options.

The recommendations above were implemented during the period under review.

3.5. Alterations to monitoring programmes for 2017-2018

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 the range of monitoring carried out during the 2016-2017 period be continued during the 2017-2018 monitoring period.

Recommendations to this effect are included in Section 4 of this report.

3.6. Exercise of optional review of consent

Resource consent 9970-1 provides for an optional review of the consent in June 2018. Condition 21 allows the Council to review the consent, if there are grounds that the conditions are not adequate to deal with any adverse effects on the environment arising from the exercise of the resource consent, which were either not foreseen at the time the application was considered or which was not appropriate to deal with at the time.

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

4. Recommendations

1. THAT the range of monitoring carried out during the 2016-2017 period be continued during the 2017-2018 monitoring period.
2. THAT the Council notes there is no requirement at this time for a consent review to be pursued or grounds to exercise the review options.

Glossary of common terms and abbreviations

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

Aquifer (freshwater)	A formation, or group or part of a formation that contains sufficient saturated permeable media to yield exploitable quantities of fresh water.
BPO	Best practicable option
Conductivity	A measure of the level of dissolved salts in a sample. Usually measured at 20°C and expressed as millisiemens per metre (mS/m) or as Total Dissolved Solids (g/m3).
Confining layer	A geological layer or rock unit that is impermeable to fluids.
Deep well injection (DWI)	Injection of fluids at depth for disposal or enhanced recovery.
Fracture gradient	A measure of how the pressure required to fracture rock in the earths crust changes with depth. It is usually measured in units of "pounds per square inch per foot" (psi/ft) and varies with the type of rock and the strain of the rock.
g/m^3	Grams per cubic metre. A measure of concentration which is equivalent to milligrams per litre (mg/L), or parts per million (ppm).
Hydraulic fracturing (HF)	The process of increasing reservoir permeability by injecting fluids at pressures sufficient to fracture rock within the reservoir ("fracking").
Injectate	Fluid disposed of by deep well injection.
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.
IR	Unauthorised Incident Register – contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
L/s	Litres per second.
m bgl	Metres below ground level.
M bmp	Metres below measuring point.
mS/m	Millisiemens per metre.
m TVD	Metres true vertical depth
m^3	Cubic metre.

pH	Numerical system for measuring acidity in solutions, with 7 as neutral. Values lower than 7 are acidic and higher than 7 are alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Produced water	Water associated with oil and gas reservoirs that is produced along with the oil and gas. Typically highly saline with salt concentrations similar to seawater and containing low levels of hydrocarbons.
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
UI	Unauthorised Incident.
Water flooding	A method of thermal recovery in which hot water is injected into a reservoir through specially distributed injection wells. Hot water flooding reduces the viscosity of the crude oil, allowing it to move more easily toward production wells.

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Appendix I

Resource consents held by Shell Todd Oil Services Limited

(For a copy of the signed resource consent
please contact the TRC Consents 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:	Shell Todd Oil Services Limited Private Bag 2035 New Plymouth 4342
Decision Date:	07 October 2014
Commencement Date:	07 October 2014

Conditions of Consent

Consent Granted:	To discharge waste fluids, associated with hydrocarbon exploration and production by deepwell injection, into the Matemateaonga Formation via the KW-2 well, or into the Mangahewa Formation via wells KA-01 and/or KA-07 as a contingency
Expiry Date:	01 June 2029
Review Date(s):	June annually
Site Location:	KW-2 wellbore at KA09 wellsite, 83 Lower Duthie Road, Kapuni KA01/KA07 wellsite, 360 Palmer Road, Kapuni
Legal Description:	Lot 1 DP 11291 Pt Sec 14 Blk XVI Kaupokonui SD (Discharge source & site)(KA09) Lots 1 & 2 DP 11138 Blk XVI Kaupokonui SD (Discharge source & site)(KA01/KA07)
Grid Reference (NZTM)	1702850E - 5629709N (KA09) 1701152E - 5630141N (KA01/KA07)
Catchment:	Inaha (KA09) Kapuni (KA01/KA07)

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

General condition

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

Special conditions

1. The volume discharged into the wellbore shall not exceed 2,000 cubic metres per day.

2. By 1 January 2015, the consent holder shall submit an "Injection Operation Management Plan". The plan shall include the operational details of the injection activities and identify the conditions that would trigger concerns about the integrity of the injection well, the receiving formation or overlying geological seals. The plan shall also detail the action(s) to be taken by the consent holder if trigger conditions are reached.

3. Before exercising this consent, the consent holder shall provide to the Chief Executive, Taranaki Regional Council:

   (a) a geological assessment of the environment in which the well is located, including the injection zone, the geological seals confining the injection zone and any associated faulting;
   (b) details of the injection well design and its structural integrity;
   (c) an assessment of the suitability of the injection well for the proposed activity;
   (d) details of how the integrity of the injection well will be monitored and maintained; and
   (e) confirmation of the depth to which fresh water resources, as defined in condition 9, are encountered below the site.

   (Note: The information required by condition 3 may be included within the "Injection Operation Management Plan" required by condition 2).

4. There shall be no injection of any fluids after 1 June 2024.

5. 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.

6. Fluids shall be injected at a minimum depth of 1,200 mbgl.

7. Before either contingency back-up wells (KA-01 and/or KA-07) are utilised for injection purposes, the consent holder must provide to the Chief Executive, Taranaki Regional Council an Injection Operation Management Plan specific to the well to be used, which includes all information required by condition 3.

8. The consent holder shall ensure that the discharge authorised by this consent does not result in the fracturing of the geological seals confining the injection zone.

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

10. Only the following types of fluid may be discharged:

    (a) produced water;
    (b) hydraulic fracturing and return fluids;
    (c) well workover fluids;
    (d) well servicing and intervention fluids;
    (e) well drilling fluids;
    (f) production chemicals
    (g) production sludges;
    (h) contaminated stormwater; and
    (i) other fluids in accordance with condition 11 below.

11. The fluids discharged under this consent shall only be those listed in condition 10(a) to 10(h) above, and other fluids that:

    (a) Can reasonably be expected to be used in petrochemical well maintenance and development in accordance with industry best practice;
    (b) Have environmental effects that are no more adverse than those listed in 10(a)–10(h) above;
    (c) Have been certified by the Chief Executive, Taranaki Regional Council as complying with 11(a) and 11(b) above; and
    (d) Have been the subject of a specific request for certification, in accordance with 11(c) above, that includes details of the proposed contaminant.

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

    (a) injection hours;
    (b) volume of fluid discharged; and
    (c) maximum and average injection pressure.

13. For each waste stream arriving on site for discharge, the consent holder shall characterise the fluids by recording the following information:

    (a) type of fluid (as listed in condition 10);
    (b) source of fluid (site name and company);
    (c) an analysis of a representative sample of the fluid for:
        (i) pH;
        (ii) conductivity;
        (iii) suspended solids concentration;
        (iv) temperature;
        (v) salinity;
        (vi) chloride concentration; and
        (vii) total hydrocarbon concentration.

    (Note: The analysis required by condition 13 above is not necessary if a sample of the same type of fluid, from the same source, has been taken, analysed and provided to the Chief Executive, Taranaki Regional Council within the previous 6 months).

14. If the analysis required by condition 13 above is not carried out in an International Accreditation New Zealand (IANZ) accredited laboratory, it shall be undertaken in accordance with a "Quality Assurance (QA) Plan" that has been certified by the Chief Executive, Taranaki Regional Council, as meeting the requirements of condition 13. The Council may also, at its discretion, carry out an audit of the consent holder's sampling and analysis regime to assess adherence to the QA plan.

15. The information required by conditions 12 and 13 above, for each calendar month, shall be provided to the Chief Executive, Taranaki Regional Council before the 28th day of the following month.

16. The consent holder shall undertake a programme of sampling and testing that monitors the effects of the exercise of this consent on fresh water resources within an Area of Review (AoR) to assess compliance with condition 9 (the 'Monitoring Programme'). The Monitoring Programme shall be designed to characterise local groundwater quality, and be submitted to the Chief Executive, Taranaki Regional Council, for certification before the exercising of this consent, and shall include:

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

    The AoR shall extend 1,000 metres from the point of injection. It is a requirement that at least one suitable monitoring bore be located within 500 metres of the injection well. If no suitable existing bores are available, it will be necessary for the Monitoring Programme to include installation of, and sampling from, a suitable bore. The bore would be of a depth, location and design determined after consultation with the Chief Executive, Taranaki Regional Council and installed in accordance with NZS 4411:2001.

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

    (a) pH;
    (b) conductivity;
    (c) chloride; and
    (d) total petroleum hydrocarbons.

    Note: *The samples required, under conditions 16 and 17, could be taken and analysed by the Taranaki Regional Council or other contracted party on behalf of the consent holder.*

18. All groundwater sampling and analysis shall be undertaken in accordance with a *Sampling and Analysis Plan*, which shall be submitted to the Chief Executive, Taranaki Regional Council for review and certification before the first sampling is undertaken. This Plan shall specify the use of standard protocols recognised to constitute good professional practice including quality control and assurance. An IANZ accredited laboratory shall be used for all sample analysis. Results shall be provided to the Chief Executive, Taranaki Regional Council within 30 days of sampling and shall include supporting quality control and assurance information.

    Note: *The Sampling and Analysis Plan may be combined with the Monitoring Programme required by condition 16.*

19. The consent holder shall provide to the Chief Executive, Taranaki Regional Council, before 31 August each year, a summary of all data collected and a report detailing compliance with consent conditions over the previous 1 July to 30 June period. Based on the data provided, the report shall also provide:

    a) A summary of injection activities over the period being reported;
    b) an assessment of injection well performance;
    c) an assessment of the on-going integrity and isolation of the wellbore; and
    d) an assessment of the on-going integrity and isolation of the receiving formation.

20. This consent shall lapse on 31 December 2019, 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.

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

Signed at Stratford on 07 October 2014

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Appendix II

Groundwater Sampling Results

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Wellington 6011
PO Box 27277
Wellington 6141
New Zealand
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26 September 2016

Adam Wood
Environmental Advisor
Shell Todd Oil Services Limited
Private Bag 2035
New Plymouth 4342

Dear Adam

STOS Kapuni - Third Party Abstraction Wells - Groundwater Monitoring Event August 2016

1.0 Terms of Reference

This letter has been prepared for Shell Todd Oil Services Ltd (STOS) by AECOM Consulting Services (NZ) Ltd (AECOM) in accordance with the proposal dated 5 July 2012 and subsequent variations. It documents the findings of the tenth groundwater monitoring event (GME) completed at four, third party abstraction wells, located within the Kapuni area – M Barr, 873 Skeet Road (Site 1); PKW Farms, 468 Hastings Road (Site 2); Kiley Estate, Inuawai Road (Site 3); and Naplin Trust, Ahipaipa Road (Site 4). It also presents the findings of the fourth GME completed at the former emergency bore located at the STOS KA9 well site, which is the location of STOS produced water re-injection well, KW-2.

2.0 Objective and Background

The objective of the groundwater monitoring is to assess groundwater quality in the subject wells located in the Kapuni area.

Nine previous GMEs of the third party abstraction wells have been completed. The dates and report references of the GMEs are provided in **Table 1** below.

Table 1 STOS Kapuni - Third Party Abstraction Wells GMEs

Date(s)	Report Reference
19 December 2012	Letter report to STOS, dated16 April 2013 and entitled STOS Kapuni – Third Party Abstraction Well - Groundwater Monitoring
2 May 2013	Letter report to STOS, dated 12 June 2013 and entitled STOS Kapuni – Third Party Abstraction Well - Groundwater Monitoring Event May 2013
30 July 2013	Letter report to STOS, dated 20 September 2013 and entitled STOS Kapuni – Third Party Abstraction Well - Groundwater Monitoring Event July 2013
13 November 2013	Letter report to STOS, dated 19 December 2013 and entitled STOS Kapuni – Third Party Abstraction Well - Groundwater Monitoring Event November 2013
10 February 2014	Letter report to STOS, dated 29 April 2014 and entitled STOS Kapuni – Third Party Abstraction Wells - Groundwater Monitoring Event February 2014
12 August 2014	Letter report to STOS, 19 November 2014 and entitled STOS Kapuni – Third Party Abstraction Wells - Groundwater Monitoring Event August 2014
30 January and 23 March 2015	Letter report to STOS, 29 June 2015 and entitled STOS Kapuni – Third Party Abstraction Wells - Groundwater Monitoring Event January and March 2015
20 August 2015	Letter report to STOS, 10 September 2015 and entitled STOS Kapuni – Third Party Abstraction Wells – Groundwater Monitoring Event August 2015
4 February 2016	Letter report to STOS, 10 March 2016 and entitled STOS Kapuni – Third Party Abstraction Wells – Groundwater Monitoring Event February 2016

This current letter report presents the results of the GME completed at the four, third party abstraction wells and the former emergency bore at the STOS KA9 well site on 16 August 2016.

The four abstraction wells monitored are located at the following third party sites:

- Site 1 – M Barr, 873 Skeet Road

- Site 2 – PKW Farms, 468 Hastings Road
- Site 3 – Kiley Estate, Inuawai Road
- Site 4 – Naplin Trust, Ahipaipa Road

The former emergency bore (Site KA9-EB) is located at the STOS KA9 well site off Lower Duthie Road (Rapid #83).

The location of each site is shown on **Figure 1** (attached).

3.0 Scope of Works

The groundwater monitoring comprised the following scope of works:

- Purging and collection of groundwater samples from the third party wells and the former emergency bore.
- Laboratory analysis of groundwater samples.
- Preparation of this factual letter report.

4.0 Sampling Methodology

Groundwater samples were collected from the four third party wells and KA9-EB on 16 August 2016. The sampling methodology for each site is summarised in the attached appendices as follows:

- **Appendix A** – Site 1 (M Barr, 873 Skeet Road)
- **Appendix B** – Site 2 (PKW Farms, 468 Hastings Road)
- **Appendix C** – Site 3 (Kiley Estate, Inuawai Road)
- **Appendix D** – Site 4 (Naplin Trust, Ahipaipa Road)
- **Appendix E** – Site KA9-EB (STOS KA9 well site, Lower Duthie Road)

The groundwater sample collected from Site 1 was collected directly from a tap attached to a secondary storage tank housed in a pump house close to the well. Groundwater samples collected from Site 2, Site 3 and Site 4 were collected from sampling ports close to the wellhead of each abstraction well. The groundwater sample collected from Site KA9-EB was collected using a down hole bladder pump.

Field sampling records for each site are attached.

4.1 Groundwater Sample Collection and Analysis

Groundwater samples were collected directly into laboratory supplied sample bottles. The samples were kept under chilled conditions and transported to Hill Laboratories Limited (Hill Laboratories) under standard chain of custody procedures.

Groundwater samples were analysed for the following:

- pH
- Conductivity
- Chloride
- Total petroleum hydrocarbons (TPH)
- Benzene, toluene, ethylbenzene, and xylenes (BTEX) (Site KA9-EB only)

Chain of custody documents and the laboratory report as received are attached.

4.2 Quality Assurance/Quality Control (QA/QC)

For quality assurance/quality control (QA/QC) purposes, a trip blank sample (identified as MWY), and duplicate sample (identified as MWX) from KA-9-EB (for BTEX) and Site 3 (for TPH), were collected during the GME.

The trip blank sample was prepared in the laboratory with deionised water, prior to bottles being shipped.

The duplicate sample was collected directly into laboratory supplied jars, chilled and transported to Hill Laboratories under AECOM chain of custody procedures. The trip blank and duplicate samples were analysed for TPH and BTEX.

Chain of custody documents and the laboratory report as received are attached.

5.0 Groundwater Sample Results

5.1 Third Party Sites (Sites 1 to 4)

The groundwater analysis results for the August 2016 monitoring event for each third party site have been tabulated and are presented in the site specific appendices attached. Results for the February 2016, August 2015, January 2015, August 2014, February 2014, November 2013, July 2013, May 2013 and December 2012 monitoring events are included in the tables for these sites.

General Groundwater Parameters

General baseline groundwater parameters for groundwater samples collected from the third party wells in August 2016 were similar to results from the February 2016, August 2015, January 2015, August 2014, February 2014, November 2013, July 2013, May 2013 and December 2012 monitoring events.

Activity Parameters

Concentrations of TPH were not detected above laboratory method detection limits (MDLs) in the groundwater samples collected from any of the third party abstraction wells sampled during the August 2016 monitoring event.

The results do not indicate contamination of third party abstraction wells by hydrocarbons or other contaminants of concern.

5.2 Site KA9-EB

General Groundwater Parameters

General baseline groundwater parameters for the groundwater sample collected from Site KA9-EB in August 2016 were similar to the results from the February 2016, August 2015 and March 2015 monitoring events.

Activity Parameters

Concentrations of TPH and BTEX were not detected above MDLs in the groundwater sample collected from Site KA9-EB. The results are similar to the results from the February 2016, August 2015 and March 2015 monitoring events, during which only trace concentrations of toluene and no TPH or other BTEX compounds were detected.

5.3 QA/QC Results

The QA/QC results for Sites 1 to 4 and Site KA9-EB have been tabulated and are attached. The following points are noted:

- Concentrations of TPH and BTEX were not detected above the laboratory MDLs in the trip blank sample.
- Concentrations of TPH were not detected above MDLs in the duplicate groundwater sample collected from Site 3.
- Concentrations of BTEX were not detected above MDLS in the duplicate groundwater sample collected from KA9-EB.

The QA/QC results are considered to meet the data quality objectives for this investigation.

6.0 Summary

The results of the GME completed for the four, third party abstraction wells in August 2016 do not indicate contamination of the deep abstraction wells by hydrocarbons or any other contaminants of concern. The results of the August 2016 monitoring event are consistent with the results of the February 2016, August 2015, January 2015, August 2014, February 2014, November 2013, July 2013, May 2013 and December 2012 monitoring events.

The results of the GME completed for the former emergency bore at Site KA9-EB in August 2016 indicate that no TPH or BTEX compounds are present at detectable concentrations in the bore. The results are similar to the results from the February 2016, August 2015 and March 2015 monitoring events, during which only trace concentrations of toluene and no TPH or other BTEX compounds were detected.

7.0 Closure

We trust that this report meets your requirements. Please do not hesitate to contact AECOM if you wish to discuss the results.

Yours sincerely

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encl: Limitations
Figure 1 - Site Location Plan
Groundwater Sampling Sheets
Laboratory Analytical Results and Chain of Custody Documentation
QA/QC Table

Appendices

Appendix A – Site 1 (M Barr, 873 Skeet Road)
Appendix B – Site 2 (PKW Farms, 468 Hastings Road)
Appendix C – Site 3 (Kiley Estate, Inuawai Road)
Appendix D – Site 4 (Naplin Trust, Ahipaipa Road)
Appendix E – Site KA9-EB (Former Emergency Bore), STOS KA9 Well Site (Lower Duthie Road)

Limitations

All information in this report is provided strictly in accordance with and subject to the following limitations and recommendations:

a. This letter should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by AECOM for use of any part of this letter in any other context.

b. Conclusions are based solely on the information and findings contained in this letter.

c. Conclusions are based solely on the scope of work agreed between AECOM and Shell Todd Oil Services Limited and described in Section 3 ("Scope of Works") of this letter.

d. This letter is based on the conditions encountered during the site monitoring conducted, and information reviewed, between August and September 2016. AECOM accepts no responsibility for any events arising from any changes in site conditions or in the information reviewed that have occurred after the completion of the site monitoring.

e. The investigations carried out for the purposes of the letter have been undertaken, and the letter has been prepared, in accordance with normal prudent practice and by reference to applicable environmental regulatory authority and industry standards, guidelines and assessment criteria in existence at the date of this letter.

f. Where this letter indicates that information has been provided to AECOM by third parties, AECOM has made no independent verification of this information except as expressly stated in the letter. AECOM assumes no liability for any inaccuracies in or omissions to that information.

g. AECOM has tested only for those chemicals specifically referred to in this letter. AECOM makes no statement or representation as to the existence (or otherwise) of any other chemicals.

h. A site which appears to be unaffected by contamination at the time the letter was prepared may later, due to natural phenomena or human intervention, become contaminated.

i. Except as specifically stated above, AECOM makes no warranty, statement or representation of any kind concerning the suitability of the site for any purpose or the permissibility of any use, development or re-development of the sites.

j. This letter has been prepared for the sole benefit of Shell Todd Oil Services Limited. Except as required by law, no third party may use or rely on this letter unless otherwise agreed by AECOM in writing. Where such agreement is provided, AECOM will provide a letter of reliance to the agreed third party in the form required by AECOM.

k. To the extent permitted by law, AECOM expressly disclaims and excludes liability for any loss, damage, cost or expenses suffered by any third party relating to or resulting from the use of, or reliance on, any information contained in this letter. AECOM does not admit that any action, liability or claim may exist or be available to any third party.

Figure 1 – Site Location Plan

Issue Status: FINAL

Last saved by: sergey.sokolov (22/09/2016) Last Ploted: 22/09/2016
Filename: \\nzwlg1fp001.au.aecomnet.com\projects\605X\60515579\4. Tech work Area\4.99 GIS\02_Maps\Site_Locations.mxd Project Management Initials: Designer: SS Checked: SL Approved: SL

THIRD PARTY WELL MONITORING
SITE LOCATION PLAN
SHELL TODD OIL SERVICES LIMITED (STOS)
Project No.:60515579 Date: 16/08/2016

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Figure: 1

Groundwater Sampling Sheets

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FQM - Groundwater Sampling and Purging Record

Q4AN(EV)-405-FM1

KA9-EB

Project Name:	Kapuni FB Monitoring	Project Number:	60515579	FW Name:	Sean Hodgers	Sample Date:	16/8/16
Client:	Stos	Project Location:	KA9; 3rd party wells	Field Work Staff:	SH, KS	Well Development or Well Sampling Event? (circle)	

General Bore Information		Parameter Info	Decontamination	Sampling Method	Hydrasleeve info	
Date of GW Level: 16/8/16	Bore Radius (mm): ~~100~~ UNK	Chem Kit Serial No.:	☑ Decontaminated	☑ Low Flow Pump, rate: 0.15	Hydrasleeve Size:	Monitoring sequence followed (number in and out):
Depth to GW (m-pvc): 13.12	Screen Interval (m): UNK	Chem Kit Model:	☐ Dedicated	Intake depth: 16m	Hydrasleeve Type:	
Bore Depth (m-pvc): 36.70	Casing Radius (mm): 100	Corrected Redox: Y / N	☑ Disposable	☐ Bailer ☐ Hydrasleeve	Sampling Depth (m-pvc):	Gauging
Depth to Product (m-pvc): —	Cover Type (gatic tick etc):	(The correction to apply is probe dependent)	☐ Other (specify)	☐ Peristaltic Pump ☐ Waterra	Hydrasleeve Install time:	Hydrasleeve in
Product Thickness (m): —	Bore Locked (YES/NO):	Parameter method: ☑ Downhole		☑ Other (specify) bladder	Sampling Start Time:	Hydrasleeve out
	Key Type (if applicable):	☐ Retrieved				Parameters

Calculated bore volume (L):	Includes/ excludes bore annulus (circle)	# purge volumes removed:	Total purged volume (L): 3.0

Water Quality Parameters

Time	Cumulative Vol. Removed (L)	SWL (m-pvc)	Pump Rate	DO (ppm or mg/L)	E.C. (mS/cm or µS/cm)	pH	Redox (mV)	Temp °C	Odour, Colour, Turbidity
11:44	0.3	13.18	0.15	~~6.9~~	~~572~~	~~7.57~~	~~72.0~~	~~13.2~~	clear, NVO
11:52	0.6	13.22	↓	6.9	573.4	7.57	72.0	13.2	" "
11:54	0.9	13.22		6.5	572.7	7.58	65.6	13.2	"
11:56	1.2	13.22		6.9	573.2	7.59	59.0	13.1	"
11:58	1.5	13.22		6.8	570.4	7.60	52.9	13.4	"
12:00	1.8	13.22		6.9	569.0	7.60	47.9	13.6	"
12:02	2.1	13.22		7.2	568.4	7.60	40.7	13.8	"
12:04	2.4	13.22		7.4	568.3	7.60	33.9	14.1	"
12:06	2.7	13.22		7.7	568.8	7.60	26.9	14.4	"
12:08	3.0	13.22	↓	7.9	569.8	7.60	20.8	14.5	"
Acceptable Parameter Range:				± 10%	± 3%	0.05	± 10 mV	± 0.2 °C	± 10% turbidity (if using turbidity meter)

Analytes Sampled for:		Bottles Collected			QA/QC Information	Field Comments
Field Filtered:	Unfiltered:	x 40 mL Vial (HCl)	x 60 mL Ferrous	x 60 mL metals (HNO_3)	2 x BTEX (40) "MWX"	Bore volume calculation, bore condition, fate of tubing, redox correction etc
X	TPH BTEX, pH EC, (~~NH~~)	x 40 mL Vial (H_2SO_4)	x 100 mL Amber	x 250 mL Plastic		0.0 ppm headspace; head loss Stabilised at 10 cm below Stat50 water level, but began to drop during sampling (after TPH/BTEX and MWX, before UP1L)
		1 TPH 250	2 BTEX (40)			
		1 Unpres 500mL				

Authorisation and Distribution

Fieldwork Staff Signature — Date: 16/8/16

Checker Name and Signature — Date: 29/8/16

Project Manager Signature — Date: 29/8/16

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FQM - Groundwater Sampling and Purging Record

Site 1

Q4AN(EV)-405-FM1

Project Name:	Kurri Kurri FB Monitoring	**Project Number:**	60515579	**FM Name:**	Sean Hudgens	**Sample Date:**	16-8-16
Client:	STOS	**Project Location:**	3rd Party wells	**Fieldwork Staff:**	SH, KS	**Well Development or Well Sampling Event? (circle)**	

General Bore Information				Parameter Info	Decontamination	Sampling Method	Hydrasleeve Info		Sequence followed (number in order):
Date of GW Level:	—	Bore Radius (mm):		Chem Kit Serial No.:	Decontaminated	Low Flow Pump rate: 20L/min	Hydrasleeve Size:		
Depth to GW (m-pvc):	—	Screen Interval (m):		Chem Kit Model:	☑ Dedicated	Intake depth:	Hydrasleeve Type:		
Bore Depth (m-pvc):	—	Casing Radius (mm):		Corrected Redox: Y / N	Disposable	Bailer / Hydrasleeve	Sampling Depth (m-pvc):		Gauging
Depth to Product (m-pvc):	—	Cover Type (gatic/stick up):		(The correction to apply is probe dependent)	Other (specify)	Peristaltic Pump / Waterra	Hydrasleeve Install time:		Hydrasleeve in
Product Thickness (m):	—	Bore Locked (YES/NO):		Parameter method: Downhole		☑ Other (specify) → Tap	Sampling Start Time:		Hydrasleeve out
		Key Type (if applicable):		☑ Retrieved					Parameters
Calculated bore volume (L):		Includes/ excludes bore annulus (circle)		# purge volumes removed:		Total purged volume (L): 160			

Water Quality Parameters

Time	Cumulative Vol. Removed (L)	SWL (m-pvc)	Pump Rate	DO (ppm or mg/L)	E.C. (mS/cm or µS/cm)	pH	Redox (mV)	Temp °C	Odour, Colour, Turbidity
13:27	—	—	—	—	—	—	—	—	Cloudy
13:29	20	—	20L/m	1.95	284.1	7.35	-39.2	12.5	" N/O, faintly yellow
13:31	40	—	"	1.09	337.6	7.03	-48.9	12.4	" N/O, faintly yellow
13:33	60	—	"	0.90	337.2	6.95	-54.7	12.4	" " "
13:35	80	—	"	0.93	336.9	6.89	-58.6	12.4	" " "
13:37	100	—	"	1.06	336.7	6.87	-61.2	12.4	" " "
13:39	120	—	"	1.34	336.7	6.86	-62.8	12.5	" " "
13:41	140	—	"	1.35	336.6	6.85	-64.0	12.5	" " "
13:43	160	—	"	1.24	337.1	6.85	-65.4	12.5	
Acceptable Parameter Range:				± 10%	± 3%	± 0.05	± 10 mV	± 0.2 °C	± 10% turbidity (if using a turbidity meter)

Analytes Sampled for:		Bottles Collected						QA/QC Information	Field Comments
Field Filtered:	**Unfiltered:**		x 40 mL Vial (HCl)		x 60 mL Ferrous		x 60 mL metals (HNO_3)		Bore volume calculation, bore condition, fate of tubing, redox correction etc
X	TPH		x 40 mL Vial (H_2SO_4)		x 100 mL Amber		x 250 mL Plastic	X	
	BTEX pH	x1	TPH 250ml	x1	Up 1L				
	EC [illegible]	x2	Vial 40ml						

Approval and Distribution

[signature]	16-8-16	[signature]	29/8/16
Fieldwork Staff Signature	**Date**	**Checker Name and Signature**	**Date**
[signature]	29/3/16		
Project Manager Signature	**Date**	**Distribution:** Project Central File	

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FQM - Groundwater Sampling and Purging Record

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Site 2

Q4AN(EV)-405-FM1

Project Name:	Kogan FB Monitoring	Project Number:	60515579	PM Name:	[illegible]	Sample Date:	16-8-16
Client:	SPOS	Project Location:	3rd Party wells	Fieldwork Staff:	SH [illegible]	Well Development or Well Sampling Event? (circle)	

General Bore Information		Parameter Info.	Decontamination	Sampling Method	Hydrasleeve Info	
Time of GW Level:	Bore Radius (mm):	Chem Kit Serial No.:	Decontaminated	Low Flow Pump rate: 2L/min	Hydrasleeve Size:	Monitoring sequence followed (number in order):
Depth to SWL (m-pvc):	Screen Interval (m):	Chem Kit Model:	☑ Dedicated	Intake depth:	Hydrasleeve Type:	
Bore Depth (m-pvc):	Casing Radius (mm):	Corrected Redox: Y / N	Disposable	Bailer / Hydrasleeve	Sampling Depth (m-pvc):	Gauging
Depth to Product (m-pvc): —	Cover Type (gatic/stickup):	(The correction to apply is probe dependent)	Other (specify)	Peristaltic Pump / Waterra	Hydrasleeve Install time:	Hydrasleeve in
Product Thickness (m): —	Bore Locked (YES/NO):	Parameter method: Downhole / ☑ Retrieved		☑ Other (specify) Tap	Sampling Start Time:	Hydrasleeve out
	Key Type (if applicable):					Parameters
Calculated bore volume (L):	Includes/ excludes bore annulus (circle)	# purge volumes removed:		Total purged volume (L): 24		

Water Quality Parameters

Time	Cumulative Vol. Removed (L)	SWL (m-pvc)	Pump Rate	DO (ppm or mg/L)	E.C. (mS/cm or µS/cm)	pH	Redox (mV)	Temp °C	Odour, Colour, Turbidity
14:07									Clear, NO
14:09	4	—	2L/m	0.22	336.1	8.39	-41.1	17.8	" "
14:11	8	—	"	0.15	336.8	8.41	-42.0	17.9	" "
14:13	12	—	"	~~[illegible]~~	337.0	8.42	-41.7	17.9	" "
14:15	16	—	"	0.13	337.3	8.42	-41.2	18.0	" "
14:17	20	—	"	0.13	337.4	8.42	-40.8	18.0	" "
14:19	24	—	"	0.12	337.4	8.42	-40.5	18.0	" "
~~14:21~~									
Acceptable Parameter Range:				± 10%	± 3%	± 0.05	± 10 mV	± 0.2 °C	± 10% turbidity (if using a turbidity meter)

Analytes Sampled for		Bottles Collected			QA/QC Information	Field Comments
Field Filtered:	Unfiltered: - TPH, - EC, Cond, pH	x 40 mL Vial (HCl)	x 60 mL Ferrous	x 60 mL metals (HNO_3)		Bore volume calculation, bore condition, fate of tubing, redox correction etc
		x 40 mL Vial (H_2SO_4)	x 100 mL Amber	x 250 mL Plastic		
		x1 TPH 250ml	x1 UP 2Lr			

Approval and Distribution

Fieldwork Staff Signature: [signature] Date: 16-8-16

Checker Name and Signature: [signature] Date: 29/8/16

Project Manager Signature: [signature] Date: 29/8/16

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FQM - Groundwater Sampling and Purging Record

Site 3

Q4AN(EV)-405-FM1

Project Name:	Kooragi FB Monitoring	Project Number:	60515579	PM Name:	Sean Hodgkins	Sample Date:	4-8-16
Client:	STCS	Project Location:	3rd Party well	Fieldwork Staff:	SH KS	Well Development or Well Sampling Event? (circle)	

General Bore Information		Parameter Info	Decontamination	Sampling Method	Hydrasleeve Info.	
Depth of GW Level:	Bore Radius (mm):	Chem Kit Serial No.:	☐ Decontaminated	☐ Low Flow Pump rate:	Hydrasleeve Size:	Monitoring sequence followed (number in order):
Depth to GW (m-pvc):	Screen Interval (m):	Chem Kit Model:	☑ Dedicated	Intake depth:	Hydrasleeve Type:	
Bore Depth (m-pvc):	Casing Radius (mm):	Corrected Redox: Y / N	☐ Disposable	☐ Bailer ☐ Hydrasleeve	Sampling Depth (m-pvc):	Gauging
Depth to Product (m-pvc):	Cover Type (gal/stick-up):	(The correction to apply is probe dependent)	☐ Other (specify)	☐ Peristaltic Pump ☐ Waterra	Hydrasleeve Install time:	Hydrasleeve in
Product Thickness (m):	Bore Locked (YES/NO):	Parameter method: ☐ Downhole		☑ Other (specify) Tap	Sampling Start Time:	Hydrasleeve out
	Key Type (if applicable):	☑ Retrieved				Parameters
Calculated bore volume (L):	Includes/ excludes bore annulus (circle)	# purge volumes removed:		Total purged volume (L):	48	

Water Quality Parameters

Time	Cumulative Vol. Removed (L)	SWL (m-pvc)	Pump Rate	DO (ppm or mg/L)	E.C. (mS/cm or µS/cm)	pH	Redox (mV)	Temp °C	Odour, Colour, Turbidity
14:39									Odour, NIL
14:41	8	—	4L/m	0.21	319.8	8.98	-46.3	16.9	" "
14:43	16	—	"	0.12	319.7	8.98	-51.9	16.8	" "
14:45	24	—	"	0.10	319.6	8.98	-58.0	16.9	" "
14:47	32	—	"	0.08	319.8	8.98	-64.0	16.9	" "
14:49	40	—	"	0.08	320.4	8.98	-69.4	16.9	" "
14:51	48	—	"	0.08	320.4	8.97	-73.8	16.9	" "
Acceptable Parameter Range:			± 10%	± 3%	± 0.05	± 10 mV	± 0.2 °C		± 10% turbidity (using a turbidity meter)

Analytes Sampled for:		Bottles Collected				QA/QC Information	Field Comments
Field Filtered:	Unfiltered:	x 40 mL Vial (HCl)	x 60 mL Ferrous	x 60 mL metals (HNO_3)		x1 TPH 250ml "MUX"	Bore volume calculation, bore condition, fate of tubing, redox correction etc.
	~~x~~ TPH pH -EC, Cond, Chlor	x 40 mL Vial (H_2SO_4)	x 100 mL Amber	x 250 mL Plastic			
		x1 TPH 250ml					
		x1 UP 1L					

Approval and Distribution

Fieldwork Staff Signature	16-8-16 Date	Checker Name and Signature	29/8/16 Date
Project Manager Signature	29/8/16 Date	**Distribution:** Project Central File	

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FQM - Groundwater Sampling and Purging Record

Site 4

Q4AN(EV)-405-FM1

Project Name:	Kwinana FB monitoring	Project Number:	60515579	PM Name:	Sean Hudgens	Sample Date:	16-8-16
Client:	SIMS	Project Location:	3rd Party wells	Fieldwork Staff:	SH, KS	Well Development or Well Sampling Event? (circle)	

General Bore Information		Parameter Info	Decontamination	Sampling Method	Hydrasleeve Info	
Date of GW Level:	Bore Radius (mm):	Chem Kit Serial No.:	☐ Decontaminated	☐ Low Flow Pump rate:	Hydrasleeve Size:	Monitoring sequence followed (number in order):
Depth to GW (m-pvc):	Screen Interval (m):	Chem Kit Model:	☑ Dedicated	Intake depth:	Hydrasleeve Type:	
Bore Depth (m-pvc):	Casing Radius (mm):	Corrected Redox: Y / N	☐ Disposable	☐ Bailer ☐ Hydrasleeve	Sampling Depth (m-pvc):	Gauging
Depth to Product (m-pvc): —	Cover Type (gatic/stick up):	(The correction to apply is probe dependent)	☐ Other (specify)	☐ Peristaltic Pump ☐ Waterra	Hydrasleeve Install time:	Hydrasleeve in
Product Thickness (m): —	Bore Locked (YES/NO):	Parameter method: ☐ Downhole		☑ Other (specify) Tap	Sampling Start Time:	Hydrasleeve out
	Key Type (if applicable):	☑ Retrieved				Parameters
Calculated bore volume (L):	Includes/ excludes bore annulus (circle)	# purge volumes removed:		Total purged volume (L): 32		

Water Quality Parameters

Time	Cumulative Vol. Removed (L)	SWL (m-pvc)	Pump Rate	DO (ppm or mg/L)	E.C. (mS/cm or µS/cm)	pH	Redox (mV)	Temp °C	Odour, Colour, Turbidity
15:09	—								Clear, H2O
15:11	4	—	2 L/m	0.16	379.0	8.04	-76.4	17.6	" "
15:13	8	—	"	0.11	379.2	8.05	-95.3	17.6	" "
15:15	12	—	"	0.09	378.7	8.05	-107.9	17.6	" "
15:17	16	—	"	0.08	378.2	8.05	-117.5	17.6	" "
15:19	20	—	"	0.08	378.4	8.05	-125.7	17.6	" "
15:21	24	—	"	0.07	378.4	8.05	-133.3	17.6	" "
15:23	28	—	"	0.08	378.2	8.05	-139.3	17.6	" "
15:25	32	—	"	0.08	378.2	8.05	-140.9	17.6	" "
Acceptable Parameter Range:				± 10%	± 3%	± 0.05	± 10 mV	± 0.2 °C	± 10% turbidity (if using a turbidity meter)

Analytes Sampled for:		Bottles Collected						QA/QC Information	Field Comments
Field Filtered:	Unfiltered:		x 40 mL Vial (HCl)		x 60 mL Ferrous		x 60 mL metals (HNO_3)		Bore volume calculation, bore condition, fate of tubing, redox correction etc.
	-TPH		x 40 mL Vial (H_2SO_4)		x 100 mL Amber		x 250 mL Plastic		
	-EC, chlor, condy	x1	TPH 250ml						
		x1	U.P. 1Ltr						

Approval and Distribution

Field Work Staff Signature — Date: 16-8-16

Checker Name and Signature — Date: 29/8/16

Project Manager Signature — Date: 29/8/16

Distribution: Project Central File

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Laboratory Analytical Results and Chain of Custody Documentation

Hill Laboratories
BETTER TESTING BETTER RESULTS

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ANALYSIS REPORT

Client:	AECOM Consulting Services (NZ) Limited	**Lab No:**	1632819 SPv1
Contact:	Sean Hudgens	**Date Received:**	18-Aug-2016
	C/- AECOM Consulting Services (NZ) Limited	**Date Reported:**	24-Aug-2016
	PO Box 27277	**Quote No:**	72191
	Wellington 6141	**Order No:**	60515579 00400
		Client Reference:	60515579 00400 KA9; 3rd Party Wells
		Submitted By:	Sean Hudgens

Sample Type: Aqueous

Sample Name:	KA9-EB 16-Aug-2016	MWX 16-Aug-2016	MWY 16-Aug-2016	Site 1 16-Aug-2016	Site 2 16-Aug-2016
Lab Number:	1632819.1	1632819.2	1632819.3	1632819.4	1632819.5
Individual Tests					
pH pH Units	7.5	-	-	7.0	8.2
Electrical Conductivity (EC) mS/m	57.2	-	-	31.8	33.4
Chloride g/m³	26	-	-	38	11.2
BTEX in Water by Headspace GC-MS					
Benzene g/m³	< 0.0010	< 0.0010	< 0.0010	-	-
Toluene g/m³	< 0.0010	< 0.0010	< 0.0010	-	-
Ethylbenzene g/m³	< 0.0010	< 0.0010	< 0.0010	-	-
m&p-Xylene g/m³	< 0.002	< 0.002	< 0.002	-	-
o-Xylene g/m³	< 0.0010	< 0.0010	< 0.0010	-	-
Total Petroleum Hydrocarbons in Water					
C7 - C9 g/m³	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14 g/m³	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36 g/m³	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36) g/m³	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7

Sample Name:	Site 3 16-Aug-2016	Site 4 16-Aug-2016			
Lab Number:	1632819.6	1632819.7			
Individual Tests					
pH pH Units	8.8	8.0	-	-	-
Electrical Conductivity (EC) mS/m	31.7	37.5	-	-	-
Chloride g/m³	11.4	11.9	-	-	-
Total Petroleum Hydrocarbons in Water					
C7 - C9 g/m³	< 0.10	< 0.10	-	-	-
C10 - C14 g/m³	< 0.2	< 0.2	-	-	-
C15 - C36 g/m³	< 0.4	< 0.4	-	-	-
Total hydrocarbons (C7 - C36) g/m³	< 0.7	< 0.7	-	-	-

Analyst's Comments

Appendix No.1 - Chain of Custody

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

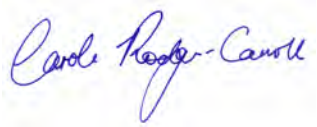
Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m³	1-3

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Total Petroleum Hydrocarbons in Water	Hexane extraction, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines [KBIs:2803,10734]	0.10 - 0.7 g/m^3	1-7
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1, 4-7
pH	pH meter. APHA 4500-H^+ B 22nd ed. 2012. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field.	0.1 pH Units	1, 4-7
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 22nd ed. 2012.	0.1 mS/m	1, 4-7
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cl^- E (modified from continuous flow analysis) 22nd ed. 2012.	0.5 g/m^3	1, 4-7

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.



Carole Rodgers-Carroll BA, NZCS
Client Services Manager - Environmental

AECOM

ANZ

FQM - Generic Chain of Custody Form

Q4AN(EV)-007-FM1

CONSULTANT: AECOM Consulting Services	ADDRESS / OFFICE: WELLINGTON	SAMPLER: SH, KS	**Destination Laboratory**
PROJECT MANAGER (PM): Sean Hudgens	SITE: KA9; 3rd party wells	MOBILE: 022 035 9612 PHONE:	Hill Laboratories
PROJECT NUMBER & TASK CODE: 60515579 00400	P.O. NO.:	EMAIL REPORT TO: Sean.hudgens@aecom.com	
RESULTS REQUIRED (Date):	QUOTE NO.:	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)	

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:
please email results to:
sean.hudgens@aecom.com
suzanne.lowe@aecom.com

Notes: e.g. Highly contaminated sample e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.

ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles	TPH	BTEX	Conductivity	Chloride	Ca	HOLD
	KA9-EB	W	16/8/16		TPH250, VOC40, UP1L	4	✓	✓	✓	✓	✓	
	MWX	W			TPH250, VOC40	3	✓	✓				
	MWY	W			" "	3	✓	✓				
	SITE 1	W			TPH250, [redacted], UP1L	2	✓		✓	✓	✓	
	SITE 2	W			" "	2	✓		✓	✓	✓	
	SITE 3	W			" "	2	✓		✓	✓	✓	
	SITE 4	W			" "	2	✓		✓	✓	✓	

Temperature On Arrival

7.2 °C

Temperature was measured on one or more arbitrarily chosen samples in this batch.

RELINQUISHED BY:		RECEIVED BY		RECEIVED BY		METHOD OF SHIPMENT
Name: Sean Hudgens	Date: 17/8/16	Name: Kaal Brendergast	Date: 18/8	Name:	Date:	Con' Note No:
Of: AECOM	Time: 7:00	Of: Hill Labs	Time: 1623	Of:	Time:	Transport Co:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic;
F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag. **Soil Container Codes**: Jar = Unpreserved glass jar

COC Page 1 of

3116328190

Job No: 163 2819 Date Recv: 18-Aug-16 05:36
Received by: Lisa Bailey

AECOM

ANZ

FQM - Generic Chain of Custody Form

Q4AN(EV)-007-FM1

CONSULTANT: AECOM Consulting Services	ADDRESS / OFFICE: WELLINGTON	SAMPLER: SH, KS			Destination Laboratory
PROJECT MANAGER (PM): Sean Hudgens	SITE: KA9; 3rd party wells	MOBILE: 022 035 9612	PHONE:		Hill Laboratories
PROJECT NUMBER & TASK CODE: 60515579 00400	P.O. NO.:	EMAIL REPORT TO: Sean.hudgens@aecom.com			
RESULTS REQUIRED (Date):	QUOTE NO.:	ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)			

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:
please email results to:
sean.hudgens@aecom.com
suzanne.lowe@aecom.com

ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles	TPH	BTEX	Conductivity	Chloride	pH	HOLD	Notes: e.g. Highly contaminated samples e.g. "High PAHs expected". Extra volume for QC or trace LORs etc.
	KA9-EB	W	16/8/16		TPH250, VOC40, UP1L	4	✓	✓	✓	✓	✓		
	MWX	W			TPH250, VOC40	3	✓	✓					
	MWY	W			" "	3	✓	✓					
	SITE 1	W			TPH250, ~~VOC40~~ UP1L	2	✓		✓	✓	✓		
	SITE 2	W			" "	2	✓		✓	✓	✓		
	SITE 3	W			" "	2	✓		✓	✓	✓		
	SITE 4	W	8		" "	2	✓		✓	✓	✓		

Temperature On Arrival

7.2 °C

Temperature was measured on one or more arbitrarily chosen samples in this batch.

RELINQUISHED BY:		RECEIVED BY		RECEIVED BY		METHOD OF SHIPMENT
Name: Sean Hudgens	Date: 17/8/16	Name: Kerri Prendergast	Date: 8/8	Name:	Date:	Con' Note No:
Of: AECOM	Time: 7:00	Of: Hills Labs	Time: 1623	Of:	Time:	Transport Co:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic;
F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag. **Soil Container Codes:** Jar = Unpreserved glass jar

COC Page 1 of

3116328190

Job No: 163 2819 Date Recv: 18-Aug-16 05:36

Received by: Lisa Bailey

QA/QC Table

QA/QC - Sample Details and Analytical Results

Sample Location	***Units***	QA/QC		
		Trip Blank	Duplicate of sample collected from Site 3	Duplicate of sample collected from KA9-EB
AECOM Sample Number		MWY	MWX	
Laboratory Sample Reference		1632819.3	1632819.2	
Date Sampled		16/08/16	16/08/16	
Total Petroleum Hydrocarbons (TPH)				
C_7-C_9	mg/L	< 0.10	< 0.10	-
C_{10}-C_{14}	mg/L	< 0.2	< 0.2	-
C_{15}-C_{36}	mg/L	< 0.4	< 0.4	-
Total hydrocarbons (C_7 - C_{36})	mg/L	< 0.7	< 0.7	-
BTEX Compounds				
Benzene	mg/L	< 0.0010	-	< 0.0010
Toluene	mg/L	< 0.0010	-	< 0.0010
Ethylbenzene	mg/L	< 0.0010	-	< 0.0010
Total Xylenes	mg/L	< 0.0030	-	< 0.0030

Appendix A – M Barr - 873 Skeet Road (Site 1)

Site Name	M Barr – 873 Skeet Road (Site 1)
Well Details	The abstraction well at 873 Skeet Road is approximately 65 m deep and is screened from 30 to 60 m below ground level. The static groundwater level is recorded as 18 m below ground level. The well is finished with a 100 mm diameter steel well casing that sticks up above ground level by approximately 400 mm. The well is operational with a pump and outlet risers permanently mounted to the well head. The well appears to fill a storage tank which feeds a small secondary above ground tank in a pump house used for reticulation.
Pump Details	Submersible pump of unknown model.
Sampling Date	16 August 2016.
Sampler	AECOM.
Well use prior to sampling	Unknown.
Sampling Methodology	A groundwater sample was unable to be collected directly from the well and therefore the groundwater sample was collected directly from a tap attached to the secondary tank in the pump house. Groundwater was purged for approximately 16 minutes with a flow rate of approximately 10 L/min. A multi parameter probe (YSI Professional Plus) was used to measure conductivity, pH, temperature, dissolved oxygen and redox in the purged groundwater. The well was sampled when parameters had stabilised. Water was observed to be cloudy and slightly yellow at the start of purging, with the cloudiness clearing quickly and the yellow colour remaining throughout purging and sampling. The groundwater sample was collected directly into laboratory supplied sample bottles. The groundwater sample was kept under chilled conditions and transported to Hill Laboratories Limited (Hill Laboratories) under standard chain of custody procedures.
Laboratory Analysis	The groundwater sample was identified as “Site 1” and was analysed by Hill Laboratories for the following analytes: - pH - Conductivity - Chloride - Total petroleum hydrocarbons (TPH)
Results Discussion	Results for the August 2016, February 2016, August 2015, January 2015, August 2014, February 2014, November 2013, July 2013, May 2013 and December 2012 monitoring events are tabulated and attached. Results for the August 2016 monitoring event are similar to those recorded previously, including TPH which was not detected.

The information included within this Appendix has been provided to Shell Todd Oil Services Limited for the purpose of and in accordance with the conditions of our engagement “STOS Kapuni Off-Site Monitoring – PO 4512765691”.

Site 1 - Sample Details and Analytical Results

Sample Location	***Units***	873 Skeet Road									
AECOM Sample Number		Site 1	Site 1	Site 1	Site 1	Site 1	Site 1	Site 1	Site 1	Site 1	Site 1
Laboratory Sample Reference		1084034.1	1131198.1	1162256.1	1202867.1	1234484.1	1310590.1	1379473.1	1465459.1	1535293.1	1632819.4
Date Sampled		19/12/12	2/05/13	30/07/13	13/11/13	10/02/14	12/08/14	30/01/15	20/08/15	4/02/16	16/08/16
Total Petroleum Hydrocarbons (TPH)											
C_7-C_9	mg/L	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
C_{10}-C_{14}	mg/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C_{15}-C_{36}	mg/L	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C_7 - C_{36})	mg/L	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
BTEX Compounds											
Benzene	mg/L	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-	-	-
Toluene	mg/L	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-	-	-
Ethylbenzene	mg/L	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-	-	-
Total Xylenes	mg/L	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	-	-	-
Dissolved Metals											
Dissolved Barium	mg/L	0.026	0.030	0.029	0.028	0.030	0.031	0.032	-	-	-
Dissolved Calcium	mg/L	14.4	15.0	14.7	14.4	14.3	14.5	14.1	-	-	-
Dissolved Copper	mg/L	0.0007	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0005	< 0.0005	-	-	-
Dissolved Iron	mg/L	1.43	1.89	2.3	1.58	2.5	4.4	4.6	-	-	-
Dissolved Magnesium	mg/L	4.8	5.6	5.6	5.7	5.6	5.7	5.6	-	-	-
Dissolved Manganese	mg/L	0.52	0.61	0.61	0.64	0.61	0.66	0.54	-	-	-
Dissolved Mercury	mg/L	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	-	-	-
Dissolved Nickel	mg/L	0.0086	0.0165	0.0015	0.0015	0.0008	0.0117	0.0073	-	-	-
Dissolved Potassium	mg/L	11.5	12.1	12.5	12.9	12.3	12.8	13.3	-	-	-
Dissolved Sodium	mg/L	31	31	33	34	32	36	34	-	-	-
Dissolved Zinc	mg/L	0.31	0.49	0.42	0.182	0.157	0.183	0.066	-	-	-
Alkyl Quaternary Ammonium Compounds in Water by LCMSMS											
Benzalkonium Chloride (C12 homologue)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-
Benzalkonium Chloride (C14 homologue)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-
Benzalkonium Chloride (C16 homologue)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-
Benzalkonium Chloride (total)	mg/L	< 0.018	< 0.018	< 0.018	< 0.018	< 0.018	< 0.018	< 0.018	-	-	-
DDAC (Didecyldimethylammonium chloride)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-
Dodine	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-
IPBC (3-Iodo-2-propynyl-n-butylcarbamate)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-
Ethylene Glycol in Water											
Ethylene glycol	mg/L	< 4	< 4	< 4	< 4	< 4	< 4	< 4	-	-	-
Propylene Glycol in Water											
Propylene glycol	mg/L	< 4	< 4	< 4	< 4	< 4	< 4	< 4	-	-	-
Methanol in Water - Aqueous Solvents											
Methanol	mg/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	-	-	-
Formaldehyde in Water by DNPH & LCMSMS											
Formaldehyde	mg/L	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	-	-	-
Gases in groundwater											
Ethane	mg/L	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	-	-	-
Ethylene	mg/L	< 0.003	< 0.004	< 0.004	< 0.003	< 0.004	< 0.003	< 0.003	-	-	-
Methane	mg/L	0.64	4.4	4.2	8.6	7.5	7.9	9.4	-	-	-
Other Analyses											
Sum of Anions	meq/L	3.0	3.2	3.2	3.1	3.1	3.1	3.1	-	-	-
Sum of Cations	meq/L	2.8	3.0	3.1	3.1	3.0	3.3	3.2	-	-	-
pH	pH Units	7	6.8	6.8	7	7.1	6.9	7	6.8	7.3	7.0
Total Alkalinity	mg/L as $CaCO_3$	105	113	111	107	108	104	107	-	-	-
Bicarbonate	mg/L at 25°C	127	137	135	130	131	127	130	-	-	-
Total Hardness	mg/L as $CaCO_3$	55	61	60	59	59	60	58	-	-	-
Electrical Conductivity (EC)	mS/m	31.9	32.3	32.6	30.8	32.1	32.3	32.4	32.0	32.0	31.8
Total Dissolved Solids (TDS)	mg/L	210	220	220	260	220	220	230	-	-	-
Bromide	mg/L	0.15	0.14	0.06	0.12	0.06	0.14	0.12	-	-	-
Chloride	mg/L	34	35	33	34	34	35	34	34	34	38
Nitrite-N	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.02	0.002	-	-	-
Nitrate-N	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.02	< 0.002	-	-	-
Nitrate-N + Nitrite-N	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	0.002	< 0.02	0.004	-	-	-
Sulphate	mg/L	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	-	-	-

Appendix B – PKW Farms - 468 Hastings Road (Site 2)

Site Name	PKW Farms – 468 Hastings Road (Site 2)
Well Details	The abstraction well at 468 Hastings Road is 337 m deep and is cased to 92 m below ground level (bgl). The depth to groundwater is unknown. The well casing is steel with a diameter of approximately 90 mm and is finished above ground. The well is operational with pump and outlet tubes permanently mounted to the well head. The well is pumped every day to supply the farm and dairy shed. Approximately 130,000 litres of groundwater is pumped each day.
Pump Details	Submersible pump of unknown model.
Sampling Date	16 August 2016.
Sampler	AECOM.
Well use prior to sampling	Unknown.
Sampling Methodology	A groundwater sample was collected by attaching silicone tubing directly to the outlet of the well and opening a valve on the outlet. Groundwater was purged for approximately 12 minutes with a flow rate of approximately 2 L/min. An inline flow cell was used in conjunction with a multi parameter probe (YSI Professional Plus) to measure conductivity, pH, temperature, dissolved oxygen and redox in the purged groundwater. The well was sampled when parameters had stabilised. Water was observed to be clear during purging and sampling. The groundwater sample was collected directly into laboratory supplied sample bottles. The groundwater sample was kept under chilled conditions and transported to Hill Laboratories Limited (Hill Laboratories) under standard chain of custody procedures.
Laboratory Analysis	The groundwater sample was identified as “Site 2” and was analysed by Hill Laboratories for the following analytes: - pH - Conductivity - Chloride - Total petroleum hydrocarbons (TPH)
Results Discussion	Results for the August 2016, February 2016, August 2015, January 2015, August 2014, February 2014, November 2013, July 2013, May 2013 and December 2012 monitoring events are tabulated and attached. Results for the August 2016 monitoring event are similar to those recorded previously, including TPH which was not detected.

The information included within this Appendix has been provided to Shell Todd Oil Services Limited for the purpose of and in accordance with the conditions of our engagement “STOS Kapuni Off-Site Monitoring – PO 4512765691”.

Site 2 - Sample Details and Analytical Results

Sample Location	*Units*	468 Hastings Road									
AECOM Sample Number		Site 2	Site 2	Site 2	Site 2	Site 2	Site 2	Site 2	Site 2	Site 2	Site 2
Laboratory Sample Reference		1084034.2	1131198.2	1162256.2	1202867.2	1234484.2	1310590.2	1379473.2	1465459.2	1535293.2	1632819.5
Date Sampled		19/12/12	2/05/13	30/07/13	13/11/13	10/02/14	12/08/14	30/01/15	20/08/15	4/02/16	16/08/16
Total Petroleum Hydrocarbons (TPH)											
C_7-C_9	mg/L	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
C_{10}-C_{14}	mg/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C_{15}-C_{36}	mg/L	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C_7 - C_{36})	mg/L	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
BTEX Compounds											
Benzene	mg/L	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-	-	-
Toluene	mg/L	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-	-	-
Ethylbenzene	mg/L	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-	-	-
Total Xylenes	mg/L	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	-	-	-
Dissolved Metals											
Dissolved Barium	mg/L	0.00199	0.0021	0.00195	0.0021	0.00199	0.00196	0.00197	-	-	-
Dissolved Calcium	mg/L	13.8	13.1	12.9	12.9	13.2	13.2	13.3	-	-	-
Dissolved Copper	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	-	-	-
Dissolved Iron	mg/L	0.05	0.06	0.05	0.04	0.05	0.04	0.03	-	-	-
Dissolved Magnesium	mg/L	4.2	4.4	4.5	4.7	4.8	4.7	5	-	-	-
Dissolved Manganese	mg/L	0.015	0.0129	0.0133	0.013	0.0134	0.0134	0.0136	-	-	-
Dissolved Mercury	mg/L	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	-	-	-
Dissolved Nickel	mg/L	0.0024	0.0008	< 0.0005	0.0013	0.0006	0.0085	0.0077	-	-	-
Dissolved Potassium	mg/L	1.41	1.43	1.46	1.45	1.41	1.38	1.73	-	-	-
Dissolved Sodium	mg/L	58	56	60	65	57	64	68	-	-	-
Dissolved Zinc	mg/L	0.0053	0.0012	0.0018	0.0045	0.0017	0.0018	0.0041	-	-	-
Alkyl Quaternary Ammonium Compounds in Water by LCMSMS											
Benzalkonium Chloride (C12 homologue)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-
Benzalkonium Chloride (C14 homologue)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-
Benzalkonium Chloride (C16 homologue)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-
Benzalkonium Chloride (total)	mg/L	< 0.018	< 0.018	< 0.018	< 0.018	< 0.018	< 0.018	< 0.018	-	-	-
DDAC (Didecyldimethylammonium chloride)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-
Dodine	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-
IPBC (3-Iodo-2-propynyl-n-butylcarbamate)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-
Ethylene Glycol in Water											
Ethylene glycol	mg/L	< 4	< 4	< 4	< 4	< 4	< 4	< 4	-	-	-
Propylene Glycol in Water											
Propylene glycol	mg/L	< 4	< 4	< 4	< 4	< 4	< 4	< 4	-	-	-
Methanol in Water - Aqueous Solvents											
Methanol	mg/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	-	-	-
Formaldehyde in Water by DNPH & LCMSMS											
Formaldehyde	mg/L	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	-	-	-
Gases in groundwater											
Ethane	mg/L	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	-	-	-
Ethylene	mg/L	< 0.004	< 0.004	< 0.004	< 0.003	< 0.004	< 0.003	< 0.003	-	-	-
Methane	mg/L	2.3	5.4	3.9	5.8	6.8	7.0	9.4	-	-	-
Other Analyses											
Sum of Anions	meq/L	3.7	3.7	3.6	3.6	3.6	3.6	3.6	-	-	-
Sum of Cations	meq/L	3.6	3.5	3.7	3.9	3.6	3.9	4.1	-	-	-
pH	pH Units	8.4	8.4	8.4	8.3	8.3	8.4	8.3	8.4	8.3	8.2
Total Alkalinity	mg/L as $CaCO_3$	169	166	166	166	166	164	165	-	-	-
Bicarbonate	mg/L at 25°C	200	198	198	199	198	196	197	-	-	-
Total Hardness	mg/L as $CaCO_3$	52	51	51	51	53	52	54	-	-	-
Electrical Conductivity (EC)	mS/m	33.8	33.3	33.5	33.4	33.3	33.6	34.1	33.5	33.5	33.4
Total Dissolved Solids (TDS)	mg/L	200	210	200	220	200	200	196	-	-	-
Bromide	mg/L	0.06	0.07	< 0.05	0.05	< 0.05	0.07	0.08	-	-	-
Chloride	mg/L	11.4	12.0	10.9	10.7	10.4	11.1	11.2	11.2	10.7	11.2
Nitrite-N	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	-	-	-
Nitrate-N	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	-	-	-
Nitrate-N + Nitrite-N	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	-	-	-
Sulphate	mg/L	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	-	-	-

Appendix C – Kiley Estate - Inuawai Road (Site 3)

Site Name	Kiley Estate - Inuawai Road (Site 3)
Well Details	The abstraction well at Kiley Estate is 448 m deep and is cased to 280 m below ground level. The depth to groundwater is unknown. The well casing is steel with a diameter of approximately 90 mm and is finished above ground. The well is operational with pump and outlet tubes permanently mounted to the well head. The well is pumped to supply water to the dairy shed.
Pump Details	Submersible pump of unknown model. Potential also for artesian supply.
Sampling Date	16 August 2016.
Sampler	AECOM.
Well use prior to sampling	Unknown.
Sampling Methodology	A groundwater sample was collected by attaching silicone tubing directly to the outlet of the well and opening a valve on the outlet. Groundwater was purged for approximately 12 minutes with a flow rate of approximately 4 L/min. An inline flow cell was used in conjunction with a multi parameter probe (YSI Professional Plus) to measure conductivity, pH, temperature, dissolved oxygen and redox in the purged groundwater. The well was sampled when parameters had stabilised. Water was observed to be clear during purging and sampling. The groundwater sample was collected directly into laboratory supplied sample bottles. The groundwater sample was kept under chilled conditions and transported to Hill Laboratories Limited (Hill Laboratories) under standard chain of custody procedures.
Laboratory Analysis	The groundwater sample was identified as “Site 3” and was analysed by Hill Laboratories for the following analytes: - pH - Conductivity - Chloride - Total petroleum hydrocarbons (TPH) A duplicate groundwater sample identified as “MWX” was also collected from the well, and was analysed for TPH.
Results Discussion	Results for the August 2016, February 2016, August 2015, January 2015, August 2014, February 2014, November 2013, July 2013, May 2013 and December 2012 monitoring events are tabulated and attached. Results for the August 2016 monitoring event are similar to those recorded previously, including TPH which was not detected.

The information included within this Appendix has been provided to Shell Todd Oil Services Limited for the purpose of and in accordance with the conditions of our engagement “STOS Kapuni Off-Site Monitoring – PO 4512765691”.

Site 3 - Sample Details and Analytical Results

Sample Location	***Units***	Inuawai Road									
AECOM Sample Number		Site 3	Site 3	Site 3	Site 3	Site 3	Site 3	Site 3	Site 3	Site 3	Site 3
Laboratory Sample Reference		1084034.3	1131198.3	1162256.3	1202867.3	1234484.3	1310590.3	1379473.3	1465459.3	1535293.3	1632819.6
Date Sampled		19/12/12	2/05/13	30/07/13	13/11/13	10/02/14	12/08/14	30/01/15	20/08/15	4/02/16	16/08/16
Total Petroleum Hydrocarbons (TPH)											
C_7-C_9	mg/L	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
C_{10}-C_{14}	mg/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C_{15}-C_{35}	mg/L	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C_7 - C_{36})	mg/L	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
BTEX Compounds											
Benzene	mg/L	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-	-	-
Toluene	mg/L	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-	-	-
Ethylbenzene	mg/L	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-	-	-
Total Xylenes	mg/L	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	-	-	-
Dissolved Metals											
Dissolved Barium	mg/L	0.00108	0.00110	0.00138	0.00129	0.00107	0.00116	0.00107	-	-	-
Dissolved Calcium	mg/L	3.8	4.0	3.6	3.8	3.8	3.7	3.8	-	-	-
Dissolved Copper	mg/L	< 0.0005	< 0.0005	0.0006	< 0.0005	< 0.0005	< 0.0005	< 0.0005	-	-	-
Dissolved Iron	mg/L	< 0.02	0.07	0.02	< 0.02	0.02	0.02	< 0.02	-	-	-
Dissolved Magnesium	mg/L	0.9	0.87	0.84	0.9	0.89	0.88	0.93	-	-	-
Dissolved Manganese	mg/L	0.0066	0.0073	0.0069	0.0064	0.0063	0.0065	0.0067	-	-	-
Dissolved Mercury	mg/L	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	-	-	-
Dissolved Nickel	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	-	-	-
Dissolved Potassium	mg/L	0.78	0.85	0.84	0.82	0.84	0.78	0.77	-	-	-
Dissolved Sodium	mg/L	67	70	74	78	71	80	66	-	-	-
Dissolved Zinc	mg/L	< 0.0010	0.0029	< 0.0010	0.0014	< 0.0010	< 0.0010	< 0.0010	-	-	-
Alkyl Quaternary Ammonium Compounds in Water by LCMSMS											
Benzalkonium Chloride (C12 homologue)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-
Benzalkonium Chloride (C14 homologue)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-
Benzalkonium Chloride (C16 homologue)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-
Benzalkonium Chloride (total)	mg/L	< 0.018	< 0.018	< 0.018	< 0.018	< 0.018	< 0.018	< 0.018	-	-	-
DDAC (Didecyldimethylammonium chloride)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-
Dodine	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-
IPBC (3-Iodo-2-propynyl-n-butylcarbamate)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-
Ethylene Glycol in Water											
Ethylene glycol	mg/L	< 4	< 4	< 4	< 4	< 4	< 4	< 4	-	-	-
Propylene Glycol in Water											
Propylene glycol	mg/L	< 4	< 4	< 4	< 4	< 4	< 4	< 4	-	-	-
Methanol in Water - Aqueous Solvents											
Methanol	mg/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	-	-	-
Formaldehyde in Water by DNPH & LCMSMS											
Formaldehyde	mg/L	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	-	-	-
Gases in groundwater											
Ethane	mg/L	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	-	-	-
Ethylene	mg/L	< 0.004	< 0.004	< 0.004	< 0.003	< 0.004	< 0.003	< 0.003	-	-	-
Methane	mg/L	1.94	4.9	4.1	6.7	7.8	8.5	6.4	-	-	-
Other Analyses											
Sum of Anions	meq/L	3.5	3.4	3.4	3.4	3.4	3.4	3.4	-	-	-
Sum of Cations	meq/L	3.2	3.3	3.5	3.7	3.4	3.7	3.2	-	-	-
pH	pH Units	8.8	8.9	8.9	8.7	8.8	8.9	8.8	8.9	8.7	8.8
Total Alkalinity	mg/L as $CaCO_3$	158	154	153	155	156	153	154	-	-	-
Bicarbonate	mg/L at 25°C	181	175	172	179	179	174	178	-	-	-
Total Hardness	mg/L as $CaCO_3$	13.3	13.4	12.5	13.3	13.1	12.7	13.4	-	-	-
Electrical Conductivity (EC)	mS/m	31.8	31.4	31.6	31.4	31.7	31.7	32.3	31.6	31.9	31.7
Total Dissolved Solids (TDS)	mg/L	199	198	197	210	200	193	200	-	-	-
Bromide	mg/L	0.07	0.07	< 0.05	0.05	< 0.05	0.07	0.06	-	-	-
Chloride	mg/L	11.6	12.3	11.4	11.1	10.7	11.6	11.6	11.5	10.8	11.4
Nitrite-N	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	-	-	-
Nitrate-N	mg/L	0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	-	-	-
Nitrate-N + Nitrite-N	mg/L	0.003	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	-	-	-
Sulphate	mg/L	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	-	-	-

Appendix D – Naplin Trust - Ahipaipa Road (Site 4)

Site Name	Naplin Trust - Ahipaipa Road (Site 4)
Well Details	The abstraction well at Naplin Trust is 432 m deep and is cased to 123 m below ground level. The depth to groundwater is unknown. The well casing is steel with a diameter of approximately 125 mm and is finished above ground. The well is operational with pump and outlet tubes permanently mounted to the well head. The well is artesian and fills a storage tank adjacent to the dairy shed.
Pump Details	Artesian.
Sampling Date	16 August 2015.
Sampler	AECOM.
Well use prior to sampling	Unknown.
Sampling Methodology	A groundwater sample was collected by attaching silicone tubing directly to the outlet of the well and opening a valve on the outlet. Groundwater was purged for approximately 16 minutes with a flow rate of approximately 2 L/min. An inline flow cell was used in conjunction with a multi parameter probe (YSI Professional Plus) to measure conductivity, pH, temperature, dissolved oxygen and redox in the purged groundwater. The well was sampled when parameters had stabilised. Water was observed to be clear during purging and sampling. The groundwater sample was collected directly into laboratory supplied sample bottles. The groundwater sample was kept under chilled conditions and transported to Hill Laboratories Limited (Hill Laboratories) under standard chain of custody procedures.
Laboratory Analysis	The groundwater sample was identified as “Site 4” and was analysed by Hill Laboratories for the following analytes: - pH - Conductivity - Chloride - Total petroleum hydrocarbons (TPH)
Results Discussion	Results for the August 2016, August 2015, January 2015, August 2014, February 2014, November 2013, July 2013, May 2013 and December 2012 monitoring events are tabulated and attached. Results for the August 2016 monitoring event are similar to those recorded previously, including TPH which was not detected.

The information included within this Appendix has been provided to Shell Todd Oil Services Limited for the purpose of and in accordance with the conditions of our engagement “STOS Kapuni Off-Site Monitoring – PO 4512765691”.

Site 4 - Sample Details and Analytical Results

Sample Location	*Units*	Ahipaipa Road									
AECOM Sample Number		Site 4	Site 4	Site 4	Site 4	Site 4	Site 4	Site 4	Site 4	Site 4	Site 4
Laboratory Sample Reference		1084034.4	1131198.4	1162256.4	1202867.4	1234484.4	1310590.4	1379473.4	1465459.4	-	1632819.7
Date Sampled		19/12/12	2/05/13	30/07/13	13/11/13	10/02/14	12/08/14	30/01/15	20/08/15	4/02/16	16/08/16
Total Petroleum Hydrocarbons (TPH)											
C_7-C_9	mg/L	< 0.10	< 0.10	< 0.10	< 0.10	< 0.15	< 0.10	< 0.10	< 0.10		< 0.10
C_{10}-C_{14}	mg/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.4	< 0.2	< 0.2	< 0.2		< 0.2
C_{15}-C_{35}	mg/L	< 0.4	< 0.4	< 0.4	< 0.4	< 0.8	< 0.4	< 0.4	< 0.4		< 0.4
Total hydrocarbons (C_7 - C_{36})	mg/L	< 0.7	< 0.7	< 0.7	< 0.7	< 1.4	< 0.7	< 0.7	< 0.7		< 0.7
BTEX Compounds											
Benzene	mg/L	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-		-
Toluene	mg/L	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-		-
Ethylbenzene	mg/L	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-		-
Total Xylenes	mg/L	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	-		-
Dissolved Metals											
Dissolved Barium	mg/L	0.006	0.0070	0.0064	0.0065	0.0064	0.0066	0.0064	-		-
Dissolved Calcium	mg/L	24	27	24	24	24	24	24	-		-
Dissolved Copper	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	-		-
Dissolved Iron	mg/L	0.17	0.20	0.12	0.13	0.12	0.12	0.13	-		-
Dissolved Magnesium	mg/L	9.6	11.3	11.2	12.3	11.2	12.0	11.6	-		-
Dissolved Manganese	mg/L	0.03	0.030	0.028	0.029	0.028	0.027	0.027	-		-
Dissolved Mercury	mg/L	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	-		-
Dissolved Nickel	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	-		-
Dissolved Potassium	mg/L	2.8	3.3	3.1	3	3	2.8	3.4	-		-
Dissolved Sodium	mg/L	39	42	42	45	41	45	46	-		-
Dissolved Zinc	mg/L	0.0068	0.0022	0.0029	0.0045	0.0027	0.0018	0.0034	-		-
Alkyl Quaternary Ammonium Compounds in Water by LCMSMS											
Benzalkonium Chloride (C12 homologue)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-		-
Benzalkonium Chloride (C14 homologue)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-		-
Benzalkonium Chloride (C16 homologue)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-		-
Benzalkonium Chloride (total)	mg/L	< 0.018	< 0.018	< 0.018	< 0.018	< 0.018	< 0.018	< 0.018	-		-
DDAC (Didecyldimethylammonium chloride)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-		-
Dodine	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-		-
IPBC (3-Iodo-2-propynyl-n-butylcarbamate)	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-		-
Ethylene Glycol in Water											
Ethylene glycol	mg/L	< 4	< 4	< 4	< 4	< 4	< 4	< 4	-		-
Propylene Glycol in Water											
Propylene glycol	mg/L	< 4	< 4	< 4	< 4	< 4	< 4	< 4	-		-
Methanol in Water - Aqueous Solvents											
Methanol	mg/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	-		-
Formaldehyde in Water by DNPH & LCMSMS											
Formaldehyde	mg/L	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	-		-
Gases in groundwater											
Ethane	mg/L	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	-		-
Ethylene	mg/L	< 0.004	< 0.004	< 0.004	< 0.003	< 0.004	< 0.003	< 0.003	-		-
Methane	mg/L	2.8	6.4	5.7	9.3	7.9	10.8	11.6	-		-
Other Analyses											
Sum of Anions	meq/L	4.1	4.1	4.1	4.1	4.0	4.0	4.0	-		-
Sum of Cations	meq/L	3.8	4.2	4.0	4.2	4.0	4.2	4.3	-		-
pH	pH Units	8.1	8.1	8.1	8.1	8.2	8.1	8	8.1		8
Total Alkalinity	mg/L as $CaCO_3$	188	185	186	186	186	185	186	-		-
Bicarbonate	mg/L at 25°C	230	220	220	220	220	220	220	-		-
Total Hardness	mg/L as $CaCO_3$	101	113	106	111	106	109	108	-		-
Electrical Conductivity (EC)	mS/m	37.3	36.6	37.2	37	36.9	37.8	37.9	37.0		37.5
Total Dissolved Solids (TDS)	mg/L	220	230	220	250	230	230	230	-		-
Bromide	mg/L	0.07	0.07	< 0.05	0.05	< 0.05	0.07	0.06	-		-
Chloride	mg/L	12	12.9	12.0	11.6	11.2	12.2	12	12.2		11.9
Nitrite-N	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	-		-
Nitrate-N	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	-		-
Nitrate-N + Nitrite-N	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	-		-
Sulphate	mg/L	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	-		-

Sample not collected due to insufficient pressure in bore

Appendix E – Site KA9-EB (Former Emergency Bore). STOS KA9 Well Site (Lower Duthie Road)

Site Name	STOS KA9 Well Site, Lower Duthie Road (Site KA9-EB)
Well Details	The well at Site KA9-EB is between 35 m and 55 m deep and is cased through the water table to approximately 35 m below ground level. The depth to groundwater is approximately 13 m. The well casing is steel with a diameter of approximately 100 mm and is finished above ground. The well was formerly used as a firewater abstraction bore but is not currently used and no pump is installed in the well.
Pump Details	No pump installed.
Sampling Date	16 August 2016.
Sampler	AECOM.
Well use prior to sampling	None.
Sampling Methodology	A groundwater sample was collected by inserting a downhole bladder pump into the well, connected via dedicated polyethylene tubing to the surface. Groundwater was purged for approximately 24 minutes with a flow rate of approximately 0.15 L/min. An inline flow cell was used in conjunction with a multi parameter probe (YSI Professional Plus) to measure conductivity, pH, temperature, dissolved oxygen and redox in the purged groundwater. The well was sampled when parameters had stabilised. Water was observed to be clear during purging and sampling. The groundwater sample was collected directly into laboratory supplied sample bottles. The groundwater sample was kept under chilled conditions and transported to Hill Laboratories Limited (Hill Laboratories) under standard chain of custody procedures.
Laboratory Analysis	The groundwater sample was identified as "KA9 – EB" and was analysed by Hill Laboratories for the following analytes: - pH - Conductivity - Chloride - Total petroleum hydrocarbons (TPH) - Benzene, toluene, ethylbenzene, and xylenes (BTEX) A duplicate groundwater sample identified as "MWX" was also collected from the well, and was analysed for BTEX.
Results Discussion	Results for the August 2016, February 2016, August 2015 and March 2015 monitoring events are tabulated and attached. General baseline groundwater parameters for the groundwater sample collected from Site KA9-EB are similar to those recorded previously. Concentrations of TPH and BTEX were not detected above MDLs in the groundwater sample collected from Site KA9-EB. The results are similar to the results from the February 2016, August 2015 and March 2015 monitoring events, during which only trace concentrations of toluene and no TPH or other BTEX compounds were detected.

The information included within this Appendix has been provided to Shell Todd Oil Services Limited for the purpose of and in accordance with the conditions of our engagement "STOS Kapuni Off-Site Monitoring – PO 4512765691".

Site KA9-EB (Former Emergency Bore)

Sample Location	*Units*	Lower Duthie Road				
AECOM Sample Number		KA9 - Emergency Bore	KA9 - Emergency Bore	KA9 - Emergency Bore	KA9 - Emergency Bore	KA9 - Emergency Bore
Laboratory Sample Reference		1402708.1	1403749.1	1465459.7	1535293.4	1632819.1
Date Sampled		23/03/15	23/03/15	20/08/15	4/02/16	16/08/16
Total Petroleum Hydrocarbons (TPH)						
C_7-C_9	mg/L	-	< 0.10	< 0.10	< 0.10	< 0.10
C_{10}-C_{14}	mg/L	-	< 0.2	< 0.2	< 0.2	< 0.2
C_{15}-C_{36}	mg/L	-	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C_7 - C_{36})	mg/L	-	< 0.7	< 0.7	< 0.7	< 0.7
BTEX Compounds						
Benzene	mg/L	-	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Toluene	mg/L	-	0.002	0.0015	0.0012	< 0.0010
Ethylbenzene	mg/L	-	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Total Xylenes	mg/L	-	< 0.0030	< 0.0030	< 0.0030	< 0.0030
Dissolved Metals						
Dissolved Barium	mg/L	0.082	-	-	-	-
Dissolved Calcium	mg/L	28	-	-	-	-
Dissolved Copper	mg/L	< 0.0005	-	-	-	-
Dissolved Iron	mg/L	3.6	-	-	-	-
Dissolved Magnesium	mg/L	20	-	-	-	-
Dissolved Manganese	mg/L	0.24	-	-	-	-
Dissolved Mercury	mg/L	< 0.00008	-	-	-	-
Dissolved Nickel	mg/L	0.0008	-	-	-	-
Dissolved Potassium	mg/L	17.1	-	-	-	-
Dissolved Sodium	mg/L	51	-	-	-	-
Dissolved Zinc	mg/L	23	-	-	-	-
Alkyl Quaternary Ammonium Compounds in Water by LCMSMS						
Benzalkonium Chloride (C12 homologue)	mg/L	< 0.010	-	-	-	-
Benzalkonium Chloride (C14 homologue)	mg/L	< 0.010	-	-	-	-
Benzalkonium Chloride (C16 homologue)	mg/L	< 0.010	-	-	-	-
Benzalkonium Chloride (total)	mg/L	< 0.018	-	-	-	-
DDAC (Didecyldimethylammonium chloride)	mg/L	< 0.010	-	-	-	-
Dodine	mg/L	< 0.010	-	-	-	-
IPBC (3-Iodo-2-propynyl-n-butylcarbamate)	mg/L	< 0.010	-	-	-	-
Ethylene Glycol in Water						
Ethylene glycol	mg/L	< 4	-	-	-	-
Propylene Glycol in Water						
Propylene glycol	mg/L	< 4	-	-	-	-
Methanol in Water - Aqueous Solvents						
Methanol	mg/L	< 2	-	-	-	-
Formaldehyde in Water by DNPH & LCMSMS						
Formaldehyde	mg/L	< 0.02	-	-	-	-
Gases in groundwater						
Ethane	mg/L	< 0.003	-	-	-	-
Ethylene	mg/L	< 0.003	-	-	-	-
Methane	mg/L	13.8	-	-	-	-
Other Analyses						
Sum of Anions	meq/L	6.8	-	-	-	-
Sum of Cations	meq/L	6.6	-	-	-	-
pH	pH Units	7.5	-	7.5	7.6	7.5
Total Alkalinity	mg/L as $CaCO_3$	300	-	-	-	-
Bicarbonate	mg/L at 25°C	370	-	-	-	-
Total Hardness	mg/L as $CaCO_3$	155	-	-	-	-
Electrical Conductivity (EC)	mS/m	62.7	-	54.8	61.1	57.2
Total Dissolved Solids (TDS)	mg/L	310	-	-	-	-
Bromide	mg/L	-	-	-	-	-
Chloride	mg/L	25	-	23	26	26
Nitrite-N	mg/L	< 0.002	-	-	-	-
Nitrate-N	mg/L	< 0.002	-	-	-	-
Nitrate-N + Nitrite-N	mg/L	< 0.002	-	-	-	-
Sulphate	mg/L	< 0.5	-	-	-	-

REPORT

STOS Kapuni Third Party Farm Bore Monitoring

for Shell Todd Oil Services

Rev 5 - 06/06/2017





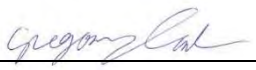
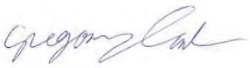

BTW COMPANY

SURVEYING | ENGINEERING | PLANNING & ENVIRONMENT

STOS Kapuni Third Party Farm Bore Monitoring

for Shell Todd Oil Services

Reviewed

Project Manager		06/06/2017
	Greg Larkin Senior Environmental Scientist, M.Sc. Environmental Science, B.Sc. Ecology	Date
Report Author		06/06/2017
	Greg Larkin Senior Environmental Scientist, M.Sc. Environmental Science, B.Sc. Ecology	Date
Reviewed by		06/06/2017
	Dave Bolger Senior Environmental Scientist, CEnvP.	Date

17214.02
Rev 5 - 06/06/2017

CONTENTS

TABLES

1 INTRODUCTION

1.1 Background

BTW Company were engaged by Shell Todd Oil Services (STOS) to undertake a groundwater monitoring event (GME) on selected bores in the Kapuni area. The selected groundwater monitoring sites were sampled in accordance with the proposal to STOS dated March 23 2017. The GME provides data and interpretation of the sampling undertaken on four bores located on third party farms located in the Kapuni area and another site located on the STOS operated KA 9 wellsite. The KA 9 Emergency Bore is adjacent the produced water re-injection well KW-02. Ten previous GME's had been undertaken on the third-party farm bores between December 2012 and August 2016 by AECOM Consulting Services (NZ) Ltd on behalf of STOS.

1.2 Objectives

The primary objective of the GME is to provide updated water chemistry data from the five sites located in the Kapuni area (Appendix A). The water chemistry data would assist in delineating any potential or actual adverse effects to the groundwater resources as a result of activities associated to STOS's activities in the Kapuni Condensate Gas field.

1.3 Scope of Works

The GME scope of works comprised of the following;

- Produce a project specific health safety and environmental (HSE) management plan outlining BTW Companies policy and procedural commitments, which includes journey management, permit to work requirements and land liaison with the third-party landowners.
- Collection of groundwater samples from the four third party farm bores and the former emergency bore on the KA 9 wellsite. Site access approval was obtained from both STOS and the third-party landowners prior to works commencing.
- Laboratory analysis of collected groundwater samples.
- Technical report for STOS.

2 GROUNDWATER MONITORING EVENT (GME) METHODOLOGY

2.1 GME Sampling Methodology

During the GME all field measurements and observations were recorded as per BTW Companies internal standard operating procedures (SOP) for groundwater sampling. All field sheets are in Appendix A and a copy of the BTW Company Groundwater Sampling SOP was provided as part of the proposal to STOS.

2.2 Chain of Custody Requirements

As per standard procedures with the analytical Laboratory ('Hills Laboratories'), a chain of custody form was completed and sent to the laboratory with the water sample. Information included; sample name, date of sample, tests required, type of material, sent by whom, date received by lab and sample temperature on arrival.

All samples collected were chilled then sent to Hills Laboratories by courier with COC maintained at all times to meet Hill's Laboratories holding time requirements for analysis. Hills Laboratories sent the chain of custody form back to BTW Company via email the following day to complete the chain of custody requirements. The analysis could be tracked via an online service Hill Laboratories provides to customers. The samples were processed under a high priority status by Hill Laboratories.

2.3 Groundwater Monitoring Event

The GME was carried out as follows;

- Site 1 (M Barr, 873 Skeet Road, Sampled on May 08 2017)
- Site 2 (PKW Farms, 468 Hastings Road, Sampled om May 08 2017)
- Site 3 (Kiley Estate, Inuawai Road, Sampled on May 08 2017)
- Site 4 (Naplin Trust, Ahipaipa Road, Sampled on May 02 2017)
- KA 9 Emergency Bore (STOS KA 9 wellsite, Lower Duthie Road, Sampled on May 08 2017)

The groundwater sample from site 1 was collected from a tap attached to a secondary storage pressure tank in the pump shed. Groundwater samples for sites 2-4 were collected from sampling taps close to the wellhead at each site. The groundwater sample for KA 9-EB was collected using a downhole 12-volt submersible pump with a low flow control unit.

Where possible the bores and sampling system were purged until the groundwater parameters (pH, Dissolved Oxygen, Electrical Conductivity, temperature and Oxidation-Reduction Potential) readings stabilised for three consecutive readings. The purge water from KA 9-EB was containerised and transported to the Kapuni Production Station for disposal in the interceptor.

2.4 GME sample collection and analysis

Groundwater samples were collected directly into laboratory supplied sample bottles.

Groundwater samples were analysed for the following;

- Sites 1-4- pH, Electrical Conductivity, Chloride, Total Petroleum Hydrocarbons (TPH)
- Site Ka 9-EB- Electrical Conductivity, Chloride, Total Petroleum Hydrocarbons (TPH) and Benzene, Toluene, Ethylbenzene and Xylenes (BTEX).

3 GME RESULTS

The GME analytical results are summarised in Table 3.1. No positive LNAPL or headspace VOC measurements were recorded from any of the monitoring bores during this GME.

Table 3.1: May 2017 GME Analytical Results

Sample Name:	Site 1 08-May-2017 12:00 pm	Site 2 08-May-2017 12:40 pm	Site 3 08-May-2017 11:00 am	Site 4 02-May-2017 11:50 am	KA9 08-May-2017 10:30 am
Lab Number	1771630.2	1771630.3	1771630.4	1768384.1	1771630.1
pH (pH units)	7	8.4	8.8	8.1	7.6
Electrical Conductivity (EC) (mS/m)	31.7	33.6	31.9	37.5	57.8
Chloride (g/m^3)	36	11.4	11.6	12.4	27
BTEX in Water by Headspace GC-MS					
Benzene (g/m^3)	-	-	-		< 0.0010
Toluene (g/m^3)	-	-	-		< 0.0010
Ethylbenzene (g/m^3)	-	-	-		< 0.0010
m&p-Xylene (g/m^3)	-	-	-		< 0.002
o-Xylene (g/m^3)	-	-	-		< 0.0010
Total Petroleum Hydrocarbons in Water					
C7 - C9 (g/m^3)	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
C10 - C14 (g/m^3)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36 (g/m^3)	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36) (g/m^3)	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7

- TPH concentrations was not recorded above the analytical method detection limit in all sites sampled during the May 2017 GME.
- BTEX concentrations was not recorded above the analytical method detection limit in the KA 9-Emergency Bore.
- Concentrations of Electrical Conductivity and Chloride at all sites are consistent with background concentrations for unimpacted groundwater.
- The results from the May 2017 GME indicate there is no hydrocarbon contamination to the groundwater resources adjacent the thirds party abstraction bores and the KA 9 wellsite.
- The results from the May 2017 GME are consistent with sampling results from the previously GME's between 2012 and 2017, indicating no hydrocarbon contamination within the groundwater resources adjacent to the five sampling sites.

4 SUMMARY

In relation to the results from the May 2017 GME, the following points are noted;

- The analytical results of the GME are consistent with the results from the previous GME's undertaken between 2012 and 2017.
- The results indicate that no hydrocarbon contamination exists in the five sampling sites which can be attributed to STOS's activities in the Kapuni area.

5 LIMITATION OF THE REPORT

This report has been produced in accordance with the project specific brief and scope of works and therefore should be read in entirety.

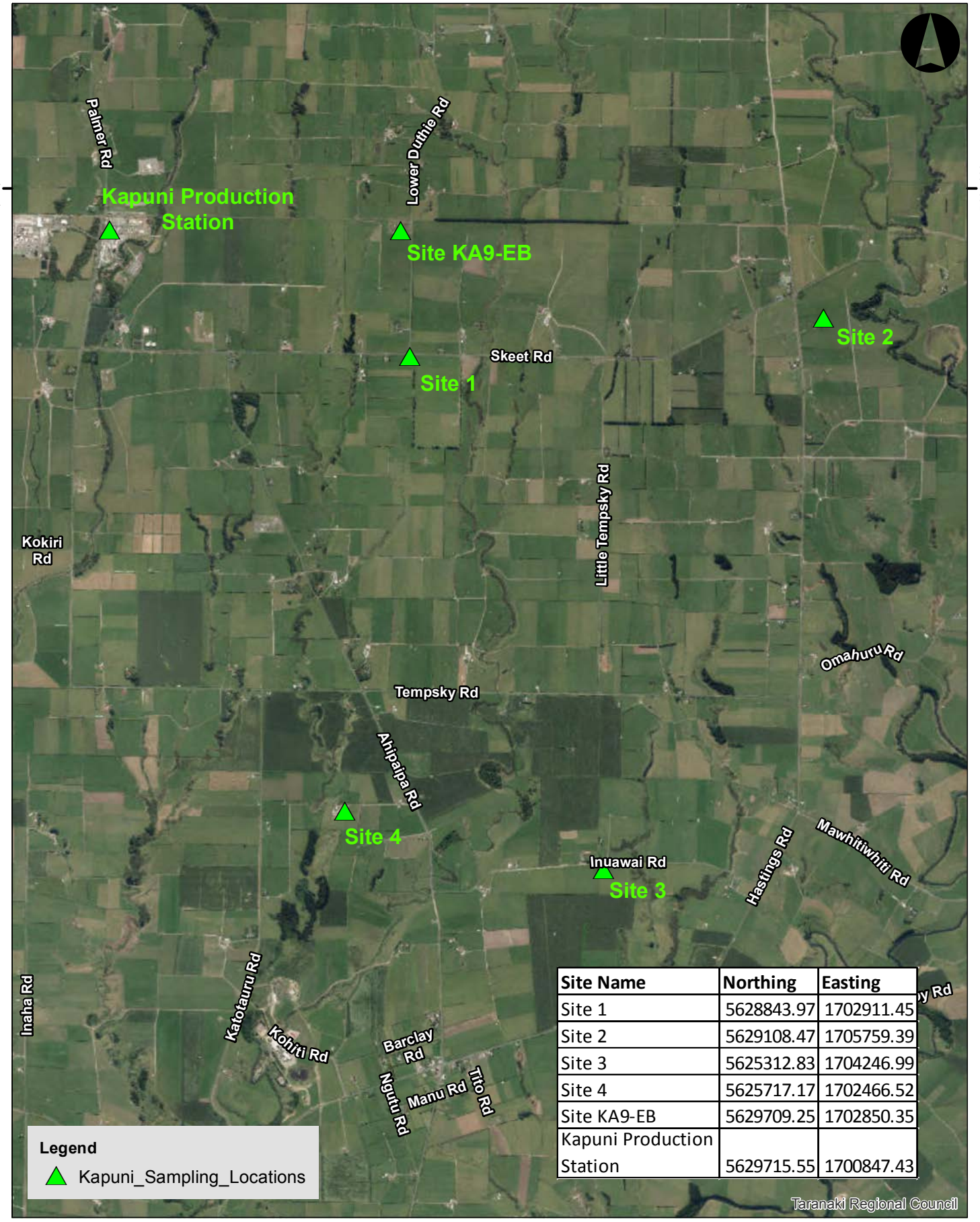
The responsibility of BTW Company is solely to the client STOS. This report is not intended for any third party, and as such no liability is undertaken to any third party.

Conclusions in this report are based solely on the information and findings of the May 2017 GME.

Groundwater and soil conditions are subject to continual natural and anthropogenic influences and can therefore exhibit a range of spatial and temporal variances. The collected data in this report is only directly relevant to the groundwater resources at the sampling sites and at the time this GME was undertaken.

If different groundwater conditions are encountered subsequent to the production of this report, BTW Company should be notified and allowed to provide an opportunity to review both the findings of this report and the new evidence.

APPENDIX A KAPUNI THIRD PARTY FARM BORES- SITE MAP



Site Name	Northing	Easting
Site 1	5628843.97	1702911.45
Site 2	5629108.47	1705759.39
Site 3	5625312.83	1704246.99
Site 4	5625717.17	1702466.52
Site KA9-EB	5629709.25	1702850.35
Kapuni Production Station	5629715.55	1700847.43

GENERAL NOTES
1. Coordinates are in terms of New Zealand Transverse Mercator

DISCLAIMER
GIS data and imagery are for indicative purposes only.
Cadastral information sourced from LINZ. Crown copyright reserved.
No works may be undertaken in the vicinity of pipelines without a work permit and 2 days' notice.
Contact Details: FirstGas: (06) 755-0861 Core Group: (06) 769-9391, (0800) 267-347

TITLE
THIRD PARTY WELL MONITORING SITE LOCATIONS

DRAWN	R.CADENHEAD	22/05/2017
CHECKED	G.LARKIN	22/05/2017
PROJECT No	17214.02	
LOCATION	KAPUNI	
SCALE	1:35,000	
ORIGINAL SIZE	A4	

Shell Todd Oil Services Limited

BTW COMPANY
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NO	DATE	BY	CHKD.

REVISIONS

0 160 320 640 960 1,280 1,600 Meters

1:35,000

DRAWING No 17214.02-GIS-REV0

SHEET 1

REVISION 0

APPENDIX B APRIL/MAY 2017 GME FIELD SHEETS

FIELD SHEET - GROUNDWATER MONITORING

Barr – Skeet Road.

BTW Company Groundwater Fieldsheet STOS Kapuni 3D seismic project

Site Name	Site 1	BORE No:	Site 1
Date	8/5/17	Collected by	DB+NC
Screen Depth	30-60	m	
Well Depth	65	m	
Location		Easting/Northing	

↳ 873 Skeet Rd

BTW Company Job No: 14576

Sample ID (Hills)	✓Site 1 08-May 2-17
Duplicate ID	NA
Routine Water test	
E.coli Profile	X
Turbidity	X

Other Notes

Sample off hose off pressure tank.

No access to bore.

- unknown submersible pump - model unknown

Aquifer 'slug test'

Static Water Level (m)	Time (hr)
NA	

Purging/drawdown

Purge method	Sub pump/ Tap
Time started	00:00
Time stopped	08:00
Flow rate	20L/Min
Sample appearance	Very discoloured orange/caramel colour
Purge depth	Tap
SWL (Start)	
SWL (End)	
Purge/drawdown volume (litres)	160L

Field Analysis

Static Water Level (m)	Time (hr) min	Volume Purged	EC (µS)	pH	T(°)	ORP (mV)	DO2 (%)	Comments (Colour, Odour)
NA	01:00	20L	313.8	7.38	14.0	224.6	21.4	Very discoloured
	02:00	40L	313.5	7.29	14.0	222.8	23.7	
	03:00	60L	313.4	7.27	13.9	223.5	27.5	discoloured/Ground
	04:00	80L	313.2	7.24	13.9	222.3	19.9	
	05:00	100L	313.4	7.20	13.9	222.2	14.8	
	06:00	120L	313.0	7.16	13.9	221.9	14.0	
	07:00	140L	312.9	7.13	13.7	222.0	13.8	Discoloured.
	08:00	160	312.8	7.13	13.9	221.9	13.9	Discoloured
								- Sample

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FIELD SHEET - GROUNDWATER MONITORING

BTW Company Groundwater Fieldsheet STOS Kapuni 3D seismic project Site 2 PKW

Site Name	Site 2 PKW	BORE No:	Site 2
Date	8/5/17	Collected by	DB/NC
Screen Depth		m	
Well Depth	337m	m	
Location	↳ 468 Hastings Rd	Easting/Northing	

BTW Company Job No: 14576

Sample ID (Hills) Site 2 08-may 2017 Other Notes

Duplicate ID NA

Routine Water test ✓

E.coli Profile ~~NV~~ ✓

Turbidity ✓

Connect to bore direct off the bore with inline flow cell.

Aquifer 'slug test'

Static Water Level (m)	Time (hr)
NA	

Purging/drawdown

Purge method	Sb pump / tap
Time started	00:00
Time stopped (min)	1h :12
Flow rate	45 L/m
Sample appearance	Clear

Purge depth unknown depth of submersible pump - model # unknown.

SWL (Start) unknown - static water level unknown

SWL (End) unknown

Purge/drawdown volume (litres) 14 - Approx 130 000 Litres per day yield

Field Analysis

Static Water Level (m)	Time (Hr)	Volume Purged	EC (µS)	pH	T(°)	ORP (mV)	DO2 (%)	Comments (Colour, Odour)
NA	0	2 L	322	8.39	17.9	250.6	3.2	Clear / No odour
	1.45 min	4	322.1	8.33	18.0	252.8	1.8	"
	3.47 min	6	322.0	8.56	18.0	254.6	1.0	"
	5.38 min	8	321.9	8.59	18.0	244.9	0.6	"
	7.41	10	321.8	8.60	18.0	255.0	0.6	"
	9.39	12	322.2	8.60	18.0	255.1	0.6	
NA	11.12	14	322.3	8.60	18.0	255.1	0.6	Clear / No odour - stable sample

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FIELD SHEET - GROUNDWATER MONITORING

Invanui Road

BTW Company Groundwater Fieldsheet STOS Kapuni 3D seismic project

Site Name	Site 3	BORE No:	Site 3
Date	8/5/17	Collected by	DB. NC
~~Screen~~ Depth	280	m	
Well Depth	448	m	
Location		Easting/Northing	

cased

↳ Kiley Estate

BTW Company Job No: 14576

		Other Notes
Sample ID (Hills)	Site 3 08-May 2017	
Duplicate ID	NA	
Routine Water test	✓	* Sample off hose at bore.
E.coli Profile	✓	
Turbidity		* Sample off hose, inline flowcell

- Sub - unknown

Aquifer 'slug test'

Static Water Level (m)	Time (hr)
NA	

Purging/drawdown

Purge method	Sb pump/Tap
Time started	00:00
Time stopped	09:00
Flow rate	1L/Min
Sample appearance	Slightly discoloured.

Purge depth	unknown submersible pump, model # unknown
SWL (Start)	NA
SWL (End)	NA
Purge/drawdown volume (litres)	7

Field Analysis

Static Water Level (m)	Time (Hr)	Volume Purged	~~EC (µS)~~ µS/cm	pH	T(°)	ORP (mV)	DO2 (%)	Comments (Colour, Odour)
unknown	10:51	1 L	304.6	9.18	17.5	249.3	1.3	Slightly discoloured
	10:52	2	304.4	9.18	17.5	248.8	0.8	
	10:54	3	304.0	9.18	17.5	243.0	0.6	
	10:56	4	304.4	9.18	17.5	248.8	0.5	
	10:57	5	305	9.18	17.5	249.7	0.5	
	10:58	6	304.8	9.18	17.5	249.9	0.5	
	10:59	7	304.4	9.18	17.5	249.0	0.5	Sample Stable

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FIELD SHEET - GROUNDWATER MONITORING

Farm Monitoring Bore - site 4.

BTW Company Groundwater Fieldsheet STOS Kapuni 3D seismic project

Site Name	Leroy Nilly	BORE No:	GND 1659
Date	2/5/17	Collected by	DB & TS
~~Screen~~ Depth	123	m	
Well Depth	~~432-456~~ 450m	m	
Location		Easting/Northing	

cased

BTW Company Job No: 14576

Sample ID (Hills)	Site 4 02 may
Duplicate ID	NA
Routine Water test	✓
E.coli Profile	✓
Turbidity	✓

Other Notes

- Sample taken directly from bore all bore head
- 20L purge and discrete YSI measurements recorded - pH, T, ORP, DO2%.
- Deep bore of 450 - Artesian / Continual flow.
- Discrete samples only from bucket.
- Bore purged after refilling tank after milking.

Aquifer 'slug test'

Static Water Level (m)	Time (hr)
NA	

Purging/drawdown

Purge method	sub pump / tap
Time started	
Time stopped	
Flow rate	NA
Sample appearance	Clear

Purge depth	unknown
SWL (Start)	unknown
SWL (End)	unknown
Purge/drawdown volume (litres)	NA

Field Analysis

Static Water Level (m)	Time (~~Hr~~ min)	Volume Purged	EC (µS)	pH	T(°)	ORP (mV)	DO2 (%)	Comments (Colour, Odour)
unknown	01:00	20 Litres	-	8.00	17.5	248.9	37.7	Clear, no odour

btw company

0:957

FIELD SHEET - GROUNDWATER MONITORING

BTW Company Groundwater Fieldsheet STOS Kapuni 3D seismic project

Site Name	KA9	BORE No:	KA9
Date	8/5/17	Collected by	OS+NC
~~Screen~~ Depth	35	m	
Well Depth	35	m	
Location	KA9 - NW (road)	Easting/Northing	

C ased

BTW Company Job No: 14576

Sample ID (Hills) KA9 08-may-2017 **Other Notes**

Duplicate ID	NA
Routine Water test	✓
E.coli Profile	✓
Turbidity	✓

PID = 0 ppm

Micro purge pump at 17m

Aquifer 'slug test'

Static Water Level (m)	Time (hr)

NA

Purging/drawdown

Purge method	Sub pump
Time started	0:957
Time stopped	10:21
Flow rate	1.13 l/ft/min
Sample appearance	discoloured

Purge depth	17m
SWL (Start)	13.28
SWL (End)	14.95
Purge/drawdown volume (litres)	25L /22 min

= Electrical conductivity probe giving eroneous reading

Field Analysis

Static Water Level (m)	Time (Hr)	Volume Purged	EC (µS)	pH	T(°)	ORP (mV)	DO2 (%)	Comments (Colour, Odour)
13.28	09:57	0		7.67	13.6	226.2	4.5	discoloured
	09:59	3L		7.76	13.7	224.8	2.0	discoloured
	10:01	5L		7.81	13.7	224.0	1.3	
	10:03	7L		7.85	13.7	223.4	1.2	
	10:05	9L		7.86	13.7	222.4	1.2	
	10:07	11L		7.84	13.8	221.9	1.2	discoloured
	10:09	13L		7.88	13.8	222.0	1.3	
	10:11	15L		7.86	13.8	221.9	1.7	
	10:13	17L		7.86	13.8	222.0	1.9	Slightly clearer than before, still discoloured though * sediment & flow is ok
	10:15	19L		7.86	13.8	221.8	3.5	
	10:17	21L		7.85	13.8	221.4	3.5	
	10:19	23L		7.85	13.8	221.3	3.5	
14.95	10:21	25L		7.85	13.8	221.4	3.5	

Stable sample

APPENDIX C HILLS LABORATORIES ANALYTIC REPORTS

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
1 Clyde Street Hamilton 3216
Private Bag 3205
Hamilton 3240 New Zealand

T 0508 HILL LAB (44 555 22)
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E mail@hill-labs.co.nz
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ANALYSIS REPORT

Client:	BTW Company Limited	**Lab No:**	1768384 SPv1
Contact:	Dave Bolger	**Date Received:**	03-May-2017
	C/- BTW Company Limited	**Date Reported:**	12-May-2017
	PO Box 551	**Quote No:**	84336
	New Plymouth 4340	**Order No:**	
		Client Reference:	KW02 Compliance GND1659
		Submitted By:	Dave Bolger

Sample Type: Aqueous

Sample Name:		KW02 Compliance - GND1659 02-May-2017 11:50 am				
Lab Number:		1768384.1				
Individual Tests						
pH	pH Units	8.1	-	-	-	-
Electrical Conductivity (EC)	mS/m	37.5	-	-	-	-
Chloride	g/m³	12.4	-	-	-	-
BTEX in Water by Headspace GC-MS						
Benzene	g/m³	< 0.0010	-	-	-	-
Toluene	g/m³	< 0.0010	-	-	-	-
Ethylbenzene	g/m³	0.0010	-	-	-	-
m&p-Xylene	g/m³	< 0.002	-	-	-	-
o-Xylene	g/m³	< 0.0010	-	-	-	-
Total Petroleum Hydrocarbons in Water						
C7 - C9	g/m³	< 0.06	-	-	-	-
C10 - C14	g/m³	< 0.2	-	-	-	-
C15 - C36	g/m³	< 0.4	-	-	-	-
Total hydrocarbons (C7 - C36)	g/m³	< 0.7	-	-	-	-

Analyst's Comments

Sample 1 Comment:
Please note that the TPH C7 - C9 band was analysed by the head space/GCMS method, with all other TPH bands analysed by hexane solvent extraction/GC/FID.

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m³	1
Total Petroleum Hydrocarbons in Water	Solvent Hexane extraction, GC-FID analysis, Headspace GC-MS FS analysis US EPA 8015B/MfE Petroleum Industry Guidelines [KBIs:2803,10734;26687,3629]	0.06 - 0.7 g/m³	1
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
pH	pH meter. APHA 4500-H+ B 22nd ed. 2012. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field.	0.1 pH Units	1
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 22nd ed. 2012.	0.1 mS/m	1

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cl^- E (modified from continuous flow analysis) 22nd ed. 2012.	0.5 g/m^3	1
C7 - C9	Head Space, GCMS analysis.	0.06 g/m^3	1
C10 - C14	Solvent extraction, GC-FID analysis. US EPA 8015B/NZ OIEWG.	0.2 g/m^3	1
C15 - C36	Solvent extraction, GC-FID analysis. US EPA 8015B/NZ OIEWG.	0.4 g/m^3	1
Total hydrocarbons (C7 - C36)	Solvent extraction, GC-FID analysis and Headspace, GC-MS FS analysis for C7-C9 carbon band.	0.7 g/m^3	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

Carole Rodgers-Carroll BA, NZCS
Client Services Manager - Environmental

Hill Laboratories
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ANALYSIS REPORT

Client:	BTW Company Limited	**Lab No:**	1771630	SPv1
Contact:	Greg Larkin	**Date Received:**	09-May-2017	
	C/- BTW Company Limited	**Date Reported:**	16-May-2017	
	PO Box 551	**Quote No:**	84336	
	New Plymouth 4340	**Order No:**	17214.02	
		Client Reference:		
		Submitted By:	Dave Bolger	

Sample Type: Aqueous

Sample Name:	KA9 08-May-2017 10:30 am	Site 1 08-May-2017 12:00 pm	Site 2 08-May-2017 12:40 pm	Site 3 08-May-2017 11:00 am	
Lab Number:	1771630.1	1771630.2	1771630.3	1771630.4	
Individual Tests					
pH (pH Units)	7.6	7.0	8.4	8.8	-
Electrical Conductivity (EC) (mS/m)	57.8	31.7	33.6	31.9	-
Chloride (g/m^3)	27	36	11.4	11.6	-
BTEX in Water by Headspace GC-MS					
Benzene (g/m^3)	< 0.0010	-	-	-	-
Toluene (g/m^3)	< 0.0010	-	-	-	-
Ethylbenzene (g/m^3)	< 0.0010	-	-	-	-
m&p-Xylene (g/m^3)	< 0.002	-	-	-	-
o-Xylene (g/m^3)	< 0.0010	-	-	-	-
Total Petroleum Hydrocarbons in Water					
C7 - C9 (g/m^3)	< 0.06	< 0.06	< 0.06	< 0.06	-
C10 - C14 (g/m^3)	< 0.2	< 0.2	< 0.2	< 0.2	-
C15 - C36 (g/m^3)	< 0.4	< 0.4	< 0.4	< 0.4	-
Total hydrocarbons (C7 - C36) (g/m^3)	< 0.7	< 0.7	< 0.7	< 0.7	-

Analyst's Comments

Samples 1-4 Comment:
Please note that the TPH C7 - C9 band was analysed by the head space/GCMS method, with all other TPH bands analysed by hexane solvent extraction/GC/FID.

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
BTEX in Water by Headspace GC-MS	Headspace GC-MS analysis, US EPA 8260B [KBIs:26687,3629]	0.0010 - 0.002 g/m^3	1
Total Petroleum Hydrocarbons in Water	Solvent Hexane extraction, GC-FID analysis, Headspace GC-MS FS analysis US EPA 8015B/MfE Petroleum Industry Guidelines [KBIs:2803,10734;26687,3629]	0.06 - 0.7 g/m^3	1-4
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-4
pH	pH meter. APHA 4500-H^+ B 22nd ed. 2012. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field.	0.1 pH Units	1-4
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 22nd ed. 2012.	0.1 mS/m	1-4
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cl^- E (modified from continuous flow analysis) 22nd ed. 2012.	0.5 g/m^3	1-4

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
C7 - C9	Head Space, GCMS analysis.	0.06 g/m^3	1-4
C10 - C14	Solvent extraction, GC-FID analysis. US EPA 8015B/NZ OIEWG.	0.2 g/m^3	1-4
C15 - C36	Solvent extraction, GC-FID analysis. US EPA 8015B/NZ OIEWG.	0.4 g/m^3	1-4
Total hydrocarbons (C7 - C36)	Solvent extraction, GC-FID analysis and Headspace, GC-MS FS analysis for C7-C9 carbon band.	0.7 g/m^3	1-4

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

Peter Robinson MSc (Hons), PhD, FNZIC
Client Services Manager - Environmental

APPENDIX D HILL LABORATORIES CHAIN OF CUSTODY FORMS

Hill Laboratories
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ANALYSIS REQUEST

R J Hill Laboratories Limited
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Job No: **177 1630**

Date Recv: 09-May-17 05:36

Received by: Chloe Vedder

3117716308

Quote No 84336

Primary Contact Greg Harkin

Submitted By Dave Bolger

Client Name BTW Company Limited 40949

Address PO Box 551, New Plymouth 4340

Phone 06 759 5040 *Mobile*

Email

Charge To BTW Company Limited 40949

Client Reference

Order No 17214.02

Results To *Reports will be emailed to Primary Contact by default. Additional Reports will be sent as specified below.*

☑ Email Primary Contact ☑ Email Submitter ☐ Email Client

☐ Email Other

☐ Other

CHAIN OF CUSTODY RECORD

Sent to Hill Laboratories
☑ Tick if you require COC to be emailed back

Date & Time: 8/5/17 15:00
Name: Dave Bolger
Signature: DBolger

Received at Hill Laboratories
Date & Time: 9/5/17 10:55
Name: Scott R
Signature:

Condition ☐ Room Temp ☐ Chilled ☐ Frozen
Temp: 1.2

☐ Sample & Analysis details checked
Signature:

ADDITIONAL INFORMATION

BTEX only on KA 9 bore

Priority ☐ Low ☐ Normal ☑ High

☐ **Urgent** (ASAP, extra charge applies, please contact lab first)

NOTE: The estimated turnaround time for the types and number of samples and analyses specified on this quote is by 4:30 pm, 5 working days following the day of receipt of the samples at the laboratory.

Requested Reporting Date:

Quoted Sample Types

Ground Water (GW)

No.	Sample Name	Sample Date/Time	Sample Type	Tests Required
1	KA 9	8/5/17 10:30	GW	As per quote
2	Site 1	" 12:00	"	As per quote - except no BTEX
3	Site 2	" 12:40	"	" "
4	Site 3	" 11:00	"	" "
5				
6				
7				
8				
9				
10				

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Job Information Summary

Client:	BTW Company Limited	**Lab No:**	1771630
Contact:	Greg Larkin	**Date Registered:**	09-May-2017 10:54 am
	C/- BTW Company Limited	**Priority:**	High
	PO Box 551	**Quote No:**	84336
	New Plymouth 4340	**Order No:**	17214.02
		Client Reference:	
		Add. Client Ref:	
		Submitted By:	Dave Bolger
		Charge To:	BTW Company Limited
		Target Date:	16-May-2017 4:30 pm

Samples

No	Sample Name	Sample Type	Containers	Tests Requested
1	KA9 08-May-2017 10:30 am	Ground Water	UP500, TPH250, VOC40, VOC40	pH; Electrical Conductivity (EC); Chloride; TPH + BTEX profile, Water
2	Site 1 08-May-2017 12:00 pm	Ground Water	UP500, TPH250	pH; Electrical Conductivity (EC); Chloride; Total Petroleum Hydrocarbons in Water
3	Site 2 08-May-2017 12:40 pm	Ground Water	UP500, TPH250	pH; Electrical Conductivity (EC); Chloride; Total Petroleum Hydrocarbons in Water
4	Site 3 08-May-2017 11:00 am	Ground Water	UP500, TPH250	pH; Electrical Conductivity (EC); Chloride; Total Petroleum Hydrocarbons in Water

SUMMARY OF METHODS

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Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-4
pH	pH meter. APHA 4500-H^+ B 22nd ed. 2012. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field.	0.1 pH Units	1-4
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 22nd ed. 2012.	0.1 mS/m	1-4
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cl^- E (modified from continuous flow analysis) 22nd ed. 2012.	0.5 g/m^3	1-4
C7 - C9	Head Space, GCMS analysis.	0.06 g/m^3	1-4
C10 - C14	Solvent extraction, GC-FID analysis. US EPA 8015B/NZ OIEWG.	0.2 g/m^3	1-4
C15 - C36	Solvent extraction, GC-FID analysis. US EPA 8015B/NZ OIEWG.	0.4 g/m^3	1-4
Total hydrocarbons (C7 - C36)	Solvent extraction, GC-FID analysis and Headspace, GC-MS FS analysis for C7-C9 carbon band.	0.7 g/m^3	1-4