Shell Todd Oil Services Limited

Application to Taranaki Regional Council for Four Discharge Consents and Assessment of Environmental Effects

Hydraulic Fracture Stimulation at Four Existing Wellsites within the Kapuni Field

January 2012

CONTENTS

APPENDICES

EXECUTIVE SUMMARY

- Shell Todd Oil Services Ltd (STOS) is seeking resource consent to discharge contaminants into land associated with hydraulic fracture stimulations planned at four wellsites within the Kapuni field. This document includes an Assessment of Environmental Effects (AEE) relating to the proposed discharge to the environment as well as the Taranaki Regional Council application forms.

- STOS is planning to undertake a 3-well programme of workover/drilling and hydraulic fracture stimulation activities at two existing wellsites (KA 1/7 and KA 4/14) within PML38839 during 2012/13. One of these wells is an existing well (KA-14) and the other two (KA-19 and KA-20) are new wells to be drilled from the KA 1/7 wellsite. Initially only KA-14 and KA-19 will be fracture stimulated.

- STOS is also planning to undertake stimulation activities at two other existing wells (KA-18 and KA-17) within the Kapuni field during 2012/13 as part of an ongoing programme to maximise the recovery of gas and condensate from existing wells.

- Additional stimulation may be undertaken at these four wellsites in the future depending upon future field development and work programmes.

- The process of hydraulic fracturing is well understood and has been successfully undertaken at a number of wells within the Kapuni field since 1993 with no identified adverse effects on the environment.

- In the Kapuni field area, a fresh water aquifer is found in the upper section of the Matemateaonga formation (down to approximately 650m below ground level), whilst more saline water is found towards the base of that formation at approximately 1,650m below ground level. Transition to higher salinity is a gradational feature.

- Kapuni Group Intervals targeted for hydraulic fracture stimulations are located at depth of approximately 3150 to 3650 m below ground level and hence separated from freshwater aquifers in the Matemateaonga by a minimum of approximately 1500 m (vertically) of geological formations.

- The wells are designed to withstand Kapuni reservoir pressures as well as the high pressures generated during hydraulic fracturing (confirmed by pressure testing). Both the well designs and hydraulic fracturing designs ensure that fracture fluids are contained in the target formations, eliminating the risk of contamination of shallow freshwater aquifers.

- Execution of hydraulic fracturing programmes are routinely monitored in real time ensuring that execution takes place as planned and contingency plans are in place to respond pro-actively to any eventualities. All chemicals used in these operations are also carefully managed on site and returned fracture treatment fluids are to be disposed under appropriate resource consents.

- The potential effects on the environment of the hydraulic fracture activities planned at these four sites have been assessed and are able to be avoided, remedied or mitigated to such an extent that they will be no more than minor.

- No affected parties have been identified in relation to these resource consent applications.

DEFFINITIONS AND ABBREVIATIONS

AEE: Assessment of Environmental Effects.

Analog well: A nearby well used to guide predictions of the likely reservoir character of a planned well that has not yet been drilled. Also referred to as an 'offset well'.

Composite plug: A plug made of a composite material that is designed to provide zonal isolation of the wellbore between multi-stage stimulation treatments. The composite material is easily milled allowing the plug to be removed at the end of the stimulation programme.

Conductor: The casing string that is usually put into the well first, particularly on land wells, to prevent the sides of the hole from caving into the wellbore.

Casing: Steel pipe cemented in place during the well construction process to stabilise the wellbore.

DCAF: Discipline Controls and Assurance Framework. The STOS quality control and assurance process for Well Engineering.

Flare: Pipe arrangement consisting of an open ended pipe with a burner on the end used for hydrocarbon combustion located a sufficient distance away from operations.

Fracture half length: Distance from the wellbore to the outer tip of one side of a fracture propagated by hydraulic fracturing.

Hydraulic fracture stimulation: The process where fluids are pumped down a well into the formation under pressure to fracture the rock in the formation and enhance well flows.

Hydrostatic pressure: The pressure exerted by a fluid at equilibrium at a given point within the fluid, due to the force of gravity. Hydrostatic pressure increases in proportion to depth measured from the surface because of the increasing weight of fluid exerting downward force from above.

mAH: Metres along hole. Actual length of well bore.

MPa: Megapascal. Unit of pressure.

Mini-frac: Diagnostic injection test using viscosified fluid but no proppant designed to evaluate formation leak off and minimum horizontal stress used to finalise hydraulic fracture stimulation design.

Offset well: A nearby well used to guide predictions of the likely reservoir character of a planned well that has not yet been drilled. Also referred to as an 'analog well'.

Open hole log: Logging operations that are performed on a well before the wellbore has been cased and cemented.

Proppant: Material used to hold hydraulic fracture open. Proppant material used at Kapuni are Ceramic beads, 0.4 - 0.9mm in diameter.

PSI: Pounds per square inch. Unit of pressure.

RFWP: Regional Freshwater Plan for Taranaki (2001).

RMA: Resource Management Act 1991.

Screen Out: A condition that occurs when the proppant in a fracture fluid create a bridge across the perforations or similar restricted flow area. This creates a sudden and significant restriction to fluid flow that causes a rapid rise in pump pressure.[1]

Stage: A reservoir interval that is the target of a particular hydraulic fracture stimulation operation.

STOS: Shell Todd Oil Services Limited.

TVD (true vertical depth): Vertical depth of well as measured from the drill floor.

TVDss (true vertical depth subsea): Vertical depth of well relative to sea level.

METRIC / IMPERIAL CONVERSIONS

	Imperial	**Metric**
Pressure	1 psi	= 6,894.8 pascal
	1 psi	= 0.00689 megapascal
Length	1 inch (in)	= 25.4mm
	1 foot (ft)	= 0.3048 metre
Weight	1 pound (lb)	= 0.4536 kg

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1. Introduction

1.1 Background

Shell Todd Oil Services Ltd (STOS) is the licence holder of Mining Licence PML 38839. The License covers an area of 218.98 square kilometres and was issued in January 1970.

As part of the 2012/2013 development programme for Kapuni, STOS plans to drill two new wells (KA-19 and KA-20) at the existing KA 1/7 wellsite, located at 360 Palmer Road, Kapuni, and to recomplete existing well KA-14, located at 598 Palmer Road, Kapuni. Both KA-19 and KA-14 are planned to be hydraulic fracture stimulated as part of this programme, whilst new well KA-20, an observation well, may be subject to stimulation at a future date. This programme is anticipated to start Q1 2012 and be completed by 2013.

In addition, as part of STOS' ongoing well optimisation programme, hydraulic fracturing is planned to be undertaken at two other existing Kapuni wells, KA-17 and KA-18 also over 2012 / 2013.

This report has been prepared to document the Resource Consent applications for the discharge of contaminants into land under Rule 44 of the Regional Freshwater Plan for Taranaki (2001), and the associated Assessment of Environmental Effects (AEE), for planned and future hydraulic fracture simulation at the four well sites targeted in STOS' 2012 / 2013 work programme.

1.2 Site Location Information

KA-1/7 Wellsite (site for new KA-19 and KA-20 wells)

Applicant	Shell Todd Oil Services Ltd
Postal address	Private Bag 2035, New Plymouth
Site location	360 Palmer Road, Kapuni
Map reference	at or about NZTM 1701152E – 5630141N
Legal description	Lots 1& 2 DP 11138 Blk XVI Kaupokonui SD
Catchment	Kapuni

KA-4/14 Wellsite

Applicant	Shell Todd Oil Services Ltd
Postal address	Private Bag 2035, New Plymouth
Site location	598 Palmer Road, Kapuni
Map reference	at or about NZTM 1700895E – 5632589N
Legal description	Lot 1 DP 9050 Blks XII & XVI Kaupokonui SD
Catchment	Kapuni

KA-8/12/15/18 Wellsite

Applicant	Shell Todd Oil Services Ltd
Postal address	Private Bag 2035, New Plymouth
Site location	939 Eltham Road, Kapuni
Map reference	at or about NZTM 1701622E – 5634657N
Legal description	Lot 1 DP 11292

Catchment	Inaha

KA-6/11/17 Wellsite

Applicant	Shell Todd Oil Services Ltd
Postal address	Private Bag 2035, New Plymouth
Site location	849 Ahipaipa Road, Kapuni
Map reference	at or about NZTM 1701956E – 5627688N
Legal description	Lot 1 DP 10950 Blk XVI Kaupokonui SD
Catchment	Inaha

2. Resource Consents Sought

Hydraulic fracture stimulation activities have been routinely undertaken by STOS within the Kapuni field since 1993. Previously, it was considered that this type of activity did not require regulation under the Resource Management Act (RMA).

However, the Taranaki Regional Council has recently reviewed its position regarding hydraulic fracture stimulations and advised late July 2011 that resource consent is now required for these activities within Taranaki, under Rule 44 of the Regional Freshwater Plan for Taranaki.

Consequently STOS, as operator of PML38839, wishes to apply for resource consents to discharge contaminants associated with hydraulic fracture activities into land at, or below, a depth of 3000 mTVss from the following Kapuni wellsites:

- KA 4/14;
- KA 1/7/19/20;
- KA 8/12/15/18; and
- KA 6/11/17.

Completed Taranaki Regional Council application forms for these four applications are contained within Appendix 8. These applications cover both the planned hydraulic fracture stimulation programme during 2012/13 and future hydraulic fracture stimulation activities at these four wellsites that may be undertaken during the term of the consent. All of the wells covered by these consent applications are vertical wells[1].

These consent applications are made on the basis of an environmental envelope approach. A complete programme of hydraulic fracturing activities for the term of the consent is not available at this stage, however, the potential effects of future hydraulic fracturing can be assessed based on: a knowledge of the Kapuni field; the limitation of the application to depths at, or below, 3000 mTVss; the limitation of the activity to the same geological formations; and the repetitive nature of the activity.

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[1] Less than 30° hole angle.

3. Related Consents

A number of related resource consents relevant to the proposed stimulation programme in PML38839 are held by STOS, or are currently in the application process, as follows:

Air discharge consents

STOS holds air discharge consents for each of the four Kapuni wellsites at which stimulation will occur. These consents provide for the discharge of emissions into air from well workovers and in emergency situations and miscellaneous emissions associated with production activities. The relevant air discharge consents are as follows:

- KA 4/14 - Consent 6825-1;
- KA 1/7/19/20 - Consent 6822-1;
- KA 8/12/15/18 - Consent 6828-1; and
- KA 6/11/17 - Consent 6827-1.

The above consents include requirements for separation of liquid and solid hydrocarbons from the gas component of the well stream. For safety reasons, separation of the liquids/solids from the gas will not be able to be achieved during flaring associated with the proposed stimulation programme at these four wellsites. STOS has recently been granted temporary variations to Consents 6825-1 and 6822 -1 to remove this requirement for the period of the stimulation programme. Applications are in progress to apply for a similar dispensation for Consent 6828-1 and 6827-1.

Stormwater Consents

STOS holds existing stormwater consents for the four Kapuni wellsites at which stimulation will occur. There will be no additional stormwater discharges associated with the stimulation programme and existing stormwater conditions will be complied with. The relevant stormwater discharge consents are as follows:

- KA 4/14 - Consent 2365-3;
- KA 1/7/19/20 - Consent 6200-1;
- KA 8/12/15/18 – Consent 3265-3; and
- KA 6/11/17 – Consent 3266-3.

Noise

Due to an increase in noise emissions associated with the pumps engines used to carry-out the hydraulic fracture stimulations, noise emissions are anticipated to be above the limits specified within the South Taranaki District Plan for a limited period of time at each of the wellsites at which hydraulic fracture stimulation will occur. Accordingly, STOS are in the process of applying to the South Taranaki District Council for Land Use consent to generate noise which exceeds District Plan noise rules during stimulation at each of the four wellsites and also for noise associated with well workover at KA 4/14 and drilling activities at KA 1/7/19/20. Similar consents were applied for and granted for hydraulic fracture stimulation operations carried-out in 2010 and 2011 at the KA 8/12/15/18 well site. The location of these wellsites is shown in Figure 1.

4. Existing Environment

4.1 General Location & Topography

The general location of the four wellsites is shown on Figure 1.

The topography of the land surrounding the wellsites is gently rolling to flat farmland interspersed with a network of rural roads, rural dwellings and petroleum infrastructure (e.g. wellsites, production facilities and pipelines).

The four sites are located on the Taranaki Ring Plain, which was formed from Pleistocene lahars and volcanic ash derived from eruptions of Mt Taranaki. The volcanic material overlies older Tertiary sediment material in which the hydrocarbons are located.

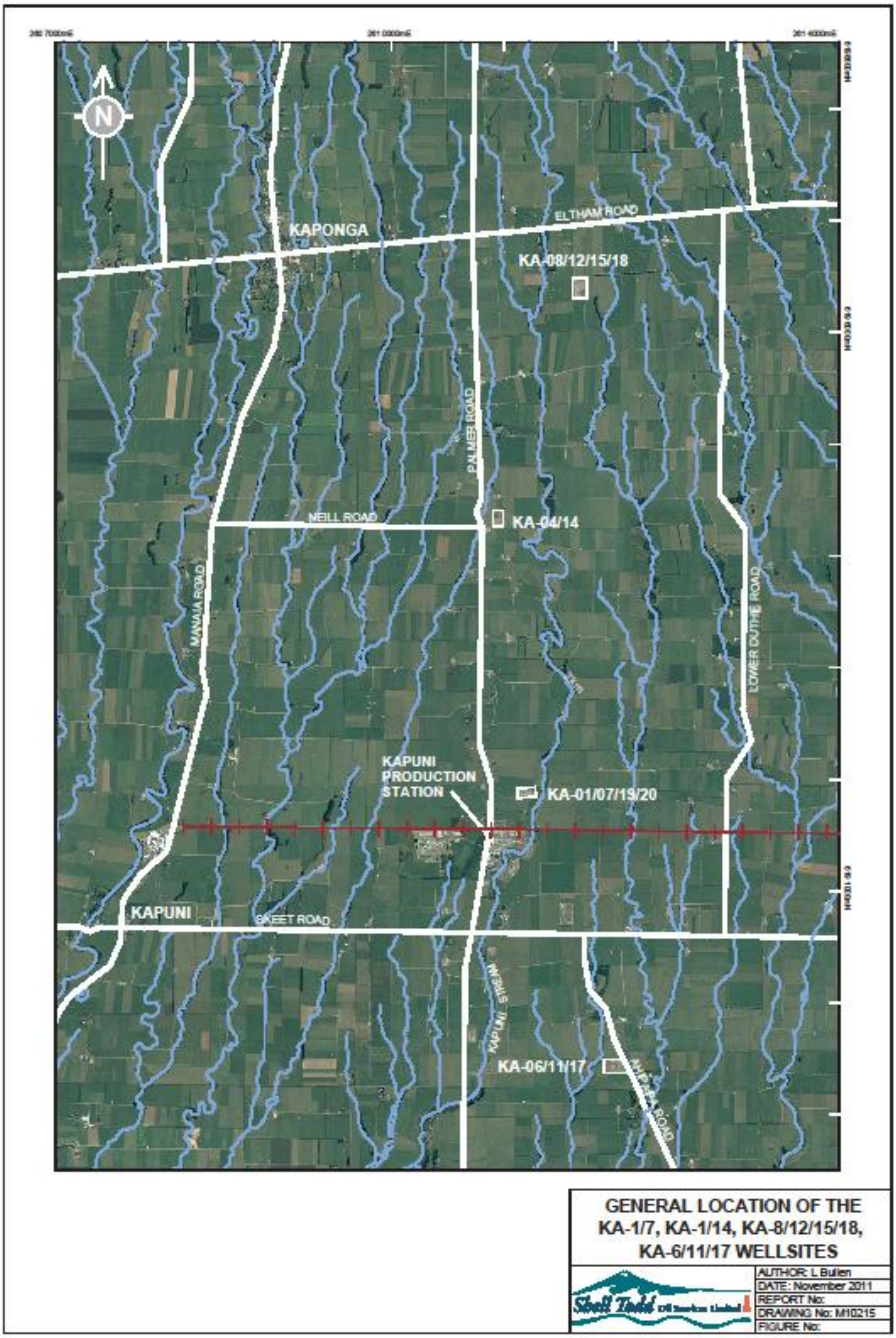
The land on which the four wellsites are located is owned by the Kapuni joint venture parties.

4.2 Land Use & Community

The surrounding land is used predominantly for dairy farming.

The area has been used for petroleum exploration and production activities since the 1950's, and petroleum infrastructure including wellsites, production facilities and pipeline installations are a feature of the existing landscape. These activities are familiar to the community and are an established part of the history of the area.

Figure 1: General location of the KA 1/7/19/20, KA 4/14, KA 8/12/15/18, and KA 6/11/17 wellsites



4.3 Vegetation and Wildlife

All of the four wellsites are located in the mid-ring plain, and surrounding landuse is dominated by grass vegetation associated with farming activities. There is no significant native vegetation in the immediate area other than the pastureland. Limited native vegetation is present along the margins of some nearby streams.

Wildlife in the immediate area is likely to be limited to common or adaptable native and introduced bird species, and limited in stream fauna. There are no scenic or recreation reserves, or State or National Parks in the immediate vicinity of the four sites.

4.4 Adjacent Water Ways

- The KA 1/7/19/20 site is located approximately 50m to the west of the Kapuni Stream.
- The KA 4/14 site is located approximately 350m to the west of the Kapuni Stream and approximately 100m to the east of an unnamed tributary.
- The KA 8/12/15/18 site is located approximately 250m to the east of the Kapuni Stream and approximately 250m to the west of an unnamed tributary.
- The KA 6/11/17 site is located approximately 50m to the east of an unnamed tributary and 250m to the west of another unnamed tributary.

4.5 Groundwater Resources

4.5.1 Aquifers

Water bores in the Kapuni area access aquifers in the shallow Egmont Volcanics, Whenuakura and Matemateaonga Formations. Upper Urenui Formation sandstones accessed in some Northern Taranaki water wells are not targeted in the Kapuni area due to the significantly greater thickness of the Matemateaonga Formation in South Taranaki, and the resistivity log response indicate that the Urenui sandstones contain saline formation water (see Table 2 below for geological sequence stratigraphy and Figure 2 for an overview of the Kapuni Field).

The Matemateaonga provides extensive aquifers within sands and shellbeds between relatively impermeable mudstones layers (Allis et al, 1997; Ref.1). The upper section of the formation contains freshwater while the lower section and below contains saline water. The saline to fresh water interface is reported to be a gradational feature both vertically and spatially i.e. it is approximate and location / elevation dependent. The Groundwater Resources of The Taranaki Region (Ref.9) states that, “A freshwater/saltwater interface extends beneath the entire Taranaki peninsula. ...The interface occurs at depths of about 700 to 1000 metres below the surface, throughout the region usually within the basal Matemateaonga Formation”.

A number of petrophysical logs are available in Kapuni to characterise this interface, although clearly the shallower formations have not been subject to the same in-depth evaluation of the hydrocarbon bearing Kapuni Group targeted in the field’s development:

- Earlier wells, KA-01 to KA-09, and KA-12 to KA-15 received full resistivity log coverage. On a few occasions other open hole formation evaluation logs (occasional sonic and density logs) were run in these wells in the shallow sections in order to give an indication of the fluid and rock properties. In general these logs were of poor quality and do not allow a modern evaluation of the reservoir properties and fluids to be carried-out.

- A comprehensive set of logs was acquired in KA-13 drilled in 1983. This comprehensive logging suite, including density and neutron logs, are required for evaluating the porosity and, combined with resistivity information, provide estimates of apparent formation water resistivity. All intervals, including the shallower sections of volcanics and the Matemateaonga formation (from 300 m below the ground level), were covered.

- Similar to earlier Kapuni wells, open hole formation evaluation logging in KA-16, -17 and -18 does not cover the full Matemateaonga formation, as these were not required to evaluate the wells' targeted objectives.

Given the above, the petrophysical evaluation of the Matemateaonga in KA-13 has formed the basis for STOS' estimation of salinities in the shallow subsurface. This evaluation shows that fresh water (total salinity approximately 300 ppm) is interpreted down to 650 m below ground level. This evaluation also shows a possible transition zone, with salinities interpreted in the range of 1,000 to 2,000 ppm (brackish water) near the base of the Matemateaonga at 1,650 m below ground level. This interpretation does not include corrections for shales that would be possible with a modern set of high quality logs. The formation water salinity is greater than 10,000 ppm below 1,750 m below ground level.

4.5.2 Water Abstractions

There are a number of water abstractions from local groundwater resources in the Kapuni area including those for water supply, agricultural and industrial purposes. The majority are reported to access the unconfined aquifers in the Egmont Volcanics and Whenuakura Formation. [2]

There are two bores associated with the South Taranaki District Council Hawera Water Supply scheme located approximately 900m to the south of the KA 1/7/19/20 wellsite. These wells have been developed to provide 2,000 – 3,000 cubic metres of water per day from sands between 402-438 metres below ground level. Water abstraction targets the MAT-01 to MAT-03 sands at the top of the Matemateaonga formation. Analysis (Ref 3) of the water from the South Taranaki District Council water bore GND 2021 determined the water to have pH 8.1, total alkalinity 150 g/m^3 as $CaCO_3$, total dissolved solids 200 g/m^3, and total sodium of 31 g/m^3. The consultancy MWH report for the Council indicated that the water was hard with the potential to form scale and would require treatment to soften the water.

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[2] The Whenuakura Formation is a basal sandy interval of the Egmont Volcanics at Kapuni.

Table 1 below provides a summary of groundwater bore information obtained from the Taranaki Regional Council groundwater database[3]. A search was undertaken of groundwater bores located within a 1,200m radius of each of the four STOS wellsites that are the subject of this AEE. Table 1 includes only those wells used for water abstraction and does not include a number of monitoring bores and gas/condensate wells within the Kapuni field that are also included in the TRC groundwater database. With the exception of the bores associated with the Hawera Water Supply Scheme at the Kapuni Water Treatment Plant, the remaining groundwater bores are targeting shallow groundwater or the abstraction depth is not recorded. There were no records of water abstraction bores within 1.2 km of the KA 8/12/15/18 wellsite.

It is noted that Table 1 only contains those groundwater bores that have been registered with the Taranaki Regional Council and that there may be other unregistered bores in the vicinity of the wellsites.

Municipal water supply in the Kapuni area is provided from the Waimate West water supply scheme operated by the South Taranaki District Council. Water for this water supply scheme is abstracted from the Mangawheroiti Stream.

Table 1: Registered Groundwater Abstractions Located within 1,200m of Kapuni Wellsites

TRC Database Code	Location	Use	Depth
KA 1/7			
GND0002	Ammonia Urea Plant, Kapuni	Industrial	83.2m
GND0093	STOS, KA 1/7 – emergency back-up water supply	Industrial	42.6
GND2005	Kapuni Water Treatment Plant	Domestic water supply	450m
GND2011	Kapuni Water Treatment Plant	Domestic water supply	450m
KA 4/14			
GND0908	Palmer Road, Kaponga	Domestic water supply	21.9
GND1689	STOS KA 4/14 – emergency back-up water supply	Industrial	70m
KA 6/11			
GND 1106	873 Skeet Road, Hawera	Stock & domestic	12m
GND1120	907 Ahipaipa Road, Hawera	Stock & domestic	7.1m
GND3002	820 Ahipaipa Road	Stock	Not recorded
GND3003	820 Ahipaipa Road	Stock	Not recorded

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[3] Information accessed October 2011

4.6 Lithology and Overpressure Containment

The Kapuni formation, which is targeted for hydraulic fracturing, is overlaid by an approximately 3000 m thick sequence of fine to extremely fine grained sedimentary rocks that become harder and decreasingly permeable with depth. A description of a typical stratigraphic column or geologic layers within the Kapuni field is given in Table 2. It should be noted that these formations extend across the field and that the depths and thicknesses included in Table 2 are based upon the KA-18 well and are representative for other wellsites within approximately 250 m.

The geological formations overlaying the Kapuni Group provide a number of natural barriers, or geological seals, which isolate the reservoir and prevent the hydrocarbons from escaping to the surface of the earth.

The Otaraoa formation, immediately above the Kapuni Group, provides the main geological seal between the Kapuni Group and other formations in the overburden. It is extensive, both locally and regionally, and sufficiently impermeable to seal (hold back) the 600 metre gas column found in Kapuni and the original reservoir over-pressure which was approximately 1100 psi (75 bar) greater than hydrostatic pressure. It is noted that the rest of the overburden section is considered at or near hydrostatic pressure, based on mud weight information.

The claystones of the Taimana, Manganui, Mount Messenger and Urenui Formations also provide extensive seals over the Kapuni field.

Finally, shales and coals within the Kapuni Group also form barriers between reservoir intervals. This is demonstrated by the different levels of reservoir pressure depletion that have been recorded for different sections of the reservoir as the hydrocarbons have been extracted.

Table 2: Stratigraphic Column (from KA-18 Well Completion Report)

Formation	***Top m along hole***	***Top m true vertical below sea level***	***Thickness m along hole***	**Description** *Dominant lithology in **bold***	**Inferred NZ Stage**	**Global Series**
Egmont Volcanics	5	*-264*	135	Dominantly orange brown **Clay / Silt / Sand** to large very hard volcanic rocks. Common volcanic ash layers, and in places buried peaty layers. **See Note 1.**	Haweran	Holocene - Pliocene
Tangahoe	140	*-129*	111	Dominantly soft grey **CLAYSTONE** and minor fine to coarse grained sandstone.	Mangapanian - Waipipian	Pliocene
Matemateaonga	251	*-19*	1426	**CLAYSTONE** with distinct sandstone and siltstone units, trace limestone.	Upper Tongaporutuan - Lower Opoitian	Pliocene - Miocene
Urenui	1677	*1348*	80	**CLAYSTONE**, medium to dark grey with very fine to fine grained sandstone, grades to siltstone to base.	Tongaporutuan - Kapitean	Miocene
Mt. Messenger	1757	*1425*	247	**CLAYSTONE**, medium to dark grey, trace light grey interbedded with siltstone and fine grained sandstone.	Waiauan - Tongaporutuan	
Upper Manganui	2004	*1659*	166	**CLAYSTONE** medium grey, firm to hard and moderately calcareous. Trace very fine grained sandstone.	Lillburnian - Tongaporutuan	
Moki	2170	*1817*	602	Medium to dark grey interbedded **SILTSTONE, CLAYSTONE, and SANDSTONE**. Sandstone very fine to medium grained, poorly sorted subangular grains.	Altonian - Lillburnian	
Lower Manganui	2772	*2390*	309	**CLAYSTONE and SILTSTONE**, medium to dark grey, firm to hard and increasingly calcareous.	Waitakian - Otaian	Oligocene - Miocene
Taimana	3081	*2684*	336	**CLAYSTONE and SILTSTONE**, medium to dark olive grey, firm to hard, moderately calcareous, in part limestone.		
Otaraoa	3417	*3009*	209	**CLAYSTONE**, with minor siltstone, medium olive grey, soft to hard, moderately to very calcareous, trace carbonaceous specks. Siltstone grades to very fine grained silty sandstone.	Duntroonian - Whaingaroan	Oligocene
Matapo Member	3626	*3218*	12	**CLAYSTONE**, light olive grey, soft to firm, very calcareous. Trace carbonaceous laminations and minor fine grained calcite cemented sandstone with glauconite grains.	Whaingaroan	
Top Kapuni	3638	*3230*	427m drilled, base not reached	**SILTSTONE**, brown grey, firm, non calcareous grades to sandstone. **SANDSTONE**, clear to translucent very fine to fine grained, well sorted subrounded grains. Trace argillaceous matrix and dark lithic grains.. COAL, black brown, jagged fracture, earthy to vitreous lustre.	Kaiatan - Runangan	Eocene

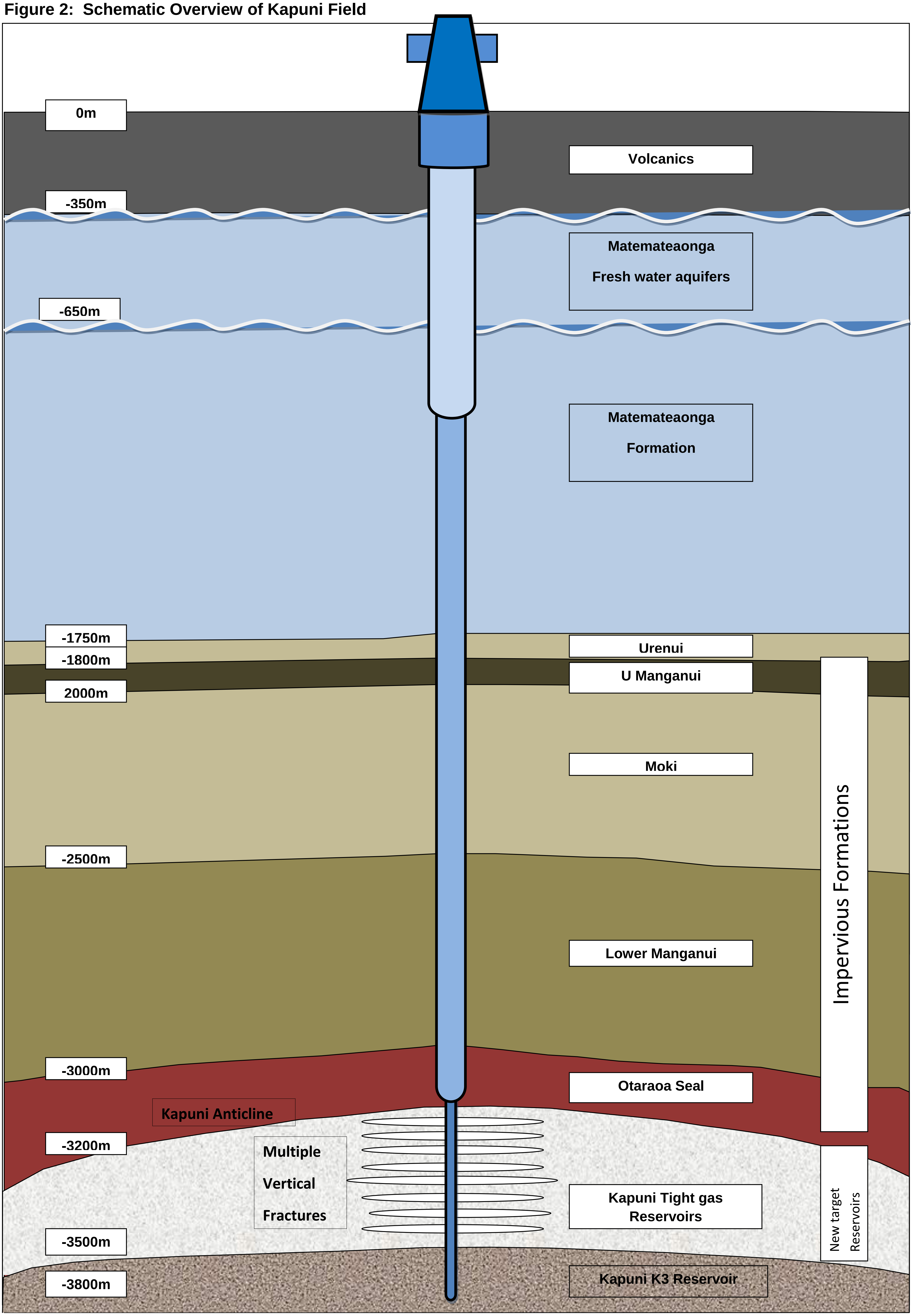
Notes.

1. The Whenuakura Formation is a basal sandy interval of the Egmont Volcanics at Kapuni.
2. Depths below sea level are negative when the depth is higher than the mean sea level.

4.7 Faulting

There are some indications that the Kapuni area was subject to faulting during deposition i.e. faults of Eocene age, more than 30 million years ago. The Eocene age faults are not generally connected to younger faults. The Kapuni group was under a compressional stress regime during the formation of the anticline. Geomechanical studies of the Kapuni field (Ref.6), supported by field data, show that faults in the Kapuni area are no longer under compressional stress but are in tension. Additionally, analysis of faults encountered at Kapuni indicate that they are not critically stressed (i.e. not prone to slippage).

Figure 2: Schematic Overview of Kapuni Field



5. Description of Proposed Activity

5.1 Overview

It is proposed to discharge contaminants – namely hydraulic fracturing fluids - during hydraulic fracturing activities at four Kapuni wellsites (KA-1/7/19/20, KA4/14, KA-6/17 and KA-08/12/15/18), at a depth below 3150 m below ground. The process of hydraulic fracturing is undertaken to encourage the gas to flow more freely from geological formations intercepted by the well, thereby increasing well rate and recovery per well.

5.2 Overview of Geological Formations

The Kapuni Group of sandstones are the target for hydraulic fracture stimulation. Within the Taranaki Basin, the targeted Kapuni Group consists of Eocene lower coastal plain fluvio-estuarine sediments deposited in an overall transgressive system. The target sands are located between 3,150 – 3,650 m below ground in depth and are comprised of both high net to gross fluvial sands interbedded with floodplain shales and coals and low net to gross siltstones, marine influenced sandstones, floodplain shales and coals. The sands contain hydrocarbons, but are of low permeability such that stimulation is required for the intervals to produce.

Appendix 1 provides well log gamma response for each of the four wells that will be subject to hydraulic fracture stimulation during 2012/13. The KA-19 well is a new well to be drilled and, therefore, there is no well log available until the drilling and logging programme has been completed. These well logs are representative of the other wells at each of these four sites that may be subject to hydraulic fracture stimulation in the future. Notable on these logs is the regionally extensive Otaroa formation, which provides an extensive regional seal to the Kapuni formation. Additional geological information is provided in Section 4.6.

5.3 Overview of Proposed Stimulation Programme

Table 3 below provides an indicative timetable of hydraulic fracture stimulation to be undertaken during 2012/13 at the four Kapuni wellsites which are the subject of this AEE. Additional stimulation activities are likely to be undertaken at each of the wellsites during the term of the resource consent. The exact location and number of stimulations to be undertaken is yet to be determined but will be based upon the results of the current programme and well performance monitoring. Future stimulation activity at each site may be associated with the wells listed in Table 3 below or may involve some of the other wells located at each of the four wellsites. There is also the potential that new wells may be drilled at these wellsites which may then be subject to stimulation.

Table 3: Indicative Hydraulic Fracture Stimulation Programme for 2012/13

Well	Planned Execution Timeframe	Number of Hydraulic Fracture Treatments / Well	Target Interval Depth Range
KA-18	2012/13	1	3500 to 3550 mTVD
KA-14	Q2/3 2012	9	3300 to 3700 mTVD
KA-17	2012/13	2-8	3150 to 3600 mTVD
KA-19*	Q4 2012	7-9	3200 to 3650 mTVD

***Well not drilled, depths and number of treatments based on analog wells**

The remainder of this section is based upon stimulation activities currently programmed for 2012/13 at the four Kapuni wellsites that are considered in this AEE. Execution timing is hinged on rig arrival for the KA-14 workover and the KA-19 new drill. The KA-18 and KA-17 execution timing will be worked around these rig based activities. In relation to stimulation programme beyond this time, it is not feasible to provide accurate descriptions of stimulation depths, fluids and timing, however any future stimulation undertaken at these wellsites would be targeting the same formations and would be undertaken in essentially the same manner as that described below. Therefore, the stimulation programme currently proposed and for which the environmental effects have been assessed can be considered representative of any future stimulation activities to be undertaken at these wellsites. While there may be some variation in the details of future hydraulic fracture stimulation programmes, the environmental effects of future activities will be similar and can be assessed based on an environmental envelope approach. STOS anticipates that a requirement to provide programme specific information (e.g. site; depth of treatment; chemicals to be used; fluid volumes; timing) for future stimulation programmes would be included as a special condition on the resource consent for each site.

5.4 Description of Process

All hydraulic fracture stimulation activities are overseen by specialist consultants with extensive experience in undertaking hydraulic fracturing.

Hydraulic fracture stimulation treatments within the Kapuni group of sandstones will occur at depths greater than 3000 mTVDss. The treatments will utilise gelled water as a viscosified carrier fluid to transport and place ceramic beads (proppant) within the desired hydrocarbon reservoir as a method to enhance productivity of gas within the low permeability sandstones.

Hydraulic fracture stimulation is the process whereby fluids are pumped down the well into the formation under pressure to enhance well flows. The intention is to create a fissure in the reservoir rock and prop it open by placing a high strength material within the fissure. The injected fluids contain mostly water and proppant (ceramic beads, 0.4 - 0.9mm in diameter) along with a mixture of chemical agents to transport the proppant. The proppant flows with the fluid into the fractures and remains there, ‘propping’ the fracture open.

A bi-wing vertical fissure is created growing away from the well in opposing directions. Stresses within the formation govern growth in both direction and height of the fissure. Each "wing" of the fissure grows to a length which is called the fracture half length and is typically assumed to be symmetric to the well. The fissure grows in height within the treatment reservoir and surrounding layers and is designed to extend to a sufficient distance away from the well to optimally enhance hydrocarbon productivity. The height of the fracture is controlled by stress variations and interface mechanics between the reservoir layers. Typically, the fractures are contained vertically by intra reservoir coal and shale layers. The proppant holds the fissure open to allow for enhanced flow of hydrocarbons from the reservoir. The chemical agents are designed to degrade the gel to a low viscosity fluid, over a period of time, allowing it to flow out of the well.

As illustrated in the operational procedure (Section 5.5), the well design allows for multiple intervals to be stimulated in a single well, by simply repeating the treatment procedure. The sand layers with indication of hydrocarbons are selected and grouped for stimulation as a hydraulic fracture treatment stage. The treatment stages are typically composed of 1 to 3 sand lenses per stage. Each stage is isolated by a composite plug which latches to the walls of the casing and provides pressure isolation from above.

Staging of a well depends on sand thickness, permeability, expected reservoir pressure and location within the well and is established based on data obtained during the drilling process (open-hole logs). The hydraulic fracture stimulation is designed to cover the entire height of the sand interval with proppant and should extend away from the well to the desired fracture half length in order to optimise productivity gains. Typical proppant filled fractures in Kapuni are a height of 10 to 30 m and an effective fracture half length of 50 to 150 m.

In order to create and fill the desired fissure geometry, treatments are designed to place between 50,000 to 300,000 pounds (22,700 – 136,000 kg) of proppant using a viscosified fluid for transport. Treatments will use 0.3 to 0.5 gals (0.001 – 0.002 m^3) of fluid per pound of proppant. This works out to 15,000 gallons (57 m^3) on the low end (0.3 gal/lb and 50,000 lbs. proppant) and 150,000 gallons (568 cubic meters) on the high end (0.5 gal/lb and 300,000 lbs proppant) consisting of mostly water. It is anticipated that actual volumes of fluid used will be in the middle of this range however a wide range of potential volumes is possible due to uncertainty in the reservoir thickness and permeability.

Specialised fracture stimulation software is used to model anticipated hydraulic fracture growth and as an aid in the design of fracture treatments. The output of the model is a proppant concentration diagram and an example of this output is provided in Appendix 2. This diagram show the extent of the cracks into which the proppant will be pumped with the darker colours close to the well bore representing the highest concentrations of proppant (where the fracture will be widest) and the lighter (green) colours at the edges of the fracture where the proppant concentrations are lowest.

5.5 Operational Procedure

Hydraulic fracturing will be completed with specialised blending equipment and high pressure positive displacement pumps allowing for maximum surface treating pressures of 10,000 psi. All equipment will be pressure tested and function tested prior to fracturing operations as standard for STOS well servicing operations.

Each stimulation treatment is designed individually once open hole logs are available and fine-tuned with a “mini-frac” preceding the main frac treatment. These designs and pre-job simulation provide estimation of treating pressures. Actual treating pressure, annular pressures, proppant volume, proppant concentration and fluid volumes are then all monitored real time to ensure treatment is executed as planned and to allow immediate action if required during the treatment. The wells will be stimulated in treatment stages from the bottom up utilising the following sequence of operations:

- Perforate stage one sand intervals (deepest interval of interest).
- Pump mini-frac with viscosified fluid and no proppant to determine formation leak off coefficient to finalise fracture stimulation design, including proppant volumes, fluid volumes and expected treating pressures.
- Pump the stimulation treatment under high pressure including proppant in viscosified carrier fluid. Displace planned treatment into the formation, distributing proppant within the created fracture.
- Flowback of fluid returns into surface tank on location.
- Run gauge ring into well to confirm it is clear of proppant and that access is possible for the next operational steps. In case of restriction enter the well with coiled tubing circulating viscosified fluid at low rate and pressure to clean wellbore. Any returns are collected and managed at surface as described in Section 5.9.
- Run composite plug to isolate prior stage. The composite plug is composed of a material which is easily milled allowing the plug to be removed at the end of the stimulation programme.
- Run perforating gun into hole on electric wireline to desired locations after confirming depth from cased hole wireline log and perforate next stage.
- Pump mini-frac then stimulate sand formations in the stage by pumping viscosified fluid to fracture the sand intervals and distribute proppant within created fracture.
- Repeat process for each stage until all stages are completed.
- Tie well into production system.
- Utilise coil tubing to mill out (remove) plugs taking fluid returns to tanks at surface and utilising flare as required.
- Flow well to the production system.

An example of detailed Fracture Treatment Operational Procedures is provided in Appendix 3.

5.6 Well Construction and Design

Appendix 1 contains schematics of the four Kapuni wells to be stimulated during 2012/13. Details of the well casing depth, type, top of cement and pressure rating are located in Appendix 4. The construction of these wells can be considered typical of any future wells to be stimulated at these four Kapuni wellsites. The casing and tubing have been designed to meet all relevant Shell and New Zealand standards including the Health and Safety in Employment (Petroleum Exploration and Extraction) Regulations 1999 and Rule 46 of the Regional Freshwater Plan for Taranaki (2001). The production casing is pressure tested to 5,000 Psi (34 MPa) and production tubing is pressure tested to 10,000 Psi (69 MPa) during completion. The wells are specifically designed for hydraulic fracture loads followed by full life cycle production.

Regarding the 2012/13 stimulation programme:

- In order to ensure the well is of a suitable design to undertake hydraulic fracturing and the associated pressures, the KA-14 well will be worked over to replace the current tubing string with a cemented heavy wall completion string. A similar design has been successfully applied in Kapuni wells KA-04 and KA-05, stimulated in 2005 and 2003 respectively.

- The KA-17 and KA-18 wells were drilled in 2010 and specifically designed to receive hydraulic fracture treatments. KA-18 received 6 hydraulic stimulation treatment during 2010 / 2011.

- The KA-19 well has not yet been drilled, but is also designed to receive hydraulic fracture treatments, incorporating design information gained from drilling the KA-17 and KA-18 wells.

5.7 Details of Stimulation Fluids

As discussed in Section 5.4, the treatments are designed to place between 50,000 to 300,000 pounds (22,700 – 136,000 kg) of proppant using a viscosified fluid for transport. Treatments will require 0.3 to 0.5 gals (0.001 – 0.002 m^3) of fluid per pound of proppant for placement.

The main component of the treatment is water, as displayed in Figure 3. Additives are required to increase the viscosity of the water in order to transport the proppant into the fissure and then reduce the fluid viscosity to return the fluid to surface. Typical concentrations of additives are listed in Table 4 below and are presented graphically, as a percentage of the total fracture fluid, in Figure 3. A summary of the fracture fluid composition to be used in the hydraulic fracturing programme planned for 2012/13 is contained in Appendix 5 and MSDS for each component are contained in Appendix 6. It should be noted that the selection of additives for hydraulic fracture stimulations is based on extensive design work and experience. The design philosophy is to minimise the amount of chemical used, whilst still achieving the planned treatment outcome with respect to proppant placement and carrier fluid flow-back.

Table 4: Additives for Kapuni Hydraulic Fracturing Programme 2012/13

Material	Function	Volume pumped per 1,000 Gallons of Fluid
Magnacide 575	Biocide	0.05
ClayTreat 3C	Clay Control	1
GasFlo G2	Surfactant	1
GS-1L	Gel Stabiliser	0.5
GLFC-5	Gel Concentrate	8.75
Caustic Soda	High pH Buffer	1
XLW-30AG	Crosslinker	1
ScaleTrol 720	Scale Inhibitor	1
GBW-41L	Breaker	2
High Perm CRB	Breaker	3

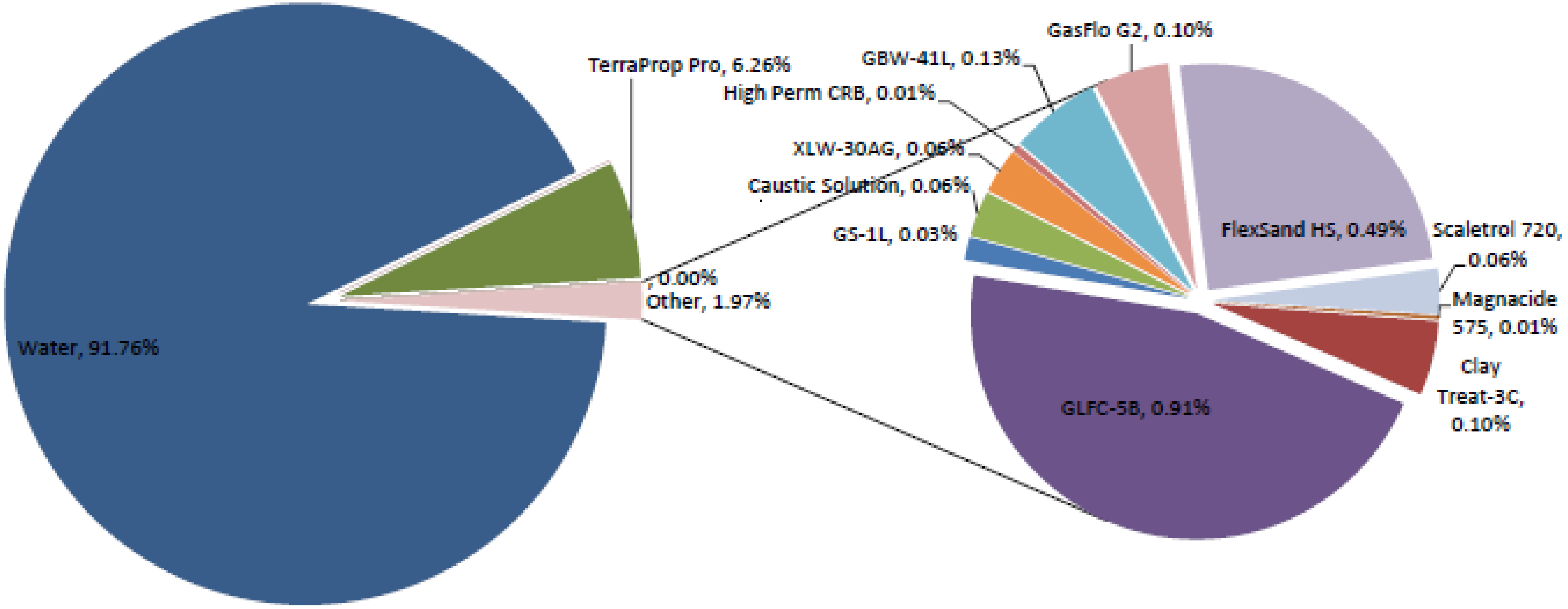
The bactericide prevents or limits growth of bacteria in the stimulation fluid that can cause formation of hydrogen sulphide and can physically plug the flow of gas into the well from the fracture. The potassium chloride (KCL) substitute and clay control agent minimise clay swelling of the formation contacted by the fluid. Surfactants are used to reduce surface tension in order to improve fluid recovery from the formation. The gel, gel stabiliser and crosslinker are mixed to viscosify the water for proppant transport. The buffer is used to stabilise the pH of the fluid in order to stabilise the gel viscosity. A scale inhibitor is used to prevent scale precipitation from the returned fluid after contact with the reservoir rock. Two types of breakers are utilised to chemically shear the gel polymer to reduce the viscosity within the fracture to improve flowback.

Aluminosilicate clay is sintered to create a high strength ceramic bead as the proppant material. The treatments may also contain a fluid loss agent (100 mesh sand) and a high strength proppant flowback control agent (Flexsand HS). The 100 mesh sand (silica) will be pumped if the mini-fracture diagnostic evaluation determines additional fluid loss control is required for the treatment due to high leak off within the interval. The flowback control agent will be added to the last portion of the treatment in order to minimise proppant flowback. This is composed of 90% aluminium and 10% resin and a volume of either 2,500 or 5,000 pounds per stage will be utilised depending on the total treatment size.

It is noted that the exact composition of fracture fluids associated with a particular programme may vary due to factors such as refinements in the treatment based on previous results, development of improved additives, and changes in supplier. The composition of the fluids described in this document are representative of future fracture fluids to be used at these four Kapuni wellsites.

As can be seen from Figure 3, over 91% of the fracture fluid is composed of water, with the proppant (TerraProp Pro) making up over 6% of the fluid, and the remaining additives comprising 2.66% of the fluid.

Figure 3: Typical Composition of Fluids Used for Hydraulic Fracturing



5.8 Subsurface Monitoring

Use of isotope tracers to diagnose hydraulic stimulation treatments has been applied in the industry for the last 30 years. Protechnics/Vause are licensed by the National Radiation Lab (NRL) to import and handle the tracer material in New Zealand. Measurements resulting from this technology provide insight on the presence or not of proppant material across stimulated intervals, thereby providing confirmation of distribution of proppant within the treatment stage. A tracer is added to the proppant slurry at very low concentrations. After all stimulation stages are completed and the plugs are removed from the well, a spectral gamma ray electric line logging tool is run to evaluate the location of the tracer for each of the stimulation stages. This information is used to better understand individual stage performance and to optimise future designs.

The Protechnics ZeroWash tracer, planned to be used in Kapuni, is manufactured by fixing non-water-soluble metals in a ceramic matrix. The ceramic matrix is then fired in a kiln and sieved to create ceramic beads which are then irradiated with very low levels of radioactivity. The material was developed and designed to prevent contamination of equipment and fluid with the potential for leaching removed by the manufacturing process. In order to trace nine stages, an estimated tracer weight of 0.7 kg containing 0.0004 gms of radioactive material is required. The level of radioactivity is low and the management of the tracer including any tracer which is returned to surface will be undertaken in accordance with Protechnics standard operating procedures (see Section 5.9 below).

The manufacturer (Protechnics) Product Specification Document states:

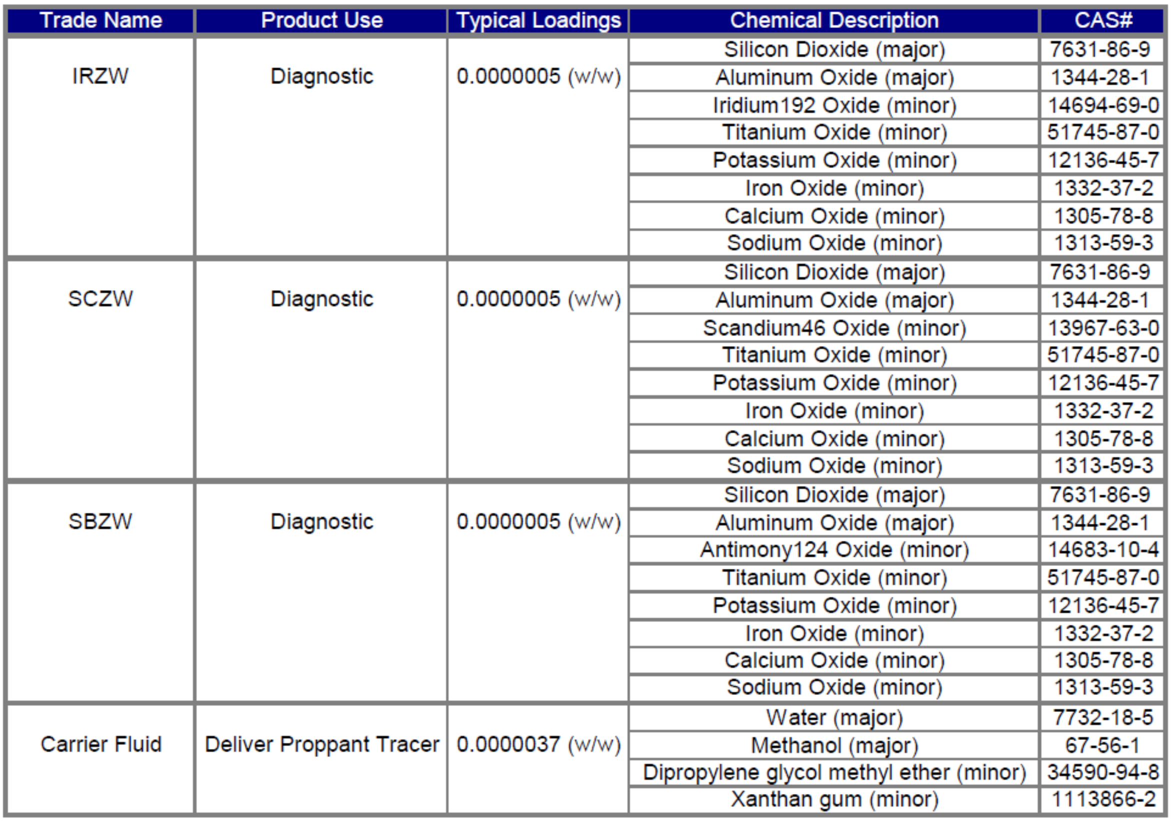
> "Activity is the measure of the amount of radioactive material present and is normally measured in Bacquerels (Bq). A Becquerel is defined as one radioactive decay per second. The following table presents the activity of some common materials along with flowback material containing the tracer."

Table 5: Activity of common materials

Substance	**Radioactivity Level (Bq)**
Flow-back Material (average)	37
Brazil Nuts	52
Coleman Lantern (Sock Style)	133
Radioactive Potassium in Human Body	4,810
Smoke Detector	18,500
Nuclear Medicine Procedure	740,000,000

Small quantities of the desired metal salts are mixed with clays to form the tracer material. A carrier fluid is used to add the tracer material into the stimulation fluid downstream of the pumps. Table 6 provides a detailed composition of the tracer materials that will be used in the 2012 stimulation programme. MSDS for the radioactive component of each of the tracer materials are contained within Appendix 7.

Table 6: Composition of Tracers and Carrier Fluid



Trade Name	Product Use	Typical Loadings	Chemical Description	CAS#
IRZW	Diagnostic	0.0000005 (w/w)	Silicon Dioxide (major)	7631-86-9
			Aluminum Oxide (major)	1344-28-1
			Iridium192 Oxide (minor)	14694-69-0
			Titanium Oxide (minor)	51745-87-0
			Potassium Oxide (minor)	12136-45-7
			Iron Oxide (minor)	1332-37-2
			Calcium Oxide (minor)	1305-78-8
			Sodium Oxide (minor)	1313-59-3
SCZW	Diagnostic	0.0000005 (w/w)	Silicon Dioxide (major)	7631-86-9
			Aluminum Oxide (major)	1344-28-1
			Scandium46 Oxide (minor)	13967-63-0
			Titanium Oxide (minor)	51745-87-0
			Potassium Oxide (minor)	12136-45-7
			Iron Oxide (minor)	1332-37-2
			Calcium Oxide (minor)	1305-78-8
			Sodium Oxide (minor)	1313-59-3
SBZW	Diagnostic	0.0000005 (w/w)	Silicon Dioxide (major)	7631-86-9
			Aluminum Oxide (major)	1344-28-1
			Antimony124 Oxide (minor)	14683-10-4
			Titanium Oxide (minor)	51745-87-0
			Potassium Oxide (minor)	12136-45-7
			Iron Oxide (minor)	1332-37-2
			Calcium Oxide (minor)	1305-78-8
			Sodium Oxide (minor)	1313-59-3
Carrier Fluid	Deliver Proppant Tracer	0.0000037 (w/w)	Water (major)	7732-18-5
			Methanol (major)	67-56-1
			Dipropylene glycol methyl ether (minor)	34590-94-8
			Xanthan gum (minor)	1113866-2

w/w = weight fraction of added components

5.9 Waste Management

Following hydraulic fracture stimulations, the well will be back-produced to remove the fracture fluid from the well. Flow from the well during this period will be directed to an 18m x 2.5 m x 2 m purpose built steel tank composed of welded containers placed approximately 500 mm below grade in a lined pit on site. A bund-wall of compacted earth will be built up around the West, North, & Eastern sides of the lined pit. Gas produced during this initial unloading will be flared as permitted by the relevant air discharge consent for the site (Consents 6825-1; 6822-1; 6828-1; and 6827-1).

Waste produced back during these flow-back periods could consist of:

- Fluids - generally frac carrier water
- Solids - proppant, with some tracer beads
- Gas/condensate

The waste will be managed as follows:

- Fluid returns will be disposed of into a consented reinjection well or a consented land-based disposal facility.
- The presence of returned tracer beads will be monitored to determine if a holding time is required to allow for decay to levels deemed acceptable per the National Radiation Laboratory prior to disposal of the solid waste to an appropriately licensed facility. If a holding period is required, the solid waste will remain in the steel tank and covered until such time that an acceptable level is achieved.
- If gas returns become evident they will be flared.

6. Mitigation Measures and Assessment of Environmental Effects

6.1 Potential Adverse Environmental Effects

Potential adverse environmental effects associated with hydraulic fracturing are considered to include the following:

- Potential contamination of freshwater aquifers;
- Chemical handling and waste management;
- Potential seismic effects; and
- Use of water.

Each of these areas of potential environmental impact is discussed in Sections 6.2 to 6.5 below. Positive environmental effects are addressed in Section 6.6, assessment of alternatives in Section 6.7, and consultation and affected parties in Section 6.8.

6.2 Potential Contamination of Freshwater Aquifers

The main area of potential adverse effects on the environment associated with the stimulation process is the potential contamination of freshwater aquifers due to the migration of hydraulic fracture fluids from the target formation to shallow freshwater aquifers.

There are four potential routes for contaminants from hydraulic fracturing operations to reach shallow aquifers.

(1) Leakage due to defective well installation / operations;
(2) Leakage through the geology overlying the petroleum reservoir;
(3) Leakage or improper handling of chemicals or waste water; and
(4) Well Blow-out.

Each of these risks is discussed in more detail in the following sections. Monitoring of groundwater is discussed in Section 6.2.5.

6.2.1 Leakage due to defective well installation / operation

The wells can provide a potential migration pathway for fluids in the deep formation targeted by the stimulation to the shallow freshwater aquifers. However, strict controls are in place to ensure well integrity and, in particular, that isolation between the producing intervals and shallow formations is maintained during the whole well life cycle.

STOS follows rigorous procedures for well planning and design:

- Well Delivery activities are regimented by a formal Well Delivery Process which addresses the way STOS designs, plans and executes well installation.
- Quality control and assurance for well engineering is standardised through the Discipline Controls and Assurance Framework (DCAF). The DCAF process consists of four key components: Discipline Standards; Discipline Authority Manual; Project Controls and Assurance Plan; and Project Controls and Assurance Schedule. These processes are designed to assure the quality of the engineering designs while providing formal documented reviews of assurance for installation.
- Each well design goes through a formal gated assurance process, which ensures that the design can cater for the full range of conditions that could be encountered in the well in the drilling, completion and production phase. This assurance is provided by designated Technical Authorities in STOS or Shell as appropriate.
- Well designs are, in particular, critically reviewed to ensure the wells can withstand the pressures associated with hydraulic fracturing and other anticipated lifecycle loads.

Specific mitigation measures, as incorporated in the well design and construction to prevent upward migration of contaminants via the well, are as follows:

- Water based mud system used for drilling of shallow casing string across shallow fresh water aquifers.
- Fresh water aquifers near surface are isolated from the well bore by at least two concentric casing strings.
- Two of the casing strings sitting across the shallow aquifers are cemented in place, to provide isolation.
- For all casings that are cemented, a thorough cement design and testing programme is undergone as part of the drilling programme to ensure the correct type, properties, density and setting time are achieved.
    1. Cement testing is performed by the cementing contractor in a laboratory environment. All chemicals and drill water that are to be used on location are used during this process.
    2. Quality Control/Assurance of all materials and equipment used in the well supplied by 3rd party suppliers including certification and inspection.
    3. The cement pumping process is simulated by the service provider, to analyse and optimise the cementing process to:
        - Prevent exceeding the fracture gradient of the formations;
        - Optimise the thickening times of the cement; and
        - Minimise cement/mud interfaces.
    4. Mud cleaning and effectiveness of the spacer fluid are simulated and optimised by the service provider.
    5. A centraliser programme is also produced to centralise the casing in the hole and optimise the isolation between formations.
    6. During the cementing process the fluid and cement volumes are monitored to react to potential losses or problems that may lead to high pressures.
    7. Cement density is also monitored and tested during pumping to make sure it is in line with the programmed density.

- Pressure testing of all casing strings to predetermined value during the drilling phase to ensure integrity, based on a full range of life cycle loads (10-3/4” casing – 3,000 PSI, 7-5/8” casing – 5,000 PSI, 5” x 4-1/2” tubing - 10,000 PSI).
- A cement sheath surrounds the 4.5” production tubing and extends above the top of the Kapuni Group. The quality of cement sheath behind the 4.5” casing is evaluated with a Cement Bond Log (CBL).
- An annulus pressure test is also carried-out for the 4.5” production casing to ensure there is no communication to the reservoir through this cement sheath.
- The 5” by 4-1/2” production tubing is made of a corrosion resistant alloy (13 chrome) designed to withstand corrosion from produced fluids.
- Only premium tubing connections (Vam Top) are used for the completion string to enable a gas tight seal.
- A cement sheath surrounds the 7” or 7-5/8” intermediate casing to above the production intervals.

A number of other measures are also in place to ensure that full control is maintained during well stimulation and in the operation / production phase:

- Annulus pressures are monitored during perforation, stimulation and flow-back operations and production to ensure the integrity of isolation measures are maintained. This continuous monitoring is via Annular pressure transducers located on the well head.
- Fluids, additives and solids used for hydraulic fracturing are monitored, measured and accounted for during the stimulation process.
- Surface lines are tested to maximum pressure prior to pumping.
- Hydraulic fracture pumping operation monitored in real time to allow quick reaction to any deviation from expectation.
- An annular pressure alarm system is in place and triggers with a 20% safety factor of calculated failure pressure of the annulus during the production phase.

The above mitigation measures ensure that isolation of the target formation, including fracture fluids and any other substances added to the well, is maintained and that there can be no transfer of hydrocarbons or other contaminants to shallow freshwater aquifers via the well.

6.2.2 Leakage through the geologic media

The risk of leakage of hydraulic fracturing fluids to shallow fresh water aquifers is discussed below:

- In the Kapuni field area, a fresh water aquifer is found in the upper section of the Matemateaonga formation (down to about 650m below ground), whilst more saline water is found towards the base of that formation at about 1650m below ground. Transition to higher salinity is a gradational feature (see section 4.5.1).
- Kapuni Group Intervals targeted for hydraulic fracture stimulations are located at depth of 3150m to 3650m below ground and hence separated from aquifers in the Matemateaonga by a minimum of approximately 1500 m (vertically) of geological formations.
- Migration of hydraulic fracturing fluids from the reservoir, through these formations, to the fresh water aquifers is extremely unlikely for the following reasons:

   1. The overburden formations include the laterally extensive (200 m thick) Otaroa formation, which provides a proven seal to the hydrocarbon accumulation in Kapuni, and would therefore also block any fluid migration from the reservoir.
   2. A number of other laterally extensive and very low permeability formations are present in the overburden (see section 4.6) providing additional seals between the reservoirs targeted by the stimulations and the shallow fresh water aquifers.

- Out of zone fracturing through a reservoir seal is also extremely unlikely:
   1. As described in sections 5.4 and 5.5, each frac stage is designed individually, taking into account the actual geology, stress contrast between the targeted zone and upper / lower bounding intervals.
   2. The fractures created by the stimulation treatments are very small on a geological scale and (by design) contained within the Kapuni Group. The energy provided to create the fractures is insufficient to break through the reservoir seals described above.
   3. Fracture diagnostic data, from previous hydraulic fracture stimulation within the Kapuni Group, confirms that the fractures are contained to the targeted intervals as a result of the stress differences between the targeted sand / silts and small intra reservoir shale / coal layers. This supports further the expected containment by the more massive geological seal located above the reservoir.

- Diversion of a fracture treatment to a fault zone could in theory provide a pathway to the overburden for hydraulic fracture fluids. This is also extremely unlikely:
   1. There is no evidence, from production or drilling data (losses in the reservoir), that the faults present in the reservoir are conductive i.e. unlikely to provide a path for significant leak-off of a treatment.
   2. Diversion of a treatment to a (would be) conductive fault zone, intercepting the well or the fracture created by the treatment is expected to result in a situation referred to as “screen-out”: The fluid is lost to the fault zone and looses its ability to transport the proppant. The pumps are immediately shut off and the treatment is terminated. Any remaining proppant in the wellbore settles to the bottom of the well. The proppant that was placed prior to screen out remains in the fracture.
   3. In the unlikely event that a treatment would enter and propagate into a fault, this interaction would then be quite localised and not on a scale to create any conduit to flow from the reservoir to the overburden.
   4. Finally, although faults cannot always be avoided within a well trajectory, the wells are, by design, placed away from faults or faulted areas, both in the reservoir and in the overburden (using seismic data) to minimise potential impact in the drilling (well bore stability), completion or production phases. This further mitigates the risk of hydraulic fracture fluids entering a fault / faulted area.

In conclusion, migration of fracture stimulation fluids out of the target zone and into the shallow fresh water aquifer, via the geologic media, fractures or faults from a properly executed hydraulic fracture is extremely unlikely.

6.2.3 Leakage or improper handling of chemicals or waste water

General chemical handling procedures and waste management from hydraulic fracturing operations is discussed in section 6.3. The specific risk of contaminating shallow water aquifers with fluids brought back to the surface from hydraulic fracture stimulation is discussed below.

Contamination of shallow aquifers or nearby waterways as a result of the loss of containment of stimulation fluid/returns is recognised by STOS as a critical risk. This risk is to be actively managed in the spill plan for hydraulic fracture stimulations. The spill plan includes proactive measures requiring the use of dry break couplings, hose inspection, pressure testing and tagging of all hard piping. In the event of a loss of containment, the sites are designed with bunding to manage fluid movement on the surface at location (site drainage with interceptor pit), tank bunding to capture any possible leakage upon fluid transfer and spill kits for immediate clean up of the ground. Initial fluid returns will be captured in steel tanks placed approximately 500 mm below grade in a lined pit in order to provide a second barrier to ensure no contamination of the surrounding soil. Management of the transfer operation through operational procedures will be in place to prevent spillage during the fluid transfer process.

6.2.4 Risk of Well Blowouts

During the well construction process, two well barriers are in place during all well construction and intervention activities where a pressure differential exists that may cause uncontrolled outflow from the borehole/well to the external environment (blow-out). Pressure testing of the barrier elements is performed as an operational quality control. The controls in place ensure that the risk of having a blow-out is as low as practically possible.

There is no heightened risk of blow-out during hydraulic fracturing operations, as the well is then completed and pressure tested to the full range of expected operating conditions.

6.2.5 Groundwater Monitoring

STOS anticipated that an appropriate programme of groundwater monitoring will be agreed with the Taranaki Regional Council to provide assurance regarding any adverse effects on groundwater in the vicinity of hydraulic fracturing activities at Kapuni.

6.3 Chemical Handling and Waste Management

6.3.1 Chemical Handling

Although a large number of chemicals are used in the planned hydraulic fracturing operations, the risks related to personal exposure and the potential environmental impact have been largely mitigated or evaluated as very minor.

1. The chemical additives used in planned hydraulic fracturing stimulation make up approximately 3% of the total treatment volume. Fresh water and the inert proppant material, approximately 6%, make up the remaining volume.
2. The chemicals that are classified as hazardous substances are significantly diluted and used and handled in accordance to manufacturers' instructions and in compliance with the Hazardous Substance and New Organisms Act, and any relevant District or Regional Council consents.
3. In a pure concentrated form, some of the chemicals planned to be used are toxic. However, these are highly diluted concentrations when mixed in the stimulation fluid as part of a strictly controlled process.
4. A significant proportion of the fluids which are pumped in the well are returned to the surface during the initial flow-back (typically 30-80%), for careful handling and disposal at a consented facility. The remainder of the chemicals are either left in the reservoir and are trapped in situ, for the reasons quoted in section 6.2.2 above, or produced back over time and handled as part of the produced water stream under appropriate consents.
5. The proppant (an inert material) is designed to remain downhole in the induced fractures. Small amount of proppant may be produced back over time and will be disposed as part of routine waste management procedures in Kapuni.
6. Low radioactivity proppant beads used for fracture diagnostic will be handled as per the procedures outlined in Section 5.8, eliminating any potential environmental impact.
7. STOS will continue to work with chemical suppliers and stimulation contractors to ensure that chemicals with the lowest possible environmental impact are used in the fluid recipes.

6.3.2 Waste management

Liquid, solid and hydrocarbon waste will be produced as part of the initial flow-back of fracture fluids immediately following the hydraulic fracture stimulation. It is anticipated that the return of fracture fluids could occur over a period of approximately 12 hours per stage and will generally be undertaken overnight. The flow-back fluids are likely to be composed of the following components:

- Fresh water used to undertake the hydraulic fracture.
- Proppant and small amounts of tracer.
- Additives used as part of the hydraulic fracture.
- Saline water from the formation.
- Hydrocarbons – liquid and gas phase.

The management and disposal of waste solids, liquids and gas from the flow-back of fracture fluids will be managed as follows:

- Hydrocarbons to be flared on-site (as permitted by existing resource consents) until adequate flow established to redirect to Kapuni Production Station.
- Liquid component (primarily water) to be directed to on-site storage tanks, as described above (section 6.2.3).
- Separation of solid and liquid components of waste fluid within on-site storage tanks.
- Waste liquid will be disposed of into a consented reinjection well or at a consented land-based disposal facility.
- Solid waste will be tested for presence of radioactive tracer.
- If tracer is absent, solid waste will be disposed to an appropriately licensed disposal facility.
- Solid waste that contains radioactive tracer will be managed on the site until such time as radioactivity has decreased to a level appropriate for off-site transportation and disposal.

As noted in Section 3 of this report, due to safety considerations, temporary changes to the conditions of resource consents regulating air emissions from the four sites have been obtained (KA-1/7 and KA-4/14), or are likely to be applied for (KA-17 and KA-18), to enable the flaring of hydrocarbons without prior liquid/solid separation.

6.4 Use of Water

Large volumes of water can be required to undertake hydraulic fracturing. It is estimated that from 50 m^3 to over 500 m^3 of water may be required for each stimulation operation. During the 2012 programme KA-14 and KA-19 will potentially have the greatest number of intervals to be treated, with up to nine stages in each. Assuming the maximum expected volume of 500 m^3 of water is required for each of these stages, a total of 4,500 m^3 of water could potentially be required for the full stimulation programme at one of these wells. It is noted however, that this is an upper estimate and it is unlikely that this amount of water will be required. In addition, not all stimulation programmes to be undertaken at these Kapuni well sites will necessarily involve this many stimulation operations. Currently one small stimulation is proposed for KA18, and a total of eight for KA17.

Water used for stimulation will be sourced from municipal supplies and will be transported to the site by water tanker. For some sites the option of delivering water via a temporary surface line is also being investigated as well as possible re-use of produced water.

6.5 Potential Seismic Effects

6.5.1 Risk Assessment

There have been some recent general concerns in the public domain regarding the use of hydraulic fracture stimulation and the potential for the process to cause seismic events such as earthquakes. These incidents, while extremely rare and uncommon must be thoroughly evaluated. However, it's absolutely critical that facts and science drive this dialogue. While more than 1.1 million wells in the United States have been hydraulically fractured over the past 60 years, there are very few such reported cases of earthquakes.

Hydraulic fracturing can trigger minute tremors. These movements are termed "microseismic events." Although significant enough to induce fracturing within the rock, they can be detected only by the most sensitive instruments because of their extremely low magnitude (-3 on the Richter scale). Humans generally only detect earthquakes with a magnitude of at least 3 (which is a million times higher than the microseismic events induced by fracturing). And every day, seismographs record several thousand quakes with a magnitude of less than 2.

Larger seismic events were however recorded after two hydraulic fracture stimulations treatment performed in 2011 at the "Preese Hall" well drilled in the Bowland shale, Lancashire, UK (Ref.2). These events, which were of a magnitude of 1.5 and 2.3 on the Richter scale, were the subject of an extensive geomechanical study commissioned by the Operator. The most likely mechanism invoked in the resulting report for the induced seismicity was the direct injection of stimulation fluids into a fault / faulted zone which was critically stressed, able to accept large amount of fluids, and was brittle enough to fail seismically.

Geomechanical conditions in Kapuni are very different to those documented in the Bowland shale. The risk of generating seismic activities as a result of stimulation activities in Kapuni has been assessed by STOS geologists and is considered to be negligible:

- Geomechanical studies (Ref.6) of Kapuni have shown that the faults intercepted in the reservoir are not critically stressed i.e. these faults are not prone to movement. This is further supported by the absence of well bore stability issues when crossing faults in the reservoir. Additionally corroborated by the limited natural seismicity observed in the Kapuni area.
- The wells are placed away from faults in both the reservoir and overburden, using seismic data. The size of the stimulation treatment (volumes and pressure) is such that induced proppant filled fractures are small on a geological scale (up to 150 m effective half-length, a few mm wide and covering a vertical plane of 10 to 30m). This further limits the chance of encountering faults both in and away from the well with the induced fracture.
- Pumping treatment fluid (water, additives and proppant) into a fault or fracture generally limits any further growth of the fracture as the fluid dissipates to the conductive feature (see "screen-out" in Section 6.2.2).
- In the unlikely event that any fault slippage / activation occurs, (the faults are not critically stressed) the volumes of the treatment are insufficient to "lubricate" a large enough area to cause a major seismic event. Any effect would be on a localised scale. Fault slippage would also not open a path way to the overlying strata, as the fault plane would close immediately.

- Finally, it is noted that, to STOS knowledge, no seismic events have been linked to stimulation activities that have been previously undertaken by STOS within the Kapuni Group.

6.5.2 Vibration Monitoring

The possibility of undertaking vibration monitoring to detect possible seismicity during hydraulic stimulations has been reviewed by STOS. It is considered to be unhelpful in this instance as explained below.

As described above, the risk of generating seismic activities as a result of stimulation activities is considered to be negligible. Micro-seismicity is however known to be generated as part of the fracturing process, and its detection has been used in the industry to map the position and extent of created fractures[6]. The seismic signal/energy resulting from hydraulic fracturing is however relatively small, and consequently the vibration sensors need to be located reasonably close to the signal to register it.

There are two options for vibration monitoring, surface monitoring and downhole monitoring in nearby wells. This technique, which is called microseismic, is based on running an array of seismic sensors in a nearby well to register the seismic signals resulting from fracture growth. The applicability of each of these techniques is further discussed below:

- Vibration monitoring at surface to pick up the seismic signal resulting from hydraulic fracturing is likely to be inconclusive and will provide little benefit for the following reasons:
  1. The vibration signal will be dominated by the surface equipment (five high pressure pumps running at full throttle).
  2. The small seismic signal resulting from the hydraulic fracturing is generated 3km below surface.
  3. The Kapuni Group formation in the Kapuni field contains extensive coal layers, which absorb the seismic energy and attenuates the resulting signal.

- The application of microseismic has been reviewed in detailed for the Kapuni field (Ref.8), primarily to assist with reservoir modelling, and well spacing/well density decisions – based on the actually achieved fracture dimension. Key results from this study were as follows:
  1. The noise level (incl. surface noise), the vicinity of coals, and the rock characteristics determine the maximum distance between the sensors and the area of interest. For Kapuni the maximum distance has been modelled as 250-400m.
  2. Currently the well spacing in the Kapuni field is far too coarse for microseismic (i.e. no wells exist, or are planned, within less than 800m of hydraulic fracturing candidates) to reveal any data of significance. This technique hence cannot be applied usefully in Kapuni.
  3. Alternatively to micro-seismic, use of low radioactivity proppants can be used to provide localised data regarding fracture placement and containment and will be applied to some of the planned treatments.

6.6 Positive Environmental Effects

For the last 40 years Kapuni has been safely providing the country with a secure supply of natural gas. Much of the "easy" Kapuni gas from high permeability reservoirs is gone. In order to make the best use of the infrastructure already in place, further development is required to extend the field life. Development of low permeability gas reservoirs ('Tight Gas') with hydraulic fracturing will significantly increase the life of the Kapuni field.

Hydraulic fracturing at Kapuni will unlock natural gas production from deep hydrocarbon bearing reservoirs and will allow:

- Further utilisation of existing wells to increase natural gas recovery and extend the field life;
- Maximised use of existing surface infrastructure which handles the produced natural gas;
- Extension of a highly reliable source of fuel for third party infrastructure in Taranaki.

The demand for energy continues to grow in New Zealand. Renewable energy sources are increasing to help meet market demand, but fossil fuels are still required to supply local energy demand. Natural gas is a clean, flexible back-up fossil fuel option to renewables and an essential part of the energy mix in New Zealand.

6.7 Assessment of Alternatives

Schedule 4 of the RMA (Ref.5) details matters that should be included in an assessment of effects on the environment. Section 4 1(b) requires a description of any possible alternative locations or methods for undertaking the activity if the activity will have significant adverse effects on the environment. As the proposed hydraulic fracturing activities are not expected to result in significant adverse effects on the environment, no assessment of alternatives has been undertaken.

6.8 Consultation and Affected Parties

No potentially affected parties have been identified based upon the mitigation measures that are in place.

Consultation with a number of neighbours has been undertaken as part of the 2012/13 development project involving the KA1/7/19/20 and KA4/14 sites. This has involved advising all neighbours within a 1.1 km radius of the KA1/7/19/20 and KA4/14 wellsites of the planned drilling, workover and hydraulic fracturing programme. This consultation was particularly aimed at advising potentially affected neighbours of the potential noise emissions associated with the project and obtaining their approval with regards to land use consents for the project. However, the information provided also provided a general overview of the project. Regular update newsletters have been provided to neighbours and will continue to be provided as the project progresses.

A similar level of consultation is planned to be undertaken with neighbours in the vicinity of the KA 8/12/15/18 and KA 6/11/17 wellsites in relation to the well optimisation programme.

STOS representative have also recently met with Nga Ruahine Iwi representatives in May and November 2011 to discuss a number of issues associated with the Kapuni field and to provide a general update of upcoming activities. During the most recent meeting on 23 November 2011, an overview of the proposed hydraulic fracturing activities during 2012 was provided and a number of questions relating to these activities were answered. Nga Ruahine Iwi requested a copy of this AEE and this will be provided to them.

It is considered that there may be interested but not affected parties to these applications.

7. Regulatory Context

7.1 Regulatory Background

Section 104 of the RMA (Ref.5) sets out the matters that a consent authority must consider when assessing a consent application. It states that:

> *'When considering an application for a resource consent and any submissions received, the consent authority must, subject to Part 2, have regard to–*
>
> > *(a) any actual and potential effects on the environment of allowing the activity; and*
> >
> > *(b) any relevant provisions of—*
> >
> > > *(i) a national environmental standard*
> > > *(ii) other regulations*
> > > *(iii) a national policy statement*
> > > *(iv) a New Zealand coastal policy statement*
> > > *(v) a regional policy statement or proposed regional policy statement*
> > > *(vi) a plan or proposed plan; and*
> >
> > *(c) any other matter the consent authority considers relevant and reasonably necessary to determine the application.'*

Based upon Section 104 of the RMA, the documents which must be considered in assessing this application are:

- Part II of the RMA;
- National Policy Statement – Freshwater Management (2011);
- Regional Policy Statement for Taranaki (2009); and
- Regional Fresh Water Plan for Taranaki (2001).

A summary of the relevant sections of each of the above documents together with an assessment of the proposed activities against the relevant sections, objectives and policies, are outlined in Sections 7.2 to 7.5 below.

7.2 Part II of the Resource Management Act

The matters that the Council must have regard to in considering these applications under Section 104 of the RMA are all subject to Part II of the Act. Part II deals with the purpose and principles of the RMA.

Section 5 of Part II states that:

> *'(1) The purpose of this Act is to promote the sustainable management of natural and physical resources.*
>
> *(2) In this Act,* **sustainable management** *means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while—*
>
> > *(a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and*

> *(b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and*
> *(c) avoiding, remedying, or mitigating any adverse effects of activities on the environment.'*

The local freshwater aquifer in the vicinity of the four wellsites is the primary resource which is relevant when considering these applications and, given the mitigation measures that are in place, it is not expected that there will be any adverse effects on freshwater resources.

In addition, it is noted that the use of hydraulic fracturing will potentially allow more efficient utilisation of existing hydrocarbon reserves and prolong the life of existing gas processing facilities which are positive effects in terms of sustainable management.

Section 6 of Part II deals with matters of national importance. Clause 6(e) of this Section is relevant to this application and states that: *'the relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga'* is a matter of national importance which must be recognised and provided for. In this regard, Nga Ruahine Iwi representatives have been informed of the proposed activities and the proposed activities will avoid any adverse effects on freshwater resources.

Section 7 of Part II deals with matters to which particular regard shall be given in exercising functions under the Act. The relevant aspects of that section are considered to be:

> *(b) the efficient use and development of natural and physical resources;*
> *(c) the maintenance and enhancement of amenity values;*
> *(f) maintenance and enhancement of the quality of the environment; and*
> *(g) any finite characteristics of natural and physical resources.*

The proposed hydraulic fracturing activities are anticipated to allow the more efficient use and development of the hydrocarbon resources contained within the Kapuni field through allowing the extraction of finite hydrocarbons resources that are not able to be extracted by other methods. Given the mitigation measures that are in place, it is considered that there will be minimal risk of any significant adverse effects on the freshwater resources in the vicinity of the wellsites which are the primary amenity values that could be affected by the proposed activities. Similarly, the quality of freshwater resources will not be affected.

Section 8 of Part II requires that the principles of the Treaty of Waitangi are taken into account. Consultation has been undertaken with Nga Ruahine Iwi regarding the proposed activities and STOS will continue to keep Nga Ruahine Iwi informed as the proposed hydraulic fracturing programme progresses.

Taking the above matters into consideration, it is concluded that the proposed activities are in accordance with Part II (Sections 5, 6, 7 and 8) of the RMA.

7.3 National Policy Statement – Freshwater Management

The National Policy Statement (Freshwater Management) (Ref.4) was issued in May 2011 and sets out objectives and policies that direct local government to manage water in an integrated and sustainable way, while providing for economic growth within set water quantity and quality limits. The objectives outlined in the National Policy Statement (Freshwater Management) that are relevant to these applications are as follows:

- ***Objective A1:*** *To safeguard the life-supporting capacity, ecosystem processes and indigenous species including their associated ecosystems of fresh water, in sustainably managing the use and development of land, and of discharges of contaminants.*
- ***Objective A2:*** *The overall quality of fresh water within a region is maintained or improved while:*
  - *a) protecting the quality of outstanding freshwater bodies;*
  - *b) protecting the significant values of wetlands; and*
  - *c) improving the quality of freshwater in water bodies that have been degraded by human activities to the point of being over-allocated.*

The National Policy Statement (Freshwater Management) also specifies a number of policies which Regional Councils are to implement in order to achieve these objectives. These are addressed in Section 7.5.1.

It is considered that the proposed hydraulic fracturing activities will not have adverse effects on the freshwater values outlined above as there are not anticipated to be any adverse effects on freshwater aquifers or surface water based on the mitigation measures that are in place as outlined in Section 6 of this AEE.

7.4 Regional Policy Statement for Taranaki

The Regional Policy Statement for Taranaki (Ref.10) provides an overview of the resource management issues of the region and the policies and methods that will be adopted to address those issues. Section 6.3 of the Regional Policy Statement addresses maintaining groundwater flows and quality at sustainable levels.

In particular, this section of the Regional Policy Statement outlines GWR Objective 1 which is relevant to this application:

> ‘*To sustainably manage the use of groundwater in the Taranaki region by:*
> *a) Enabling people and communities to take and use groundwater to meet their needs while avoiding, remedying or mitigating adverse effects arising from that use; and*
> *b) Avoiding, remedying or mitigating adverse effects on groundwater quality from over abstraction, intensive agricultural land uses, the discharge of contaminants, and poor well and bore construction.’*

A number of policies are outlined to achieve this objective, in particular, GWR Policy 4 is relevant to this application, as follows:

> *'Groundwater quality will be maintained and enhanced by:*
>
> *a) managing the discharge of contaminants to land and water such that any actual or potential adverse effects on groundwater quality are avoided, remedied or mitigated;*
> *b) managing the siting, drilling, construction or alteration of wells and bores;*
> *c) managing old, damaged and unused wells or bores;*
> *d) controlling deepwell injection of wastewater or other contaminants to groundwater to ensure there is no significant risk of degradation to useable groundwater resources; and*
> *e) promoting land use practices that minimise as far as practicable the potential for adverse effects on groundwater quality.'*

Items (a) and (d) are particularly relevant to these applications and are addressed through the mitigation measures outlined in Section 6 which are designed to ensure there are no impacts on freshwater aquifers in the vicinity of the wellsites.

7.5 Regional Fresh Water Plan for Taranaki

The Regional Fresh Water Plan for Taranaki (Ref.11) (RFWP) is intended to assist the Taranaki Regional Council to carry out its functions under the RMA to promote the sustainable management of the freshwater resources of the Taranaki region. These resource consent applications are made under Rule 44 of the RFWP. The following assessment has been made against the policy references specified as being relevant to Rule 44 within the rule tables of the RFWP. The relevant policies are discussed below under the headings that these policies are listed under within the main text of the Plan.

7.5.1 Maori Cultural Values

Objective 4.1.1 of the RFWP is intended:

> *'To recognise and provide for the cultural relationship and values of Iwi and hapu of Taranaki with water, and with ancestral land and sites, wahi tapu and other taonga associated with fresh water, and the beds of rivers and lakes, in a manner reflective of their status as Tangata Whenua and in accordance with Tikanga Maori.*

Policies 4.1.1 to 4.1.6 outline a number of specific policies that will be implemented to achieve Objective 4.1.1 above. Of relevance to these applications is Policy 4.1.1 as follows:

> *'Wahi tapu and other sites or features of historical or cultural significance to Iwi and hapu of Taranaki, and the cultural and spiritual values associated with fresh water, will be protected from the adverse effects of activities, as far as practicable.'*

The potential for the proposed hydraulic fracturing activities to impact upon the cultural and spiritual values associated with fresh water have been avoided by the adoption of the mitigation measures outlined in Section 6. Based on these mitigation measures, it is not anticipated that there will be any adverse effects on freshwater values.

7.5.2 Use and Development of Freshwater

Objective 5.1.1 of the RFWP is intended:

> *'To enable people and communities to use and develop fresh water resources and the beds of rivers and lakes to provide for their social, economic and cultural wellbeing and for their health and safety, in accordance with the sustainable management of those resources.'*

Policy 5.1.1 is intended to implement this objective and states:

> *When managing the use and development of fresh water and the beds of rivers and lakes, the Taranaki Regional Council will recognise:*
>
> *a) the need for all activities to avoid, remedy, or mitigate adverse environmental effects in accordance with the objectives and policies of this Plan;*
> *b) the positive benefits to people and communities arising from the use or development;*
> *c) existing uses of physical resources including any human-made resources that have a specific-use purpose;*
> *d) the effects on existing lawfully established activities;*
> *e) the need to allow existing users to progressively upgrade their environmental performance, where improvements are necessary to meet the provisions of this Plan.*

These applications do not directly involve the consumptive use or development of freshwater and the proposed discharges will avoid impacts on freshwater aquifers through the adoption of appropriate mitigation measures. Water to be used for hydraulic fracturing will be obtained from existing municipal supplies.

7.5.3 Adverse Effects on Surface Water Quality from the Discharge of Contaminants from Point Sources

Objective 6.2.1 of the RFWP is intended:

> *'To maintain and enhance the quality of the surface water resources of Taranaki by avoiding, remedying or mitigating the adverse effects of contaminants discharged to land and water from point-sources.'*

Policies 6.2.1 to 6.2.7 implement this objective and deal with the effects of point discharges on surface waters. These applications do not involve the use of point wastewater discharges which could impact upon surface waters. The main area of potential impact on surface waters associated with hydraulic fracturing activities is the potential for a spill at one of the wellsites to reach the stormwater system and then be discharged to surface water. This risk has be mitigated by a number of measures that will be adopted at the site as outlined in Section 6.2.3 of this AEE including the use of steel tanks to capture initial fluid returns, strict operational procedures to prevent spillage during the fluid transfer process, tank bunding to capture any possible leakage, and spill kits for immediate clean up of the ground in the event of a spill.

7.5.4 Adverse Effects on Groundwater Quality from the Discharge of Contaminants to Land and Water

Objective 6.5.1 of the RFWP is intended:

> *'To avoid, remedy or mitigate adverse effects on groundwater quality from bore and well drilling, construction or alteration.'*

In addition, Objective 6.5.2 of the RFWP is intended:

> *'To promote the sustainable management of groundwater while avoiding, remedying or mitigating adverse effects on groundwater quality from the discharge of contaminants.'*

Policies 6.5.1 to 6.5.5 implement this objective and address the effects on groundwater quality from the discharge of contaminants to land and water.

Policy 6.5.1 requires:

> *'Drilling and well or bore construction or alternation will be managed to prevent aquifer cross-contamination from the surface due to open or unsealed bores or wells, or contamination from other drilling activities'*

While these consent applications are not directly related to the drilling or alteration of the wells themselves, it is noted that all wells which are subject to hydraulic fracture stimulation are designed to ensure no contamination of shallow freshwater aquifers occurs. Specific measures are outlined in Sections 5.6 and 6.2.1 of this AEE.

Policy 6.5.2 is concerned with the management of oil, damaged and unused wells or bores and is not relevant to this application.

Policy 6.5.3 states:

> *'The Taranaki Regional Council will manage the discharge of contaminants to land and water such that any actual or potential adverse effects on groundwater quality are avoided, remedied or mitigated.'*

The requirement to obtain a resource consent for the hydraulic fracturing activities together with this AEE addresses this requirement.

Policy 6.5.4 states:

> *'The deepwell injection of wastewater or other contaminants to groundwater will only be allowed at depths and locations and under circumstances in which there is no significant risk of contamination of groundwater resources which may be used for consumptive purposes.'*

Section 6.2 of this AEE describes the mitigation measures that are in place to ensure that there is no significant risk of contamination of groundwater resources which may be used for consumptive purposes due to the discharge of hydraulic fracture fluids at depths below 3,000mTVss.

Policy 6.5.5 relates to the collection of information on bores and wells and is not directly relevant to this application.

7.5.5 Transitional Provisions – National Policy Statement on Freshwater Management

The RFWP has recently been updated to include additional policies as required by the recently published National Policy Statement – Freshwater Management (2011). This includes the following two policies (POL 5A.1.1 and POL 5A.2.1) that could potentially be relevant to the applications covered by this AEE:

> POL 5A.1.1 *'When considering any application for a discharge the consent authority must have regard to the following matters:*
>
> *a) the extent to which the discharge would avoid contamination that will have an adverse effect on the life-supporting capacity of fresh water including on any ecosystem associated with fresh water; and*
>
> *b) the extent to which it is feasible and dependable that any more than minor adverse effect on fresh water, and on any ecosystem associated with fresh water, resulting from the discharge would be avoided.'*

> POL 5A.2.1 *'When considering any application the consent authority must have regard to the following matters:*
>
> *a) the extent to which the change would adversely affect safeguarding the life-supporting capacity of fresh water and of any associated ecosystem; and*
>
> *b) the extent to which it is feasible and dependable that any adverse effect on the life-supporting capacity of fresh water and of any associated ecosystem resulting from the change would be avoided.'*

The proposed hydraulic fracturing activities are not anticipated to have any adverse affects on the life-supporting capacity of freshwater or ecosystems associated with freshwater. This conclusion is based on the mitigation measures in place to ensure freshwater aquifers will not be impacted by the activities and the spill avoidance and mitigation measures that will be in place at each wellsite.

7.6 Summary of Regulatory Context

Based on an assessment of the applications to undertake hydraulic fracturing against the relevant statutory documents, it is concluded that the proposed activities would not be contrary to the relevant sections, objectives and policies of the RMA and supporting regulatory documents.

8. Conclusion

This assessment of environmental effects has demonstrated that the potential and actual effects of the proposed hydraulic fracture stimulation activities at four Kapuni wellsites will be no more than minor based on the mitigation measures that are in place. Key mitigation measures include:

- Depth of the target zones compared to the depth of potentially affected freshwater aquifers.
- Well design and construction.
- Well integrity monitoring.
- Design and monitoring of the stimulation treatments.
- Appropriate chemical handling and waste management procedures.

No affected parties have been identified and therefore it is considered that the criteria for a non-notified consent application for the Discharge Consents sought have been met (Section 95 of the RMA).

The activity will have, or is likely to have, adverse effect on the environment that are less than minor and there are considered to be no affected parties.

9. References

1. Allis, R G; Zhan, X; Evans, C; Kroopnick, P (1997). Groundwater flow beneath Mt Taranaki, New Zealand, and implications for oil and gas migration. New Zealand Journal of Geology and Geophysics 40.
2. Geomechanical Study of Bowland Shale Seismicity Synthesis Report, Caudrilla report, 2nd Nov 2012
3. Hill Laboratories Analysis Report 707212, 23 July 2009
4. National Policy Statement – Freshwater Management 2011. Issued by notice in the Gazette on 12 May 2011.
5. Resource Management Act 1991
6. Sarfare, M and Ebote, S (2011). 1D Geomechanics Study to Support Drilling and Completion Operations in Kapuni Field. April 2011
7. Schlumberger Web based Oilfield Glossary, , ID 2802, Nov 2011
8. STOS Kapuni Tight Gas Development Pilot Microseismic Feasibility Study, W. Berlang, April 2010
9. TRC (1996) 'Groundwater Resources of the Taranaki Region' Taranaki Regional Council, August 1996.
10. TRC (2010) 'Regional Policy Statement for Taranaki'. Taranaki Regional Council, January 2010.
11. TRC (2001) 'Regional Freshwater Plan for Taranaki'. Taranaki Regional Council, October 2001.
12. www.halliburton.com, FracTrac, Nov 2011

Appendix 1

Well Logs and Casing Schematics for Wells included in 2012/13 Programme

LAYOUT

Well(s): **KA-04, KA-14**

Project: **Kapuni**
Dataset(s): **KA-04_LOGIC_KAEVAL_1, KA-14_LOGIC_KAEVAL_1**
Scale: 1:**10000**

Author: **Dave RAWLENCE**
(ID: **Dave.Rawlence**)
Date: **31/08/2011**

Well: **KA-04**

UWI: **KA-04**
Short name:
Long name:

Elevation: **232.6000 M**
Elevation datum:
Total depth: **3901 M**
Coordinate system:

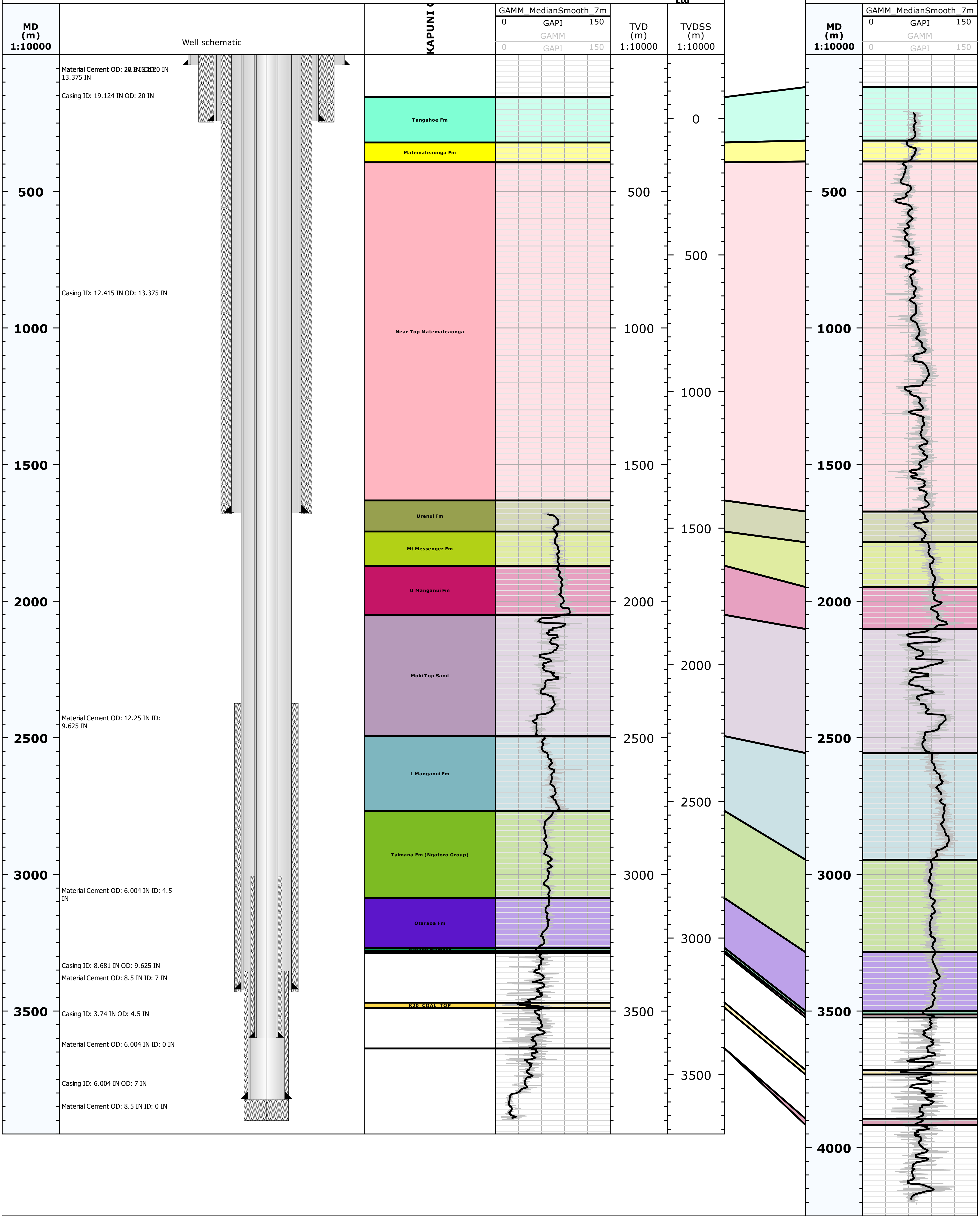
X: **2610964.0000 M**
Y: **6194306.0000 M**
Longitude: **174.172561**
Latitude: **-39.452317**

SPUD date:
Completion date:
Status:
Operator:

Country: **UN**
Field: **UNKN**
State: **UNK**
Company: **S**
Ltd

Well: **KA-14**

UWI: **KA-14**
Short name:
Long name:



LAYOUT

Well(s): **KA-14**

Project: **Kapuni**
Dataset(s): **KA-14_LOGIC_KAEVAL_1**
Scale: 1:**10000**

Author: **Dave RAWLENCE**
(ID: **Dave.Rawlence**)
Date: **31/08/2011**

Well: **KA-14**

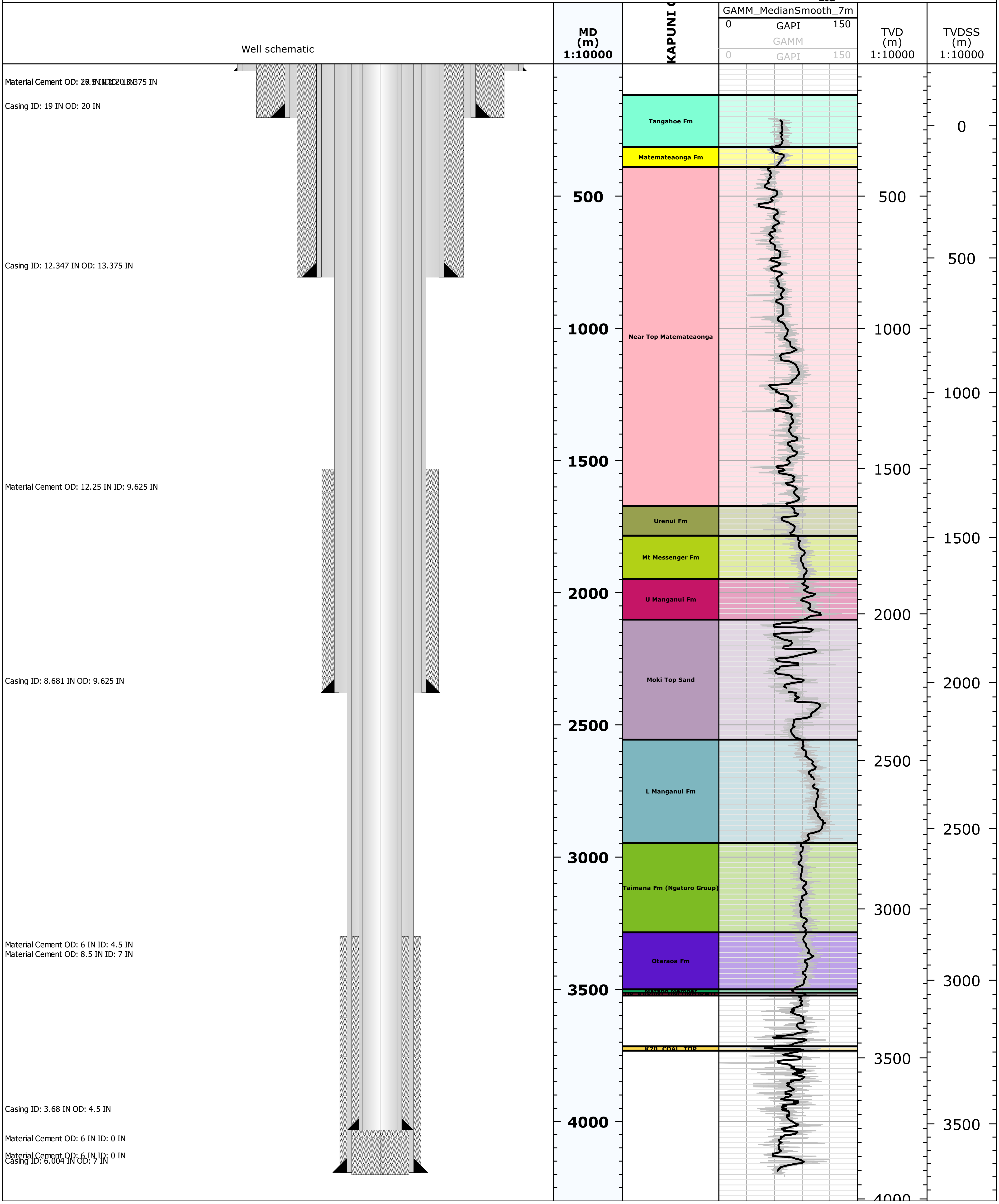
UWI: **KA-14**
Short name:
Long name:

Elevation: **233.8999 M**
Elevation datum:
Total depth: **4201 M**
Coordinate system:

X: **2610927.0000 M**
Y: **6194325.0000 M**
Longitude: **174.172129**
Latitude: **-39.452151**

SPUD date:
Completion date:
Status:
Operator:

Country: **UNKNOWN**
Field: **UNKNOWN**
State: **UNKNOWN**
Company: **Shell BP & Todd Oil Serv Ltd**



LAYOUT

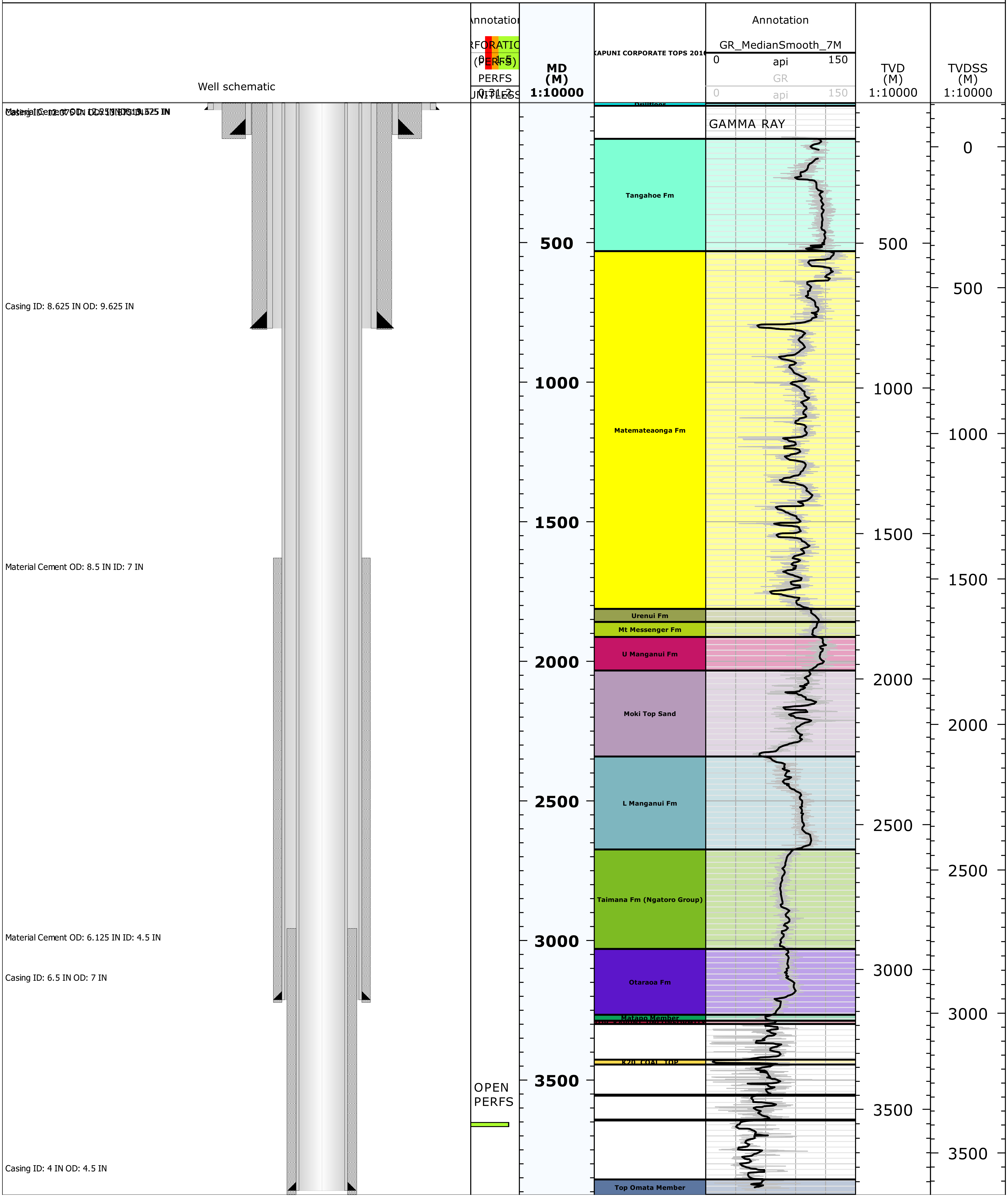
Well(s): **KA-17**

Project: **Kapuni**
Dataset(s): **KA-17_LQC_1524**
Scale: 1:**10000**

Author: **Dave RAWLENCE**
(ID: **Dave.Rawlence**)
Date: **31/08/2011**

Well: **KA-17**

UWI: **N/A** Short name: Long name:	Elevation: Elevation datum: Total depth: **3903. m** Coordinate system:	X: Y: Longitude: **174? 11'05.24" E DMS** Latitude: **39? 29' 46.88" S DMS**	SPUD date: Completion date: Status: Operator:	Country: **NE** Field: **Kapuni** State: **N/A** Company: **Shell Todd**



LAYOUT

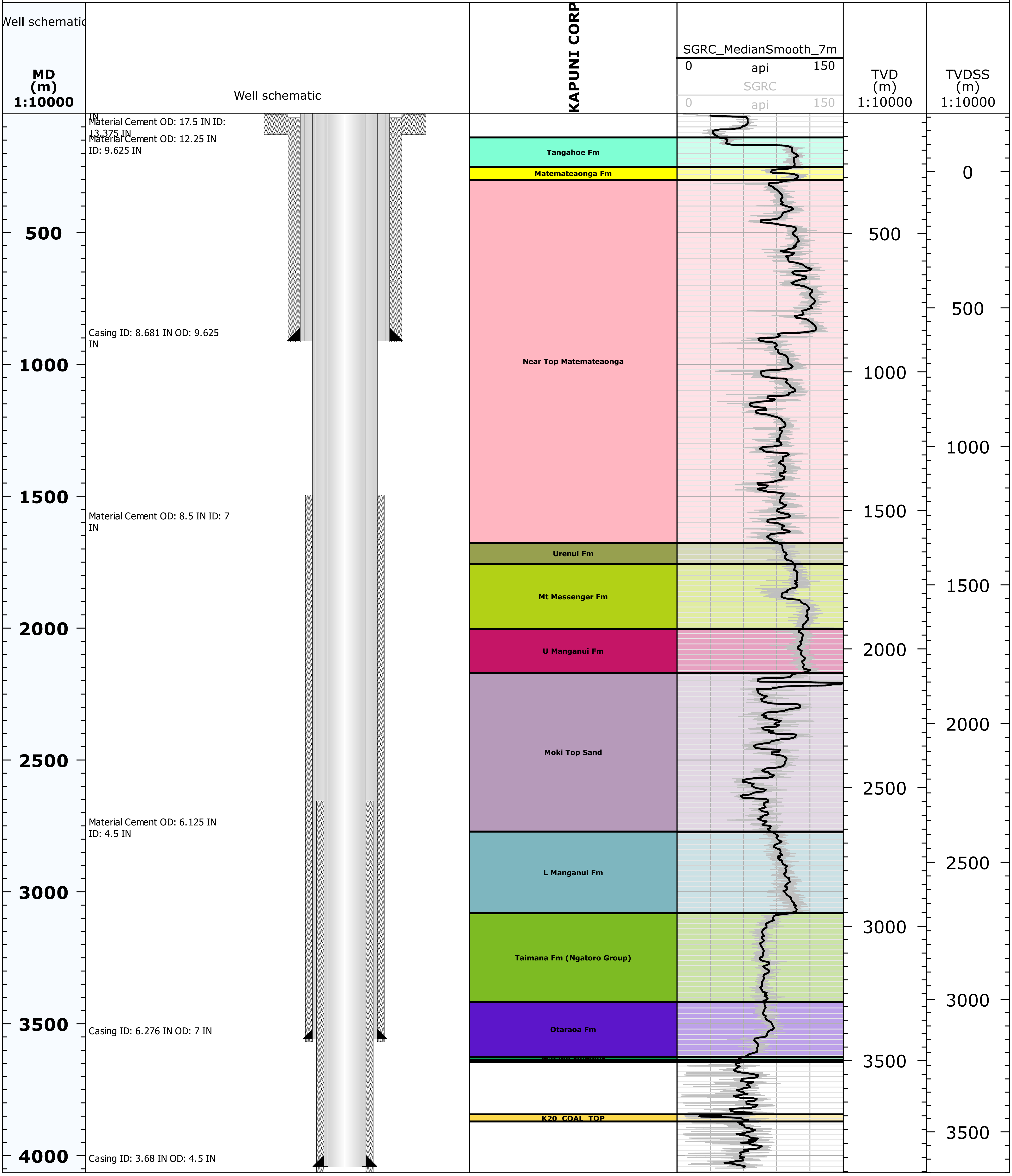
Well(s): **KA-18**

Project: **Kapuni**
Dataset(s): **KA-18_LWD_REC_FIELD_DATA_Working File**
Scale: 1:**10000**

Author: **Dave RAWLENCE**
(ID: **Dave.Rawlence**)
Date: **31/08/2011**

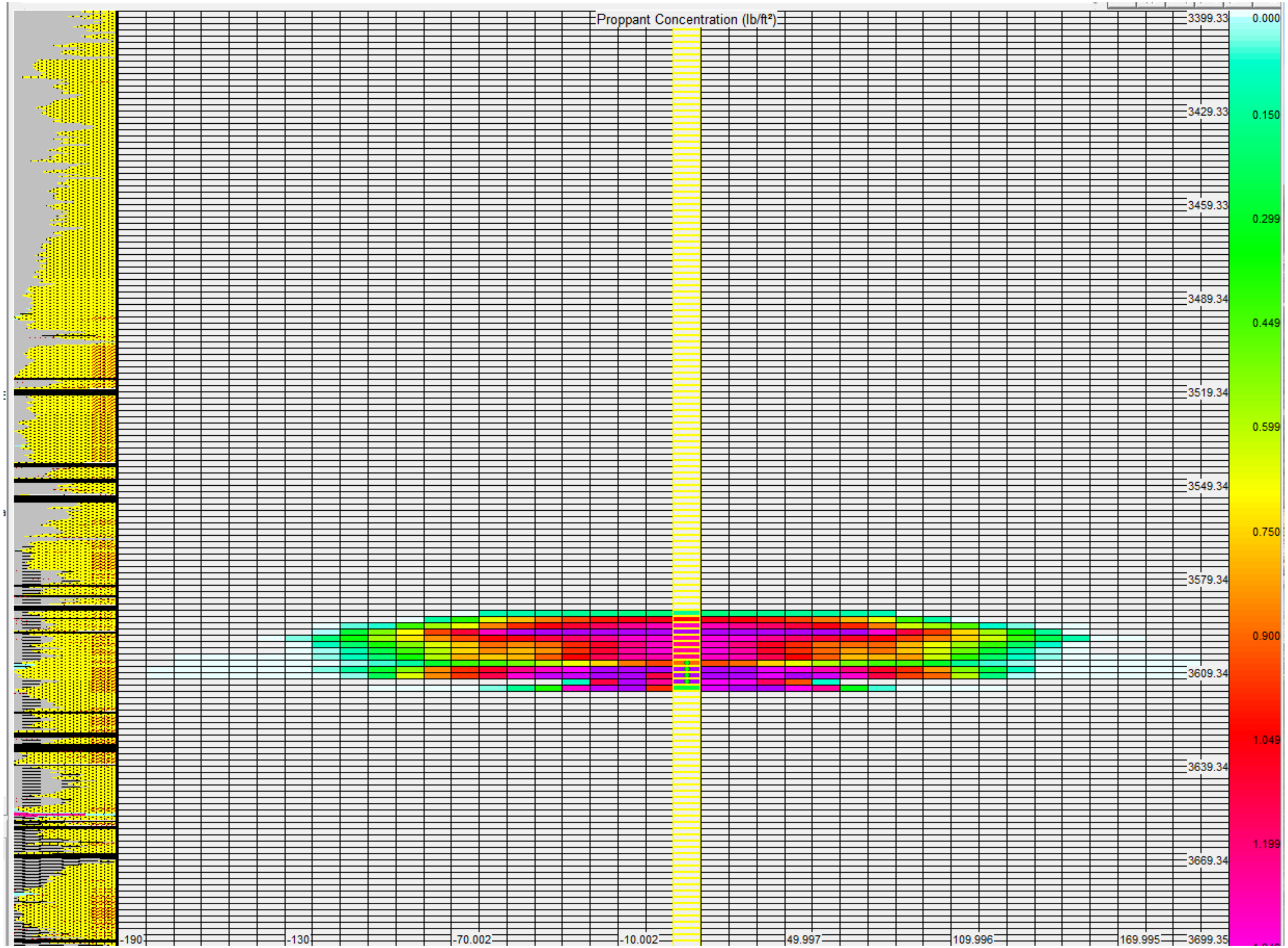
Well: **KA-18**

UWI: **N/A**	Elevation: **280.07 m**	X:	SPUD date:	Coun
Short name:	Elevation datum:	Y:	Completion date:	Field:
Long name:	Total depth:	Longitude: **174A 10'50.68" E DMS**	Status:	State
	Coordinate system:	Latitude: **39A 26' 00.47" S DMS**	Operator:	Comp



Appendix 2

Example of Proppant Concentration Diagram


Proppant Concentration (lb/ft²)
3399.33
3429.33
3459.33
3489.34
3519.34
3549.34
3579.34
3609.34
3639.34
3669.34
3699.35
0.000
0.150
0.299
0.449
0.599
0.750
0.900
1.049
1.199
-190
-130
-70.002
-10.002
49.997
109.996
169.995

Appendix 3

Example of Fracture Treatment Operational Procedures

Fracture Treatment Operational Procedures

STOS - Shell Todd Oil Services

KA-18
K1C, K1B Lower, K1B Upper Zones
Tarnaki
New Zealand

Disclaimer:-

1. Introduction

The purpose of this treatment is to carry out propped hydraulic fracture stimulation treatments, in order to by-pass near well bore formation damage and also to provide stimulation of K1C, K1B Lower and K1B Upper gas-bearing formations in well KA-18, located close to New Plymouth, Taranaki, New Zealand. This will then provide a path of increased conductivity from the reservoir to the well bore, increasing production. This treatment will be carried out for Shell Todd Oil Services Company. It should be noted that the final treatment schedules for each zone will be altered as a result of the MiniFrac and step rate test analysis.

2. Pre-Fracturing Preparation

2.1 Prepare Job Safety Analysis.
2.2 Prepare location according to STOS's procedure.
2.3 Prepare water tanks and treat with biocide (Magnacide-575 at 0.25gpt) immediately after or before filling tanks. Bacteria grows very quickly without bacteriacide and if left untreated can become unusable in a short period of time.

3. Equipment and Personnel

Equipment:-	6 x	2000 HHP Frac Pumps
	1 x	Cyclone V Blender
	1 x	Hydration Unit
	4 x	640 cu ft Proppant Bins
	1 x	Proppant conveyer
	1 x	Treatment Monitoring Container c/w Field Lab
	9 x	400 bbls tanks
	1 x	Suction Manifold
	3 x	Liquid Additive Tote Tanks
	1 lot	3" Fig 1502 Frac Iron
	1 lot	2" Fig 1502 Iron
	2 x	HP Pop-Off Valves
	1 lot	Pressure Transducers and Cables
	2 x	Chemical Transfer Pump c/w Hoses
	1 lot	4" Suction and Discharge Hoses
	1 x	Mechanics Workshop/Spares Container
	1 x	Personnel Communications System
	1 x	Generator
	1 x	Air Compressor
Personnel:-	1 x	FracMaster
	1 x	Frac Engineer
	1 x	Frac Supervisor
	1x	Datavan Operator
	1 x	Blender Operator
	1 x	Hydration Unit Operator
	1 x	Pump Operator

1 x Mechanics
1 x Electronic Technician
1 x Lab Technician
3 x Equipment Operators

4. Arrive on Location and Rig Up

4.1 Mobilise all equipment and materials to the KA-18 location
4.2 Stop equipment on location using crane, as per attached diagram, in the following order; hydration unit, blender, proppant bins, high pressure pumps and finally the treatment monitor van and field lab.
4.3 Rig tanks to suction manifold using suction hoses.
4.4 Rig suction manifold to blender using suction hoses. A minimum of 4 lines is required.
4.5 Rig blender discharge to high pressure pumps using discharge hoses.
4.6 Rig up a “suicide line” from hydration unit to a frac pump to enable flush in the event of blender failure.
4.7 Rig up two 3” fig 1502 high pressure lines, as per the attached diagram. At this stage, do not attach lines to frac head.
4.8 Install 2” high pressure relief valves on treating line. Avoid creating a pivot point in the event of the valve relieving.
4.9 Rig up bleed-off line with two 2” x 1” plug valves, complete with fitting for connecting line to vacuum truck. Tee off this line to the annulus pump with sufficient isolation valves. This line will be used for bullhead washes.
4.10 Secure all low pressure hoses with “whip-stop” safety devices.
4.11 Rig up treatment monitor vehicle and data cables.
4.12 Hook up Lab with sample lines.
4.13 Ensure all equipment is fitted with an electrical ground, especially proppant bins and blender.
4.14 Rig Up Safery Showe, Eye Wash etc. Check all chemical handling PPE is available approved chemical handler is on site. Lay out collapsible bunds & call off chemicals.
4.15 Perform pre-job lab testing with water samples and samples of additives taken from location.
4.16 Perform material inventory.

5. Rig Up to Wellhead and Pressure Test

Test pressures and maximum working pressures to be agreed with on-site STOS representative prior to commencing this section of the procedure.

5.1 Prepare wellhead as per STOS’s procedure. Line out x-tree valves and manifold valves ready for pressure testing. Ensure double 10,000 psi wing valves are closed on x-tree and lines are vented to atmosphere downstream to protect 5,000 psi rate flow-back manifolds and lines.
5.2 Rig Up slickline lubricator on top of BJ frac head and working valve.
5.3 Ensure all items are nippled up square to wellhead.
5.4 Rig up two 3” fig 1502 high pressure lines to the wellhead, as per the attached diagram.
5.5 Position barrier tape around equipment to isolate all hazardous areas.
5.6 Evacuate all unnecessary personnel.
5.7 Pressure test frac lines to 10,000 psi pas per STOS and BJ procedures.
5.8 Set high pressure relief valve at pre-agreed maximum working pressure, and function test.
5.9 Carry out complete system checks and pressure testing of lines.
5.10 Line out the annulus pump the A-annulus for holding back pressure. Pressure test lines to 5,000 psi. Open valves and pressure up annulus to 1450 psi. The annulus pump will also be used for pumping KCL.
5.11 Take control of SSV (UMGV is hydraulically actuated on the frac tree).
5.12 Carry out pre job audit.

6. Pre-Mix Fluids for Minifrac and Step Rate Test for K1C

6.1 Ensure there is sufficient water into tanks. Injection test will be conducted with treated water (7000 gals) and MiniFrac will be 35 Linear Gel (5000 gals).
6.2 Premix 35 base gel, as per attached fluid formulation and mixing schedule. Quantity as specified by BJ Engineer.

7. Safety Meeting

7.1 Carry out pre-job safety meeting as per STOS and BJ procedures. Ensure all persons present on location attend safety meeting.
7.2 Ensure all unnecessary personnel are off location or in safe areas.

8. Breakdown and Step Down Test

Exact treatment and displacement volumes to be verified on location and agreed with on-site STOS representative.

8.1 Perform radio check.
8.2 Notify KPS of imminent fracturing operation.
8.3 If required, equalise pressure across master valves on wellhead.
8.4 Open master valves on wellhead. Visually check all valves on wellhead and high pressure lines are positioned to allow pumping down well from BJ treating lines. STOS and BJ Supervisors to walk the lines
8.5 Record shut in wellhead pressure.
8.6 Perform an injection test with treated water by filling well, pump at 10 bbl/in to achieve breakdown. Once formation breaks increase rate to 30bpm (without exceeding pressure limitation), and pump 5,000 gal at 32 BPM.
8.7 Begin Step Down test by decreasing rates and holding rate only long enough for pressure to equalize (15 seconds or so). This will be done by taking a pump offline for each rate decrease.

> NOTE: The actual step down rate is not important just that the step down be done quickly and held for only as short a time as possible for the pressure to equalize before going to the next rate.

8.8 Shut down pumps, monitor and record pressure decline until well past closure (2 hours minimum).**Do not shut in wellhead, bleed off lines, close any valves or carry out any pumping until notified by BJ Frac Engineer.** These operations may prevent the recording of accurate pressure data during the pressure decline.
8.9 Shut in well when notified by BJ Frac Engineer. Bleed off pressure on treating line and annulus.
8.10 Perform materials inventory.
8.11 Start loading proppant and water. Do not load full amount of proppant or water until treatment design has been finalised.

9. Load TerraProp Pro, FlexSand HS Water and Chemicals for Main Treatment for Zone K1C

9.1 Load sufficient water into the tanks (bottoms) for main treatment.
9.2 Prepare and load additives into Hydration unit for Lightning-3500 base gel, as per separate mixing procedure. Quantity as specified by BJ Frac Engineer.
9.3 Load 20/40 Terraprop and Flexand HS into sand bins. Quantity as specified by BJ Frac Engineer.
9.4 Verify all quantities of materials with BJ Frac Engineer.
9.5 Load liquid additive tanks with sufficient additives for treatment.
9.6 Prime LA pumps.

10. Safety Meeting

10.1 Carry out pre-job safety meeting as per STOS and BJ procedures. Ensure all persons present on location attend safety meeting.

10.2 Ensure all unnecessary personnel are off location or in safe areas.

11. Pump Main Treatment for Zone K1C

12.1 Perform radio check.
12.2 If required, equalise pressure across master valves on wellhead.
12.3 Open master valves on wellhead. Visually check all valves on wellhead and high pressure lines are positioned to allow pumping down well from BJ treating lines.
12.4 Set up remote data trasmisstion via web portal.
12.5 Record shut in wellhead pressure.
12.6 Start main treatment by pumping Lightning-3500and proppant as per the pumping procedure. Exact volumes and rates may change as a result of the step rate test analysis, as specified by BJ Frac Engineer and agreed by on-site STOS representative.

Note: In the event of a premature screenout, isolate frac treating line, ensure pressure at tree is below 5,000 psi and flow well back immediately. To reduce the pressure in the tree down to flowback line pressure limit, utilize bleed off line.

12.7 Take real-time fluid samples during the job and store in water bath for break tests.
Take photographs of each sample bottle before placing in water bath and after to show fluid consistency. Measure viscosity on fann-35 before and after at same bob speed.
12.8 Displace main treatment by pumping flush as per pumping procedure.
12.9 After pumping agreed displacement volume, shut down pumps.

Note:- Pumping rate may be increased or decreased as directed by BJ and STOS Frac Engineer , depending upon pressure performance of the well.

12.10 Shut down pumps. Monitor pressure decline. **Do not shut in wellhead, bleed off lines, close any valves or carry out any pumping until notified by BJ Frac Engineer.** These operations may prevent the recording of accurate pressure data during the pressure decline.
12.11 Shut in well when directed by BJ and STOS Frac Engineer. Bleed off pressure in treating line.
12.12 Isolate frac head and line by closing swab valve and the frac head line valves
12.13 As soon as possible after shutting in the treating lines, open secondary flow-back line to the pit and perform a forced closure. Flowback at 2-3 bpm. Secondary line shall be used for fluids and high proppant concentrations (post screenout) and first line shall be used when sufficient gas break through is achieved.
12.14 Perform materials inventory.
12.15 Wait for frac fluid samples to break.

13. Repeat steps 6-12 to perform propped hydraulic fracturing treatment for Zones K1B Lower and K1B Upper.

14. Post Treatment

14.1 Once all zones have been stimulated, Rig Down fracturing equipment.
14.2 Deassemble 3” treating lines, remove frac head, working valve and tree cap

SHELL TODD OIL SERVICES

December 2, 2010

KA-18

MAIN PROPPED FRAC TREATMENT K1C ZONE

		Sand 20/40	Sand 20-40	Displ. to K1C (bbl)
Specific Gravity		**3.31**	**3.31**	
Abs.Vol. (gal/lb)		0.036225	0.036225	**173**

				CLEAN				SLURRY									
Stg	**Stage Description**	**Avg. Prop ppa**	**Sand type**	**Stg Vol gal**	**Stg Vol bbl**	**Cum Vol bbl**	**Clean Rate bpm**	**Stg Vol gal**	**Stg Vol bbl**	**Cum Vol bbl**	**Slurry Rate bpm**	**Sand Rate lbs/min**	**Sand Stage lbs**	**Sand Cum lbs**	**Stg Time min**	**Cum Time min**	**Stg**
MAIN TREATMENT																	
ZONE 1																	
1	(Pre-pad) Lightning 3500	0	-	4,000	95	95	30.0	4,000	95	95	30.0	0.00	0	0	00:03:10	00:03:10	1
2	(Slug) Lightning 3500	2	20/40 TerraProp	1,000	24	119	28.0	1,072	26	121	30.0	15.67	2,000	2,000	00:00:51	00:04:02	2
3	(Pad) Lightning 3500	0	-	4,000	95	214	30.0	4,000	95	216	30.0	0.00	0	2,000	00:03:10	00:07:12	3
4	(Proppant Laden) Lightning 3500	2	20/40 TerraProp	2,000	48	262	28.0	2,145	51	267	30.0	15.67	4,000	6,000	00:01:42	00:08:54	4
5	(Proppant Laden) Lightning 3500	3	20/40 TerraProp	2,000	48	310	27.1	2,217	53	320	30.0	22.73	6,000	12,000	00:01:46	00:10:40	5
6	(Proppant Laden) Lightning 3500	4	20/40 TerraProp	2,500	60	369	26.2	2,862	68	388	30.0	29.35	10,000	22,000	00:02:16	00:12:56	6
7	(Proppant Laden) Lightning 3500	5	20/40 TerraProp	2,500	60	429	25.4	2,953	70	458	30.0	35.56	12,500	34,500	00:02:21	00:15:17	7
8	(Proppant Laden) Lightning 3500	6	20/40 TerraProp	7,500	179	607	24.6	9,130	217	676	30.0	41.40	45,000	79,500	00:07:15	00:22:31	8
9	(Proppant Laden) Lightning 3500	7	20/40 TerraProp	2,700	64	671	23.9	3,385	81	756	30.0	46.91	18,900	98,400	00:02:41	00:25:13	9
10	(Proppant Laden) Lightning 3500	7	20/40 TerraProp FlexSand HS	2,000	48	719	23.9	2,507	60	816	30.0	46.91	14,000	112,400	00:01:59	00:27:12	10
11	(Proppant Laden) Lightning 3500	8	20/40 TerraProp FlexSand HS	1,800	43	762	23.3	2,322	55	871	30.0	52.10	14,400	126,800	00:01:51	00:29:03	11
12	(Flush) Linear 3000	0	-	7,130	170	932	30.0	7,130	170	1,041	30.0	0.00	0	126,800	00:05:40	00:34:42	12
		28.1%		**39,130**	**932**								**126,800**		**0:34:42**		

Shut down and monitor pressure decline.

Table 1 Main Frac Treatment Schedule Zone K1C

SHELL TODD OIL SERVICES

December 2, 2010

MAIN FRAC ADDITIVE SCHEDULE K1C ZONE

ADDITIVES: MIXED ON-THE-FLY

Stg	Stage Description	GLFC-5C				CLAYMASTER-5C				BF-7L				XLW-30				HIGHPERM CRB				GBW-41L				Stg
		Conc gpt	Rate gal/min	Stage gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	Conc lbs	Rate gal/min	Stg gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	Conc gpt	Rate lbs/min	Stg lbs	Cum lbs	Conc gpt	Rate gal/min	Stg gals	Cum gals	
													ZONE 1													
1	(Pre-pad) Lightning 3500	8.75	11.0	35.0	35.0	1.0	1.3	4.0	4.0	2.0	2.5	8.0	8.0	2.0	2.5	8.0	8.0	1.0	1.3	4.0	4.0	2.0	2.5	8.0	8.0	1
2	(Slug) Lightning 3500	8.75	10.3	8.8	43.8	1.0	1.2	1.0	5.0	2.0	2.3	2.0	10.0	2.0	2.3	2.0	10.0	1.0	1.2	1.0	5.0	2.0	2.3	2.0	10.0	2
3	(Pad) Lightning 3500	8.75	11.0	35.0	78.8	1.0	1.3	4.0	9.0	2.0	2.5	8.0	18.0	2.0	2.5	8.0	18.0	1.0	1.3	4.0	9.0	2.0	2.5	8.0	18.0	3
4	(Proppant Laden) Lightning 350	8.75	10.3	17.5	96.3	1.0	1.2	2.0	11.0	2.0	2.3	4.0	22.0	2.0	2.3	4.0	22.0	1.0	1.2	2.0	11.0	2.0	2.3	4.0	22.0	4
5	(Proppant Laden) Lightning 350	8.75	9.9	17.5	113.8	1.0	1.1	2.0	13.0	2.0	2.3	4.0	26.0	2.0	2.3	4.0	26.0	1.0	1.1	2.0	13.0	2.0	2.3	4.0	26.0	5
6	(Proppant Laden) Lightning 350	8.75	9.6	21.9	135.6	1.0	1.1	2.5	15.5	2.0	2.2	5.0	31.0	2.0	2.2	5.0	31.0	1.0	1.1	2.5	15.5	2.0	2.2	5.0	31.0	6
7	(Proppant Laden) Lightning 350	8.75	9.3	21.9	157.5	1.0	1.1	2.5	18.0	2.0	2.1	5.0	36.0	2.0	2.1	5.0	36.0	1.0	1.1	2.5	18.0	2.0	2.1	5.0	36.0	7
8	(Proppant Laden) Lightning 350	8.75	9.1	65.6	223.1	1.0	1.0	7.5	25.5	2.0	2.1	15.0	51.0	2.0	2.1	15.0	51.0	1.0	1.0	7.5	25.5	2.0	2.1	15.0	51.0	8
9	(Proppant Laden) Lightning 350	8.75	8.8	23.6	246.8	1.0	1.0	2.7	28.2	2.0	2.0	5.4	56.4	2.0	2.0	5.4	56.4	1.0	1.0	2.7	28.2	2.0	2.0	5.4	56.4	9
10	(Proppant Laden) Lightning 350	8.75	8.8	17.5	264.3	1.0	1.0	2.0	30.2	2.0	2.0	4.0	60.4	2.0	2.0	4.0	60.4	1.0	1.0	2.0	30.2	2.0	2.0	4.0	60.4	10
11	(Proppant Laden) Lightning 350	8.75	8.5	15.8	280.0	1.0	1.0	1.8	32.0	2.0	2.0	3.6	64.0	2.0	2.0	3.6	64.0	1.0	1.0	1.8	32.0	2.0	2.0	3.6	64.0	11
12	(Flush) Linear 3000	8.75	11.0	60.1	340.1	1.0	1.3	6.9	38.9	0.0	0.0	0.0	64.0	0.0	0.0	0.0	64.0	1.0	1.3	6.9	38.9	2.0	2.5	13.7	77.7	12

PREMIX IN TANKS

Stg	Stage Description	INFLO-150				CLAYTREAT 3C				GS-1L				MAGNACIDE 575												Stg
		Conc gpt	Rate gal/min	Stage gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	
													ZONE 1													
1	(Pre-pad) Lightning 3500	2.0	2.5	8.0	8.0	1.0	1.3	4.0	4.0	0.5	0.6	2.0	2.0	0.25	0.3	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
2	(Slug) Lightning 3500	2.0	2.3	2.0	10.0	1.0	1.2	1.0	5.0	0.5	0.6	0.5	2.5	0.25	0.3	0.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2
3	(Pad) Lightning 3500	2.0	2.5	8.0	18.0	1.0	1.3	4.0	9.0	0.5	0.6	2.0	4.5	0.25	0.3	1.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3
4	(Proppant Laden) Lightning 350	2.0	2.3	4.0	22.0	1.0	1.2	2.0	11.0	0.5	0.6	1.0	5.5	0.25	0.3	0.5	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
5	(Proppant Laden) Lightning 350	2.0	2.3	4.0	26.0	1.0	1.1	2.0	13.0	0.5	0.6	1.0	6.5	0.25	0.3	0.5	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
6	(Proppant Laden) Lightning 350	2.0	2.2	5.0	31.0	1.0	1.1	2.5	15.5	0.5	0.6	1.3	7.8	0.25	0.3	0.6	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
7	(Proppant Laden) Lightning 350	2.0	2.1	5.0	36.0	1.0	1.1	2.5	18.0	0.5	0.5	1.3	9.0	0.25	0.3	0.6	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7
8	(Proppant Laden) Lightning 350	2.0	2.1	15.0	51.0	1.0	1.0	7.5	25.5	0.5	0.5	3.8	12.8	0.25	0.3	1.9	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8
9	(Proppant Laden) Lightning 350	2.0	2.0	5.4	56.4	1.0	1.0	2.7	28.2	0.5	0.5	1.4	14.1	0.25	0.3	0.7	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9
10	(Proppant Laden) Lightning 350	2.0	2.0	4.0	60.4	1.0	1.0	2.0	30.2	0.5	0.5	1.0	15.1	0.25	0.3	0.5	7.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
11	(Proppant Laden) Lightning 350	2.0	2.0	3.6	64.0	1.0	1.0	1.8	32.0	0.5	0.5	0.9	16.0	0.25	0.2	0.5	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11
12	(Flush) Linear 3000	2.0	2.5	13.7	77.7	1.0	1.3	6.9	38.9	0.0	0.0	0.0	16.0	0.25	0.3	1.7	9.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12

Table 2 Chemicals Schedule Zone K1C

SHELL TODD OIL SERVICES

December 2, 2010

KA-18

MAIN PROPPED FRAC TREATMENT K1B LOWER ZONE

		Sand 20/40	Sand 20-40	Displ. to K1BL (bbl)
Specific Gravity		**3.31**	**3.31**	
Abs.Vol. (gal/lb)		0.036225	0.036225	**170**

				CLEAN				**SLURRY**									
Stg	**Stage Description**	**Avg. Prop ppa**	**Sand type**	**Stg Vol gal**	**Stg Vol bbl**	**Cum Vol bbl**	**Clean Rate bpm**	**Stg Vol gal**	**Stg Vol bbl**	**Cum Vol bbl**	**Slurry Rate bpm**	**Sand Rate lbs/min**	**Sand Stage lbs**	**Sand Cum lbs**	**Stg Time min**	**Cum Time min**	**Stg**
MAIN TREATMENT																	
ZONE 1																	
1	(Pre-pad) Lightning 3500	0	-	4,000	95	95	30.0	4,000	95	95	30.0	0.00	0	0	00:03:10	00:03:10	1
2	(Slug) Lightning 3500	2	20/40 TerraProp	1,000	24	119	28.0	1,072	26	121	30.0	15.67	2,000	2,000	00:00:51	00:04:02	2
3	(Pad) Lightning 3500	0	-	5,000	119	238	30.0	5,000	119	240	30.0	0.00	0	2,000	00:03:58	00:08:00	3
4	(Proppant Laden) Lightning 3500	2	20/40 TerraProp	2,000	48	286	28.0	2,145	51	291	30.0	15.67	4,000	6,000	00:01:42	00:09:42	4
5	(Proppant Laden) Lightning 3500	3	20/40 TerraProp	2,000	48	333	27.1	2,217	53	344	30.0	22.73	6,000	12,000	00:01:46	00:11:27	5
6	(Proppant Laden) Lightning 3500	4	20/40 TerraProp	3,000	71	405	26.2	3,435	82	425	30.0	29.35	12,000	24,000	00:02:44	00:14:11	6
7	(Proppant Laden) Lightning 3500	5	20/40 TerraProp	3,000	71	476	25.4	3,543	84	510	30.0	35.56	15,000	39,000	00:02:49	00:17:00	7
8	(Proppant Laden) Lightning 3500	6	20/40 TerraProp	7,000	167	643	24.6	8,521	203	713	30.0	41.40	42,000	81,000	00:06:46	00:23:45	8
9	(Proppant Laden) Lightning 3500	7	20/40 TerraProp	2,700	64	707	23.9	3,385	81	793	30.0	46.91	18,900	99,900	00:02:41	00:26:27	9
10	(Proppant Laden) Lightning 3500	7	20/40 TerraProp FlexSand HS	3,500	83	790	23.9	4,388	104	898	30.0	46.91	24,500	124,400	00:03:29	00:29:56	10
11	(Proppant Laden) Lightning 3500	8	20/40 TerraProp FlexSand HS	3,050	73	863	23.3	3,934	94	991	30.0	52.10	24,400	148,800	00:03:07	00:33:03	11
12	(Flush) Linear 3000	0	-	7,017	167	1,030	30.0	7,017	167	1,159	30.0	0.00	0	148,800	00:05:34	00:38:37	12
		24.8%		**43,267**	**1,030**								**148,800**		**0:38:37**		

Shut down and monitor pressure decline.

Table 3 Main Frac Treatment Schedule Zone K1B Lower

SHELL TODD OIL SERVICES

December 2, 2010

MAIN FRAC ADDITIVE SCHEDULE K1B LOWER ZONE

Shell Todd Oil Services Limited

ADDITIVES: MIXED ON-THE-FLY

Stg	Stage Description	GLFC-5C				CLAYMASTER-5C				BF-7L				XLW-30				HIGHPERM CRB				GBW-41L				Stg
		Conc gpt	Rate gal/min	Stage gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	Conc lbs	Rate gal/min	Stg gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	Conc gpt	Rate lbs/min	Stg lbs	Cum lbs	Conc gpt	Rate gal/min	Stg gals	Cum gals	
ZONE 1																										
1	(Pre-pad) Lightning 3500	8.75	11.0	35.0	35.0	3.0	3.8	12.0	12.0	2.0	2.5	8.0	8.0	2.0	2.5	8.0	8.0	1.0	1.3	4.0	4.0	2.0	2.5	8.0	8.0	1
2	(Slug) Lightning 3500	8.75	10.3	8.8	43.8	3.0	3.5	3.0	15.0	2.0	2.3	2.0	10.0	2.0	2.3	2.0	10.0	1.0	1.2	1.0	5.0	2.0	2.3	2.0	10.0	2
3	(Pad) Lightning 3500	8.75	11.0	43.8	87.5	3.0	3.8	15.0	30.0	2.0	2.5	10.0	20.0	2.0	2.5	10.0	20.0	1.0	1.3	5.0	10.0	2.0	2.5	10.0	20.0	3
4	(Proppant Laden) Lightning 350	8.75	10.3	17.5	105.0	3.0	3.5	6.0	36.0	2.0	2.3	4.0	24.0	2.0	2.3	4.0	24.0	1.0	1.2	2.0	12.0	2.0	2.3	4.0	24.0	4
5	(Proppant Laden) Lightning 350	8.75	9.9	17.5	122.5	3.0	3.4	6.0	42.0	2.0	2.3	4.0	28.0	2.0	2.3	4.0	28.0	1.0	1.1	2.0	14.0	2.0	2.3	4.0	28.0	5
6	(Proppant Laden) Lightning 350	8.75	9.6	26.3	148.8	3.0	3.3	9.0	51.0	2.0	2.2	6.0	34.0	2.0	2.2	6.0	34.0	1.0	1.1	3.0	17.0	2.0	2.2	6.0	34.0	6
7	(Proppant Laden) Lightning 350	8.75	9.3	26.3	175.0	3.0	3.2	9.0	60.0	2.0	2.1	6.0	40.0	2.0	2.1	6.0	40.0	1.0	1.1	3.0	20.0	2.0	2.1	6.0	40.0	7
8	(Proppant Laden) Lightning 350	8.75	9.1	61.3	236.3	3.0	3.1	21.0	81.0	2.0	2.1	14.0	54.0	2.0	2.1	14.0	54.0	1.0	1.0	7.0	27.0	2.0	2.1	14.0	54.0	8
9	(Proppant Laden) Lightning 350	8.75	8.8	23.6	259.9	3.0	3.0	8.1	89.1	2.0	2.0	5.4	59.4	2.0	2.0	5.4	59.4	1.0	1.0	2.7	29.7	2.0	2.0	5.4	59.4	9
10	(Proppant Laden) Lightning 350	8.75	8.8	30.6	290.5	3.0	3.0	10.5	99.6	2.0	2.0	7.0	66.4	2.0	2.0	7.0	66.4	1.0	1.0	3.5	33.2	2.0	2.0	7.0	66.4	10
11	(Proppant Laden) Lightning 350	8.75	8.5	26.7	317.2	3.0	2.9	9.2	108.8	2.0	2.0	6.1	72.5	2.0	2.0	6.1	72.5	1.0	1.0	3.1	36.3	2.0	2.0	6.1	72.5	11
12	(Flush) Linear 3000	8.75	11.0	61.4	378.6	3.0	3.8	21.1	129.8	0.0	0.0	0.0	72.5	0.0	0.0	0.0	72.5	1.0	1.3	7.0	43.3	2.0	2.5	14.0	86.5	12

PREMIX IN TANKS

Stg	Stage Description	INFLO-150				CLAYTREAT 3C				GS-1L				MAGNACIDE 575												Stg
		Conc gpt	Rate gal/min	Stage gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	
ZONE 1																										
1	(Pre-pad) Lightning 3500	2.0	2.5	8.0	8.0	1.0	1.3	4.0	4.0	0.5	0.6	2.0	2.0	0.25	0.3	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
2	(Slug) Lightning 3500	2.0	2.3	2.0	10.0	1.0	1.2	1.0	5.0	0.5	0.6	0.5	2.5	0.25	0.3	0.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2
3	(Pad) Lightning 3500	2.0	2.5	10.0	20.0	1.0	1.3	5.0	10.0	0.5	0.6	2.5	5.0	0.25	0.3	1.3	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3
4	(Proppant Laden) Lightning 350	2.0	2.3	4.0	24.0	1.0	1.2	2.0	12.0	0.5	0.6	1.0	6.0	0.25	0.3	0.5	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
5	(Proppant Laden) Lightning 350	2.0	2.3	4.0	28.0	1.0	1.1	2.0	14.0	0.5	0.6	1.0	7.0	0.25	0.3	0.5	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
6	(Proppant Laden) Lightning 350	2.0	2.2	6.0	34.0	1.0	1.1	3.0	17.0	0.5	0.6	1.5	8.5	0.25	0.3	0.8	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
7	(Proppant Laden) Lightning 350	2.0	2.1	6.0	40.0	1.0	1.1	3.0	20.0	0.5	0.5	1.5	10.0	0.25	0.3	0.8	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7
8	(Proppant Laden) Lightning 350	2.0	2.1	14.0	54.0	1.0	1.0	7.0	27.0	0.5	0.5	3.5	13.5	0.25	0.3	1.8	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8
9	(Proppant Laden) Lightning 350	2.0	2.0	5.4	59.4	1.0	1.0	2.7	29.7	0.5	0.5	1.4	14.9	0.25	0.3	0.7	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9
10	(Proppant Laden) Lightning 350	2.0	2.0	7.0	66.4	1.0	1.0	3.5	33.2	0.5	0.5	1.8	16.6	0.25	0.3	0.9	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
11	(Proppant Laden) Lightning 350	2.0	2.0	6.1	72.5	1.0	1.0	3.1	36.3	0.5	0.5	1.5	18.1	0.25	0.2	0.8	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11
12	(Flush) Linear 3000	2.0	2.5	14.0	86.5	1.0	1.3	7.0	43.3	0.0	0.0	0.0	18.1	0.25	0.3	1.8	10.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12

Table 4 Chemicals Schedule Zone K1B Lower

SHELL TODD OIL SERVICES

December 2, 2010

KA-18

MAIN PROPPED FRAC TREATMENT K1B UPPER ZONE

		Sand	Sand	
		20/40	20-40	Displ. to
Specific Gravity		**3.31**	**3.31**	K1BU (bbl)
Abs.Vol. (gal/lb)		0.036225	0.036225	**168**

				CLEAN				SLURRY									
Stg	**Stage Description**	**Avg. Prop ppa**	**Sand type**	**Stg Vol gal**	**Stg Vol bbl**	**Cum Vol bbl**	**Clean Rate bpm**	**Stg Vol gal**	**Stg Vol bbl**	**Cum Vol bbl**	**Slurry Rate bpm**	**Sand Rate lbs/min**	**Sand Stage lbs**	**Sand Cum lbs**	**Stg Time min**	**Cum Time min**	**Stg**
MAIN TREATMENT																	
ZONE 1																	
1	(Pre-pad) Lightning 3500	0	-	4,000	95	95	30.0	4,000	95	95	30.0	0.00	0	0	00:03:10	00:03:10	1
2	(Slug) Lightning 3500	2	20/40 TerraProp	1,000	24	119	28.0	1,072	26	121	30.0	15.67	2,000	2,000	00:00:51	00:04:02	2
3	(Pad) Lightning 3500	0	-	5,000	119	238	30.0	5,000	119	240	30.0	0.00	0	2,000	00:03:58	00:08:00	3
4	(Proppant Laden) Lightning 3500	2	20/40 TerraProp	2,000	48	286	28.0	2,145	51	291	30.0	15.67	4,000	6,000	00:01:42	00:09:42	4
5	(Proppant Laden) Lightning 3500	3	20/40 TerraProp	2,000	48	333	27.1	2,217	53	344	30.0	22.73	6,000	12,000	00:01:46	00:11:27	5
6	(Proppant Laden) Lightning 3500	4	20/40 TerraProp	3,000	71	405	26.2	3,435	82	425	30.0	29.35	12,000	24,000	00:02:44	00:14:11	6
7	(Proppant Laden) Lightning 3500	5	20/40 TerraProp	3,000	71	476	25.4	3,543	84	510	30.0	35.56	15,000	39,000	00:02:49	00:17:00	7
8	(Proppant Laden) Lightning 3500	6	20/40 TerraProp	7,000	167	643	24.6	8,521	203	713	30.0	41.40	42,000	81,000	00:06:46	00:23:45	8
9	(Proppant Laden) Lightning 3500	7	20/40 TerraProp	2,700	64	707	23.9	3,385	81	793	30.0	46.91	18,900	99,900	00:02:41	00:26:27	9
10	(Proppant Laden) Lightning 3500	7	20/40 TerraProp FlexSand HS	3,500	83	790	23.9	4,388	104	898	30.0	46.91	24,500	124,400	00:03:29	00:29:56	10
11	(Proppant Laden) Lightning 3500	8	20/40 TerraProp FlexSand HS	3,050	73	863	23.3	3,934	94	991	30.0	52.10	24,400	148,800	00:03:07	00:33:03	11
12	(Flush) Linear 3000	0	-	6,946	165	1,028	30.0	6,946	165	1,157	30.0	0.00	0	148,800	00:05:31	00:38:34	12
		24.8%		**43,196**	**1,028**								**148,800**		**0:38:34**		

Shut down and monitor pressure decline.

Table 5 Main Frac Treatment Schedule Zone K1B Upper

SHELL TODD OIL SERVICES

December 2,2010

MAIN FRAC ADDITIVE SCHEDULE K1B UPPER ZONE

ADDITIVES: MIXED ON-THE-FLY

Stg	Stage Description	GLFC-5C				CLAYMASTER-5C				BF-7L				XLW-30				HIGHPERM CRB				GBW-41L				Stg
		Conc gpt	Rate gal/min	Stage gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	Conc lbs	Rate gal/min	Stg gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	Conc gpt	Rate lbs/min	Stg lbs	Cum lbs	Conc gpt	Rate gal/min	Stg gals	Cum gals	
ZONE 1																										
1	(Pre-pad) Lightning 3500	8.75	11.0	35.0	35.0	1.0	1.3	4.0	4.0	2.0	2.5	8.0	8.0	2.0	2.5	8.0	8.0	1.0	1.3	4.0	4.0	2.0	2.5	8.0	8.0	1
2	(Slug) Lightning 3500	8.75	10.3	8.8	43.8	1.0	1.2	1.0	5.0	2.0	2.3	2.0	10.0	2.0	2.3	2.0	10.0	1.0	1.2	1.0	5.0	2.0	2.3	2.0	10.0	2
3	(Pad) Lightning 3500	8.75	11.0	43.8	87.5	1.0	1.3	5.0	10.0	2.0	2.5	10.0	20.0	2.0	2.5	10.0	20.0	1.0	1.3	5.0	10.0	2.0	2.5	10.0	20.0	3
4	(Proppant Laden) Lightning 350	8.75	10.3	17.5	105.0	1.0	1.2	2.0	12.0	2.0	2.3	4.0	24.0	2.0	2.3	4.0	24.0	1.0	1.2	2.0	12.0	2.0	2.3	4.0	24.0	4
5	(Proppant Laden) Lightning 350	8.75	9.9	17.5	122.5	1.0	1.1	2.0	14.0	2.0	2.3	4.0	28.0	2.0	2.3	4.0	28.0	1.0	1.1	2.0	14.0	2.0	2.3	4.0	28.0	5
6	(Proppant Laden) Lightning 350	8.75	9.6	26.3	148.8	1.0	1.1	3.0	17.0	2.0	2.2	6.0	34.0	2.0	2.2	6.0	34.0	1.0	1.1	3.0	17.0	2.0	2.2	6.0	34.0	6
7	(Proppant Laden) Lightning 350	8.75	9.3	26.3	175.0	1.0	1.1	3.0	20.0	2.0	2.1	6.0	40.0	2.0	2.1	6.0	40.0	1.0	1.1	3.0	20.0	2.0	2.1	6.0	40.0	7
8	(Proppant Laden) Lightning 350	8.75	9.1	61.3	236.3	1.0	1.0	7.0	27.0	2.0	2.1	14.0	54.0	2.0	2.1	14.0	54.0	1.0	1.0	7.0	27.0	2.0	2.1	14.0	54.0	8
9	(Proppant Laden) Lightning 350	8.75	8.8	23.6	259.9	1.0	1.0	2.7	29.7	2.0	2.0	5.4	59.4	2.0	2.0	5.4	59.4	1.0	1.0	2.7	29.7	2.0	2.0	5.4	59.4	9
10	(Proppant Laden) Lightning 350	8.75	8.8	30.6	290.5	1.0	1.0	3.5	33.2	2.0	2.0	7.0	66.4	2.0	2.0	7.0	66.4	1.0	1.0	3.5	33.2	2.0	2.0	7.0	66.4	10
11	(Proppant Laden) Lightning 350	8.75	8.5	26.7	317.2	1.0	1.0	3.1	36.3	2.0	2.0	6.1	72.5	2.0	2.0	6.1	72.5	1.0	1.0	3.1	36.3	2.0	2.0	6.1	72.5	11
12	(Flush) Linear 3000	8.75	11.0	61.2	378.4	1.0	1.3	6.9	43.2	0.0	0.0	0.0	72.5	0.0	0.0	0.0	72.5	1.0	1.3	7.0	43.2	2.0	2.5	14.0	86.5	12

PREMIX IN TANKS

Stg	Stage Description	INFLO-150				CLAYTREAT 3C				GS-1L				MAGNACIDE 575												Stg
		Conc gpt	Rate gal/min	Stage gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	Conc gpt	Rate gal/min	Stg gals	Cum gals	
ZONE 1																										
1	(Pre-pad) Lightning 3500	2.0	2.5	8.0	8.0	1.0	1.3	4.0	4.0	0.5	0.6	2.0	2.0	0.25	0.3	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
2	(Slug) Lightning 3500	2.0	2.3	2.0	10.0	1.0	1.2	1.0	5.0	0.5	0.6	0.5	2.5	0.25	0.3	0.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2
3	(Pad) Lightning 3500	2.0	2.5	10.0	20.0	1.0	1.3	5.0	10.0	0.5	0.6	2.5	5.0	0.25	0.3	1.3	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3
4	(Proppant Laden) Lightning 350	2.0	2.3	4.0	24.0	1.0	1.2	2.0	12.0	0.5	0.6	1.0	6.0	0.25	0.3	0.5	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
5	(Proppant Laden) Lightning 350	2.0	2.3	4.0	28.0	1.0	1.1	2.0	14.0	0.5	0.6	1.0	7.0	0.25	0.3	0.5	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
6	(Proppant Laden) Lightning 350	2.0	2.2	6.0	34.0	1.0	1.1	3.0	17.0	0.5	0.6	1.5	8.5	0.25	0.3	0.8	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
7	(Proppant Laden) Lightning 350	2.0	2.1	6.0	40.0	1.0	1.1	3.0	20.0	0.5	0.5	1.5	10.0	0.25	0.3	0.8	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7
8	(Proppant Laden) Lightning 350	2.0	2.1	14.0	54.0	1.0	1.0	7.0	27.0	0.5	0.5	3.5	13.5	0.25	0.3	1.8	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8
9	(Proppant Laden) Lightning 350	2.0	2.0	5.4	59.4	1.0	1.0	2.7	29.7	0.5	0.5	1.4	14.9	0.25	0.3	0.7	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9
10	(Proppant Laden) Lightning 350	2.0	2.0	7.0	66.4	1.0	1.0	3.5	33.2	0.5	0.5	1.8	16.6	0.25	0.3	0.9	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
11	(Proppant Laden) Lightning 350	2.0	2.0	6.1	72.5	1.0	1.0	3.1	36.3	0.5	0.5	1.5	18.1	0.25	0.2	0.8	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11
12	(Flush) Linear 3000	2.0	2.5	14.0	86.5	1.0	1.3	7.0	43.2	0.0	0.0	0.0	18.1	0.25	0.3	1.7	10.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12

Table 6 Chemicals Schedule Zone K1B Upper

Appendix 4

Well Casing Details

KA-14 Casing Scheme

Casing type	Outer Diameter	Weight	Grade	Burst Rating	Collapse Rating	Casing Shoe		Top of Cement	
	(inch)	(lb/ft)		(PSI)	(PSI)	mAH	mTV	mAH	mTV
Conductor	30.000	310	1" WT			19.7	19.7		
Surface	20.000	94	J-55	2110	520	195.7	195.7	Surface	
Surface	13.375	72/61	N-80/K-55	5380/3090	2670/1540	799.6	799.6	Surface	
Intermediate	9.625	47	N-80	6870	4750	2370.4	2262	1525	1495
Production	7.000	35.00	P-110	12700	13010	0-913	0-913		
Production	7.000	29.00	N-80	8160	7020	913-1473	913-1441		
Production	7.000	35.00	N-80	9240	10180	1473-4185.8	1441-3898.7	3293	3083
Completion	5.000	18.00	13CrS110	14340	13470	0-150	0-150		
Completion	4.500	17.00	13Cr95	16260	17010	150-4026	150-3750	2500	2380

KA-17 Casing Scheme

Casing type	Outer Diameter	Weight	Grade	Burst Rating	Collapse Rating	Casing Shoe		Top of Cement	
	(inch)	(lb/ft)		(PSI)	(PSI)	mAH	mTV	mAH	mTV
Conductor	20.000					24.4	24.4	Driven	
Surface	13.375	68	K-55	3450	1950	113.4	113.0	Surface	
Intermediate	9.625	47	P110	9440	5310	807.1	795.3	~ 6.2	~ 64.9
Production	7.000	26	P110	9960	6210	3212.6	3108.2	1629.84	1404.7
Completion	5.000	18.00	13CrS110	14340	13470	0-60.7	0-60.7		
Completion	4.500	17.00	13Cr95	16260	17010	60.7-3895.7	60.7-3790.7	2957.0	2463.9

KA-18 Casing Scheme

Casing type	Outer Diameter	Weight	Grade	Burst Rating	Collapse Rating	Casing Shoe		Top of Cement	
	(inch)	(lb/ft)		(PSI)	(PSI)	mAH	mTV	mAH	mTV
Conductor	20.000					19.4	19.4	Driven	
Surface	13.375	68	K-55	3450	1950	46.6	46.6	Surface	
Intermediate	9.625	47	P110	9440	5310	910.8	887.7	~ 65.0	~ 64.9
Production	7.000	26	P110	9960	6210	3557.9	3418.9	1494.8	1443.6
Completion	5.000	18.00	13CrS110	14340	13470	0-60.4	0-60.3		
Completion	4.500	17.00	13Cr95	16260	17010	60.4-4041.0	60.3-3898.3	2654.9	2547.6

KA-19 Casing Scheme

Casing type	Outer Diameter (inch)	Weight (lb/ ft)	Grade	Burst Rating (PSI)	Collapse Rating (PSI)	Planned Casing Shoe		Planned Top of Cement	
						mAH	mTV	mAH	mTV
Conductor	20.000		K55				52		
Conductor	13.375	68	L80	3450	1950	100	152	Surface	
Surface	10.750	46	P-110	7160	2610	1010	955	Surface	
Production	7.625	26	P-110	9470	5350	3262	3086	1500	1385
Completion	5.000	18.00	13Cr110	14340	13470	0-150	0-150		
Completion	4.500	15.10	13Cr95	12450	12760	150-3242	150-3062	2500	2324
Completion	4.500	17.00	13Cr95	16260	17010	3242-3900	3062-3724		

Appendix 5

Hydraulic Fracture Fluid Composition

API No.:		State:	Taranaki
Operator Name:	Shell Todd Oil Services	County:	New Zealand
Well Name:	KA-14	Longitude:	
True Vertical Depth:		Latitude:	
Measured Depth:		Long Lat Projection:	
Date:	12/12/2011	Production Type:	

File Name:	Carrier Data File.xls	Proppant Data File.xls	Additive Data File.xls
Last Modified:	15/01/2011 2:48:48 PM	19/08/2011 12:52:53 AM	17/08/2011 3:10:41 AM

Proposal No.:

Invoice No.:

Product	Use	Product Volume (Gallons)	Product % Volume (% of Total Volume)	Product Density (lb/gal)	Product Weight (lb)	Product % Weight (% of Total Product Weights)	Ingredient	Ingredient CAS No.	Ingredient % (% of Product) (Conservative*)	Ingredient Weight (lb) (Conservative*)	Ingredient % Weight (%) (Conservative*)
Water	Carrier	461,034	91.76%	8.33	3,840,413	79.07%					
							Water	7732-18-5	100%	3,840,413	74.94%
TerraProp Pro	Proppant	31,475	6.26%	28.36	892,620	18.38%					
							Corundum	1302-74-5	70%	624,834	12.19%
							Mullite	1302-93-8	60%	535,572	10.45%
Magnacide 575	Biocide	26	0.01%	11.42	297	0.01%					
							Tetrakis(Hydroxymethyl) Phosphonium Sulfate	55566-30-8	100%	297	0.01%
Clay Treat-3C	Clay Control	523	0.10%	8.51	4,451	0.09%					
							Tetramethyl Ammonium Chloride	75-57-0	60%	2,670	0.05%
GLFC-5B	Gellant	4,572	0.91%	9.59	43,845	0.90%					
							Petroleum Distillate Blend	CBI	70%	30,692	0.60%
							Guar Gum^ Substituted	68130-15-4	40%	17,538	0.34%
GS-1L	Gel Stabilizer	160	0.03%	10.82	1,731	0.04%					
							No Hazardous Ingredients	-	100%	1,731	0.03%
Caustic Solution	High pH buffer	319	0.06%	10.59	3,378	0.07%					
							Sodium Hydroxide	1310-73-2	25%	845	0.02%
							Water	7732-18-5	75%	2,534	0.05%
XLW-30AG	Crosslinker	319	0.06%	8.76	2,794	0.06%					
							Hydrotreated Light Distillate	64742-47-8	70%	1,956	0.04%
High Perm CRB	Breaker	48	0.01%	14.34	692	0.01%					
							Ammonium Persulphate	7727-54-0	100%	692	0.01%
							Crystalline Silica Quartz	14808-60-7	15%	104	0.00%
GBW-41L	Breaker	638	0.13%	8.42	5,372	0.11%					
							Hydrogen Peroxide	7722-84-1	15%	806	0.02%
							Water	7732-18-5	85%	4,566	0.09%
GasFlo G2	Surfactant	523	0.10%	9.84	5,146	0.11%					
							Amphoteric Surfactant	CBI	100%	5,146	0.10%
FlexSand HS	Proppant	2,456	0.49%	21.52	52,850	1.09%					
							Aluminum Needles	7429-90-5	90%	47,565	0.93%
							Cured Resin	CBI	10%	5,285	0.10%
Scaletrol 720	Scale Inhibitor	319	0.06%	9.84	3,139	0.06%					

API No.:		State:	Taranaki
Operator Name:	Shell Todd Oil Services	County:	New Zealand
Well Name:	KA-14	Longitude:	
True Vertical Depth:		Latitude:	
Measured Depth:		Long Lat Projection:	
Date:	12/12/2011	Production Type:	

File Name:	Carrier Data File.xls	Proppant Data File.xls	Additive Data File.xls
Last Modified:	15/01/2011 2:48:48 PM	19/08/2011 12:52:53 AM	17/08/2011 3:10:41 AM

Proposal No.:

Invoice No.:

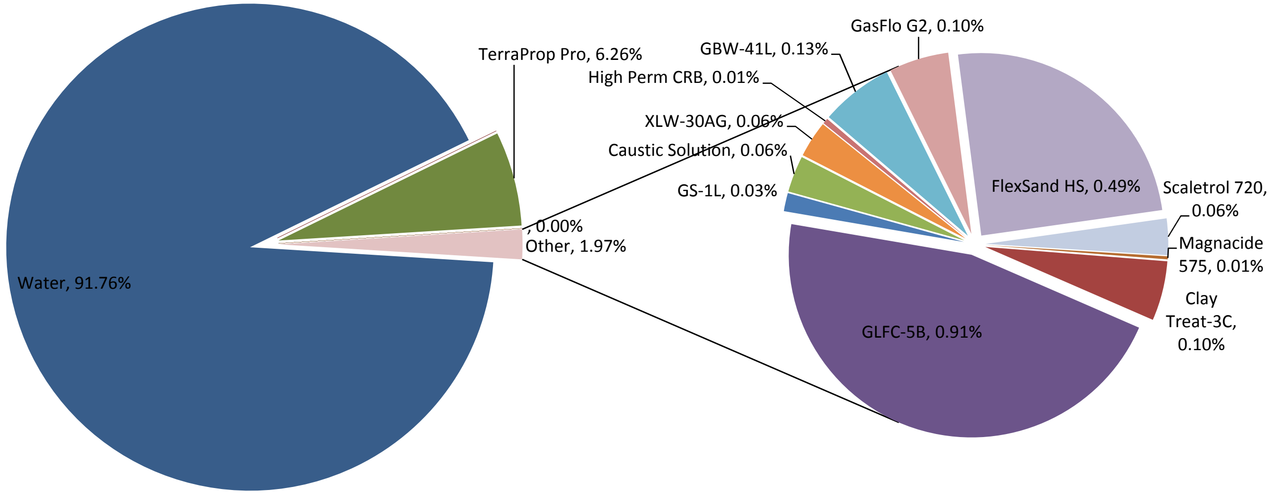
					Ethylene Glycol	107-21-1	45%	1,413	0.03%
					Diethylene Glycol	111-46-6	5%	157	0.00%
TOTALS	502,412	100%	4,856,729	100%				5,124,815	100.00%

🟩 Data entered by USER via PROGRAM

🟦 Data calculated by EXCEL

🟨 Data transferred from "MSDS" by PROGRAM

Conservative* = Total Ingredient Percentages may exceed 100% and
Total Ingredient Weights may exceed Product Weight



API No.:
Operator Name: Shell Todd Oil Services
Well Name: KA-14
True Vertical Depth:
Measured Depth:
Date: 12/12/2011

State: Taranaki
County: New Zealand
Longitude:
Latitude:
Long Lat Projection:
Production Type:

File Name:	Carrier Data File.xls	Proppant Data File.xls	Additive Data File.xls
Last Modified:	15/01/2011 2:48:48 PM	19/08/2011 12:52:53 AM	17/08/2011 3:10:41 AM

Proposal No.:
Invoice No.:

Appendix 6

MSDS of Fracture Fluid Components

SAFETY DATA SHEET

Product Name CERAMIC PROPPANT

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Supplier Name	**BJ SERVICES COMPANY (NEW ZEALAND) LTD**
Address	54 Corbett Road , Bell Block , New Plymouth, NEW ZEALAND, 4341
Telephone	+64 6 759 0059
Fax	+64 6 759 0039
Emergency	0800 CHEMCALL [243 622]
Synonym(s)	499820; 499817; 499876; 426807 - ITEM NUMBERS • CARBOPROP
Use(s)	CERAMIC PROPPANT • REFRACTORY APPLICATIONS • REFRACTORY CASTABLE
SDS Date	28 Feb 2011

2. HAZARDS IDENTIFICATION

NOT CLASSIFIED AS HAZARDOUS ACCORDING TO HAZARDOUS SUBSTANCES [CLASSIFICATION] REGULATIONS 2001

NOT CLASSIFIED AS A DANGEROUS GOOD ACCORDING TO LAND TRANSPORT RULE: DANGEROUS GOODS 2005; NZS 5433:2007, UN, IMDG OR IATA

UN No.	None Allocated	**DG Class**	None Allocated	**Subsidiary Risk(s)**	None Allocated
Packing Group	None Allocated	**Hazchem Code**	None Allocated		

3. COMPOSITION/ INFORMATION ON INGREDIENTS

Ingredient	CAS No.	Content
QUARTZ (SILICA CRYSTALLINE)	14808-60-7	<1%
ALUMINIUM OXIDE	1344-28-1	30-70%
KYANITE	1302-76-7	30-70%

4. FIRST AID MEASURES

Eye	If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.
Inhalation	If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.
Skin	If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.
Ingestion	For advice, contact the National Poisons Centre at 0800 764 766 (0800 POISON) or +643 479 7248 or a doctor (at once). If swallowed, do not induce vomiting.
Advice to Doctor	Treat symptomatically.
First Aid Facilities	Eye wash facilities should be available.

5. FIRE FIGHTING MEASURES

Flammability	Non flammable. May evolve toxic gases if strongly heated.
Fire and Explosion	No fire or explosion hazard exists.
Extinguishing	Prevent contamination of drains or waterways.

6. ACCIDENTAL RELEASE MEASURES

Spillage Contact emergency services where appropriate. Use personal protective equipment. Clear area of all unprotected personnel. Ventilate area where possible. Contain spillage, then cover / absorb spill with non-combustible absorbant material (vermiculite, sand, or similar), collect and place in suitable containers for disposal. Avoid generating dust.

7. STORAGE AND HANDLING

Storage Store tightly sealed in a cool, dry, well ventilated area, removed from acids, alkalis, heat or ignition sources and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use. Check regularly for leaks or spills.

Handling Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

8. EXPOSURE CONTROLS/ PERSONAL PROTECTION

Exposure Stds

Ingredient	**Reference**	**TWA**		**STEL**	
Aluminium oxide	WES (NZ)	--	10 mg/m^3	--	--
Silica, Crystalline Quartz	WES (NZ)	--	0.2 mg/m^3	--	--

Engineering Controls Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended. Maintain dust levels below the recommended exposure standard.

PPE Wear dust-proof goggles and PVC or rubber gloves. When using large quantities or where heavy contamination is likely, wear: coveralls. At high dust levels, wear: a Full-face Class P3 (Particulate) respirator. Where an inhalation risk exists, wear: a Class P1 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	DARK GREEN TO GRAY PELLETS	**Solubility (water)**	INSOLUBLE
Odour	ODOURLESS	**Specific Gravity**	3.25
pH	NOT AVAILABLE	**% Volatiles**	NOT AVAILABLE
Vapour Pressure	NOT AVAILABLE	**Flammability**	NON FLAMMABLE
Vapour Density	NOT AVAILABLE	**Flash Point**	NOT RELEVANT
Boiling Point	NOT AVAILABLE	**Upper Explosion Limit**	NOT RELEVANT
Melting Point	NOT AVAILABLE	**Lower Explosion Limit**	NOT RELEVANT
Evaporation Rate	NOT AVAILABLE		
Autoignition Temperature	NOT AVAILABLE	**Decomposition Temperature**	NOT AVAILABLE
Partition Coefficient	NOT AVAILABLE	**Viscosity**	NOT AVAILABLE

10. STABILITY AND REACTIVITY

Chemical Stability Stable under recommended conditions of storage.

Conditions to Avoid Avoid heat, sparks, open flames and other ignition sources.

Material to Avoid Incompatible with acids (eg. nitric acid) and alkalis (eg. hydroxides).

Hazardous Decomposition Products May evolve toxic gases if heated to decomposition.

Polymerization Polymerization is not expected to occur.

11. TOXICOLOGICAL INFORMATION

Health Hazard Summary Low toxicity - irritant. Use safe work practices to avoid eye or skin contact and inhalation. Chronic exposure to crystalline silica may result in lung fibrosis (silicosis). However, due to the low levels of crystalline silica, chronic health effects are not anticipated with normal use. Crystalline silica is classified as carcinogenic to humans (IARC Group 1).

Eye Irritant. Contact may result in irritation, lacrimation, pain and redness.

Inhalation High chronic toxicity - irritant. Over exposure to dust may result in mucous membrane irritation of the respiratory tract. Chronic exposure to crystalline silica may result in silicosis (lung fibrosis). Crystalline silica is classified as carcinogenic to humans (IARC Group 1).

Skin Irritant. Contact may result in irritation, redness, pain and rash.

Ingestion Low toxicity. Ingestion of large quantities may result in nausea, vomiting and gastrointestinal irritation.

Toxicity Data QUARTZ (SILICA CRYSTALLINE) (14808-60-7)
- LCLo (Inhalation): 300 ug/m^3/10 years (human)
- LDLo (Intratracheal): 200 mg/kg (rat)
- LDLo (Intravenous): 20 mg/kg (dog)
- TCLo (Inhalation): 16 000 000 particles/ft3/8 hours/17.9 years (human-fibrosis)

12. ECOLOGICAL INFORMATION

Environment The main component/s of this product are not anticipated to cause any adverse effects to plants or animals.

13. DISPOSAL CONSIDERATIONS

Waste Disposal Ensure product is covered with moist soil to prevent dust generation and dispose of to approved Council landfill. Contact the manufacturer if additional information is required.

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD ACCORDING TO LAND TRANSPORT RULE: DANGEROUS GOODS 2005; NZS 5433:2007, UN, IMDG OR IATA

Shipping Name	None Allocated				
UN No.	None Allocated	**DG Class**	None Allocated	**Subsidiary Risk(s)**	None Allocated
Packing Group	None Allocated	**Hazchem Code**	None Allocated		

15. REGULATORY INFORMATION

Approval Code Not Available

Group Name Not Available

HSNO Controls **Refer to the ERMA website for more information: www.ermanz.govt.nz**

16. OTHER INFORMATION

Additional Information ALUMINO SILICATES: When alumino silicates have been exposed to service temperatures exceeding 982°C for prolonged periods, cristobalite, a form of crystalline silica may be formed. Exposure to cristobalite dust may cause pulmonary fibrosis-silicosis. A hazard is only anticipated during demolition of used refractory materials. Cristobalite is classified as carcinogenic to humans (IARC Group 1).

RESPIRATORS: In general the use of respirators should be limited and engineering controls employed to avoid exposure. If respiratory equipment must be worn ensure correct respirator selection and training is undertaken. Remember that some respirators may be extremely uncomfortable when used for long periods. The use of air powered or air supplied respirators should be considered where prolonged or repeated use is necessary.

ABBREVIATIONS:
ACGIH - American Conference of Industrial Hygienists.
ADG - Australian Dangerous Goods.
BEI - Biological Exposure Indice(s).
CAS# - Chemical Abstract Service number - used to uniquely identify chemical compounds.
CNS - Central Nervous System.
EC No - European Community Number.
HSNO - Hazardous Substances and New Organisms.

IARC - International Agency for Research on Cancer.
mg/m³ - Milligrams per Cubic Metre.
NOS - Not Otherwise Specified.
pH - relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm - Parts Per Million.
RTECS - Registry of Toxic Effects of Chemical Substances.
STEL - Short Term Exposure Limit.
SWA - Safe Work Australia.
TWA - Time Weighted Average.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a Chem Alert report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this Chem Alert report is provided as a guide only. Factors such as method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

Report Status This document has been compiled by RMT on behalf of the manufacturer of the product and serves as the manufacturer's Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

Prepared By
Risk Management Technologies
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Western Australia 6005
Phone: +61 8 9322 1711
Fax: +61 8 9322 1794
Email: info@rmt.com.au
Web: www.rmt.com.au

SDS Date 28 Feb 2011

End of Report

Material Safety Data Sheet

SIBELCO GRADED SAND & GRAVEL PRODUCTS

Infosafe™ No.	LPVEG	**Issue Date**	December 2006	**Status**	ISSUED by SIBELCO	BS: 1.10.9

Not classified as hazardous according to criteria of NOHSC

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Product Name SIBELCO GRADED SAND & GRAVEL PRODUCTS

Product Code

Company Name SIBELCO AUSTRALIA LIMITED

Address
49-55 Woodlands Drive Braeside
Vic 3195

Emergency Tel. 1800 638 556

Telephone/Fax Number
Tel: (03)9586 5400
Fax: (03)9586 5413

Recommended Use Used in filtration and drilling applications.
This product is not to be used for abrasive blasting applications.

Other Names

Name	Product Code
FILTERSIL SERIES	8/16, 16/30, 18/40, 30/60, 12/20, 20/40
FRACSAND SERIES	16/30, 20/40
UNIFRAC SERIES	16/30, 20/40
GRAVEL SERIES	5/2, 6/3

2. HAZARDS IDENTIFICATION

Hazard Classification Not classified as Hazardous according to criteria of Australian National Occupational Health & Safety Commission (NOHSC), Australia.
Not classified as Dangerous Goods, according to the Australian Code for the Transport of Dangerous Goods by Road and Rail.

Undertake health and safety risk assessment on safe methods of handling and use appropriate to your workplace.

Safety Phrase (s)	S22 Do not breathe dust. S38 If insufficient ventilation, wear suitable respiratory equipment.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredients	**Name**	**CAS**	**Proportion**
	Quartz	14808-60-7	99 %

Other Information	Contains <1% respirable crystalline silica in the form of quartz.

4. FIRST AID MEASURES

Inhalation	Move the affected person to fresh air. Ensure airways are clear. Keep at rest. Seek medical attention.
Ingestion	Do not induce vomiting. Wash out mouth with water. If symptoms develop seek medical attention.
Skin	Wash affected area thoroughly with soap and water. If symptoms develop seek medical attention.
Eye	If contact with the eyes occurs, wash with running water for several minutes holding eyelids open. If irritation develops seek medical attention.
First Aid Facilities	Eye wash and normal washroom facilities.
Advice to Doctor	Treat symptomatically.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Use appropriate fire extinguishing media for surrounding combustible materials involved in the fire.
Specific Methods	Fire fighters should wear Self-Contained Breathing Apparatus (SCBA) and full protective clothing to prevent exposure to vapours, fumes, dust or products of combustion.
Specific Hazards	The product is not combustible.

6. ACCIDENTAL RELEASE MEASURES

Emergency Procedures

Wear sufficient respiratory protection and clothing to minimise exposure. Sweep up material avoiding dust generation or dampen spilled material with water to avoid airborne dust. Seal all wastes in labelled containers for subsequent recycling or disposal. If the spillage enters the waterways inform the Environmental Protection Authority, or your local Waste Management Authority.
The disposal must be done in accordance with the applicable local and national regulations.

7. HANDLING AND STORAGE

Precautions for Safe Handling

Prevent the creation of dust concentration higher than the occupational exposure limit. Wear appropriate protective equipment to prevent inhalation, skin and eye contact. Keep containers closed when not in use. Ensure a high level of personal hygiene is maintained when using the product.

Conditions for Safe Storage

Store in a cool, dry, well-ventilated area. Protect containers/bags from damage. Avoid generation of dust.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

National Exposure Standards

Name	STEL (mgm3)	STEL (ppm)	TWA (mgm3)	TWA (ppm)	FootNote
Quartz			0.1		

Other Exposure Information

No exposure standard is established for this material by the National Occupational Health & Safety Commission (NOHSC), Australia, however the exposure standard for respirable crystalline silica, in the form of quartz, as set by NOHSC is given above.
Note: The exposure limit for dust otherwise not specified is TWA 10 mg/m^3 (inspirable fraction).
TWA (Time Weighted Average): The average airborne concentration of a particular substance when calculated over a normal eight-hour working day, for a five-day week.

Engineering Controls

Good ventilation adequate to maintain the concentration below exposure standards is required. The use of a local exhaust ventilation system (drawing dusts away from workers breathing zone) is recommended. If the engineering controls are not sufficient to maintain concentrations of particulates below the exposure standards, suitable respiratory protection must be worn.

Respiratory Protection

If engineering controls are not effective in controlling airborne exposure then an approved respirator with a replaceable particulate filter should be used. Reference should be made to Australian Standards AS/NZS 1715, Selection, Use and Maintenance of Respiratory Protective Devices; and AS/NZS 1716, Respiratory Protective Devices, in order to make any necessary changes for

	individual circumstances.
Eye Protection	Safety glasses with side shields or chemical goggles should be worn. Final choice of appropriate eye/face protection will vary according to individual circumstances. Eye protection devices should conform with Australian/New Zealand Standard AS/NZS 1337 - Eye Protectors for Industrial Applications.
Hand Protection	Wear gloves of impervious material conforming to AS/NZS 2161: Occupational protective gloves - Selection, use and maintenance. Final choice of appropriate glove type will vary according to individual circumstances. This can include methods of handling, and engineering controls as determined by appropriate risk assessments.
Body Protection	Suitable protective workwear should be worn when working with this material, e.g. cotton overalls buttoned at neck and wrist.
Hygiene Measures	Ensure a high level of personal hygiene is maintained when using this product. Always wash hands before eating, drinking, smoking or using the toilet facilities.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Off white to light brown crystals.
Boiling Point	Not applicable
Solubility in Water	Insoluble
Specific Gravity	2.65
pH Value	Not available
Vapour Pressure	Not applicable
Flash Point	Not applicable (non-combustible solid).
Flammability	Non-combustible solid.
Auto-Ignition Temperature	Not applicable
Flammable Limits - Lower	Not applicable
Flammable Limits - Upper	Not applicable

10. STABILITY AND REACTIVITY

Chemical Stability	Stable
Hazardous	

Polymerization	Will not occur.

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11. TOXICOLOGICAL INFORMATION

Toxicology Information	Respirable crystalline silica (particle size smaller than 7 micrometres), is regarded as a danger to health by prolonged exposure through inhalation. Repeated, prolonged or concentrated inhalation of respirable crystalline silica dust may lead to silicosis, a serious lung disease.
Inhalation	Inhalation may cause the drying and irritation of the respiratory tract. Acute aspiration may cause cough, dyspnea, sneezing, vomiting, cyanosis, and pulmonary edema which may be delayed by up to several hours.
Ingestion	Ingestion of large amounts may irritate the gastric tract causing nausea and vomiting.
Skin	Skin contact may cause dryness. May cause mild irritation in the case of some individuals with sensitive skin.
Eye	Eye contact may cause mechanical irritation.
Chronic Effects	Repeated, prolonged or concentrated inhalation of fine dust may cause delayed lung injury. Breathing of fine dust may cause shortness of breath, and aggravate asthma and inflammatory or fibrotic pulmonary disease. Prolonged or repeated contact with the skin in the absence of proper hygiene, may cause dryness and dermatitis.
Carcinogenicity	The product contains a small proportion of respirable crystalline silica as quartz (<1%). Crystalline silica has been classified by International Agency for Research on Cancer (IARC) as carcinogenic to humans by inhalation (Group 1) Furthermore, crystalline silica can cause silicosis or other lung diseases on prolonged exposure.

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12. ECOLOGICAL INFORMATION

Ecotoxicity	Not available
Persistence / Degradability	Not available
Mobility	Not available
Bioaccumulative Potential	Not available

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13. DISPOSAL CONSIDERATIONS

Disposal Considerations	The disposal of the waste or spilled material must be done in accordance with the applicable local, state and federal government regulations.

14. TRANSPORT INFORMATION

Transport Information	The product is not classified as Dangerous Goods, according to the Australian Code for the Transport of Dangerous Goods by Road and Rail.

15. REGULATORY INFORMATION

Regulatory Information	Not classified as Dangerous Goods, according to the Australian Code for the Transport of Dangerous Goods by Road and Rail. Not classified as Hazardous according to criteria of National Occupational Health & Safety Commission (NOHSC), Australia. Not classified as a Scheduled Poison according to the Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP).
Poisons Schedule	Not Scheduled
AICS (Australia)	All constituents of this material are listed on the Australian Inventory of Chemical Substances (AICS).

16. OTHER INFORMATION

Date of preparation or last revision of MSDS	MSDS created: April 2006
Contact Person/Point	Emergency Advice: ACOHS ERS - 1800 638 556 (24 Hours) PLEASE NOTE: The information contained herein is based on data available to Sibelco Australia Limited from both our own technical sources and from recognised published references and is believed to be both accurate and reliable. Sibelco Australia Limited has made no effort to censor nor to conceal deleterious aspects of this product. Since we cannot anticipate or control the many different conditions under which this information and our products may be used, each user should review these recommendations in the specific context of the intended application and confirm whether they are appropriate. It is therefore recommended that you undertake your own risk assessment in relation to your method of handling and proposed use of this product. Sibelco Australia Limited accepts no liability whatsoever for damage or injury caused from the use of this information or of suggestions contained herein.

End of MSDS

Print Date: 25/08/2011 BS: 1.10.9

BJ SERVICES COMPANY
MATERIAL SAFETY DATA SHEET

Region
USA

SECTION I - GENERAL INFORMATION

PRODUCT NAME:	**FlexSand HS**
ITEM NUMBER:	499908
CHEMICAL DESCRIPTION:	Resin coated needle
PRODUCT USE:	Proppant
SUPPLIER:	BJ Services Company
ADDRESS:	11211 FM 2920 Tomball, TX 77375
EMERGENCY TELEPHONE NUMBER	**(800)424-9300 for CHEMTREC** **(703)527-3887 Alaska and International**
PREPARED BY:	BJ Services Environmental Group (281)351-8131
DATE PREPARED:	September 11, 2002 Supersedes: June 14, 2002

HMIS HAZARD INDEX

HEALTH:	1
FLAMMABILITY:	1
REACTIVITY:	1
PERSONAL PROTECTION:	e

SECTION II - HAZARDOUS COMPONENTS

HAZARDOUS COMPONENTS	CAS #	PERCENT	HAZARD
Aluminum needles	7429-90-5	90-100	Irritant
Cured resin	Proprietary	0-10	Irritant

SECTION III - FIRE AND EXPLOSION HAZARD DATA

FLASHPOINT (METHOD):	1190°F
UPPER EXPLOSION LIMIT(% BY VOL):	N.A.
LOWER EXPLOSION LIMIT(% BY VOL):	N.A.
AUTO-IGNITION TEMPERATURE:	1094°F
EXTINGUISHING MEDIA:	Gently smother burning material with dry sand or other inert substance.
SPECIAL FIRE FIGHTING PROCEDURES:	Prolonged contact with water may result in a reaction releasing hydrogen gas – ignition risk.
EXPLOSION DATA:	Will react with oxidizing agents causing heating and hydrogen release – explosion risk.
HAZARDOUS COMBUSTION PRODUCTS:	None known.

SECTION IV - HEALTH HAZARD DATA

PRIMARY ROUTES OF ENTRY: Eye contact

ACUTE OVEREXPOSURE EFFECTS:

SKIN CONTACT:	May cause skin irritation by abrasion.
SKIN ABSORPTION:	Not absorbed through intact skin.
EYE CONTACT:	May cause irritation.
INHALATION:	May cause irritation and shortness of breath. Prolonged exposure to large concentrations of fine dusts may cause emphysema and pulmonary fibrosis characterized by coughing, sputum production, weakness, anorexia, basal crackles, dyspnea, pneumothorax and cardiac failure.
INGESTION:	Large doses may cause gastrointestinal irritation. Aluminum is poorly absorbed and may decrease absorption of other substances.

CHRONIC OVEREXPOSURE EFFECTS: None known.

EXPOSURE LIMITS:

HAZARDOUS COMPONENT	ACGIH TLV	OSHA PEL
Aluminum needles	N.E.	N.E.
Cured resin	N.E.	N.E.

CARCINOGENICITY, REPRODUCTIVE EFFECTS:
Not listed as carcinogenic - IARC, NTP, or OSHA

TERATOGENICITY, MUTAGENICITY:
No effects listed.

TOXICITY STUDIES:

LD(50)	N.E.
LC(50)	N.E.

SECTION V - FIRST AID PROCEDURES

FOR EYES:	Immediately flush with plenty of water for at least 15 minutes. If irritation persists, contact a physician.
FOR SKIN:	Gently and thoroughly wash the contaminated skin with plenty of running water and non-abrasive soap. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.
FOR INHALATION:	Remove to fresh air. If breathing has stopped, give artificial respiration. Keep person warm, quiet and get medical attention.
FOR INGESTION:	If vomiting occurs, keep head lower than hips to help prevent aspiration. Treat symptomatically and supportively. Get medical attention.

SECTION VI - PHYSICAL DATA

APPEARANCE AND ODOR:	Golden green, needle-like solid with slight odor
SPECIFIC GRAVITY:	2.58
VAPOR PRESSURE:	N.A.
VAPOR DENSITY (air=1):	N.A.
EVAPORATION RATE:	N.A.
BOILING POINT:	N.A.
FREEZING POINT:	N.A.
SOLUBILITY IN H20:	Insoluble
pH:	N.E.

SECTION VII - REACTIVITY DATA

CHEMICAL STABILITY:	Stable under normal conditions.
INCOMPATIBLE MATERIALS:	Separate from acids, bases, halogenated compounds, oxidizers and combustible materials.
HAZARDOUS POLYMERIZATION:	Does not polymerize
HAZARDOUS DECOMPOSITION PRODUCTS:	None known.

SECTION VIII - SPECIAL/PERSONAL PROTECTION

VENTILATION:	The use of mechanical ventilation is recommended whenever this product is used in a confined space. Where engineering controls are not feasible, assure use is in an area where there is natural air movement.
RESPIRATORY PROTECTION:	Use NIOSH/MSHA approved equipment when airborne exposure limits are exceeded.
PROTECTIVE GLOVES:	Work gloves
EYE PROTECTION:	Goggles
OTHER PROTECTIVE EQUIPMENT:	Eyewash bottles or other rinsing equipment should be easily accessible.

SECTION IX - HANDLING PRECAUTIONS

LEAK AND SPILL PROCEDURES:	Sweep and shovel material into container. Do not use water to clean area.
WASTE DISPOSAL:	If this product becomes a waste it does not meet the requirements of a RCRA hazardous waste. Always dispose of according to local, state, and federal regulations.
HANDLING & SPECIAL EQUIPMENT:	Keep away from heat. Keep away from sources of ignition.
STORAGE REQUIREMENTS:	Store in cool, dry well-ventilated place. Separate from acids, alkalis, halogenated compounds, oxidizers, and combustible materials.

SECTION X - REGULATORY INFORMATION

SHIPPING INFORMATION

PROPER SHIPPING NAME:	Not DOT Regulated
HAZARD CLASS:	N.A.
UN/NA NUMBER:	N.A.
PACKING GROUP W/ "PG":	N.A.
SUBSIDIARY RISK:	N.A.
REPORTABLE QUANTITY (RQ):	N.A.
EMERGENCY RESPONSE GUIDE #:	N.A.

ENVIRONMENTAL INFORMATION

SARA TITLE III

SECTION 302/304	This product does not contain ingredients listed as an Extremely Hazardous Substance.
SECTION 311/312	Immediate
SECTION 313	This product does not contain ingredients (at a level of 1% or greater) on the List of Toxic Chemicals.

OTHER REGULATORY INFORMATION

TSCA INVENTORY:	All of the components in this product appear on the TSCA inventory.
CALIFORNIA PROP 65:	None of the chemicals on the current Proposition 65 list are known to be present in this product.

The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in his use of the material.

Safety Data Sheet

PRODUCT NAME **MAGNACIDE 575 MICROBIOCIDE**

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Supplier Name	**BJ SERVICES COMPANY (NEW ZEALAND) LTD**
Address	Level 5 Tasman Towers, PO Box 333 Fitzroy, New Plymouth, NEW ZEALAND, 4341
Telephone	+646 759 0059
Fax	+646 759 0039
Emergency	+64 0800 CHEMCALL [243 622]
Synonym(s)	MICROBIOCIDE 575
Use(s)	BIOCIDE • MICROBIOCIDE
MSDS Date	03 August 2007

2. HAZARDS IDENTIFICATION

CLASSIFIED AS HAZARDOUS ACCORDING TO CRITERIA IN THE HS (MIN DEG OF HAZ) REGULATIONS 2001

HAZARD CLASSIFICATION

6.1C	Substances that are acutely toxic.
6.5B	Substances that are contact sensitisers.
8.2C	Substances that are corrosive to dermal tissue.
8.3A	Substances that are corrosive to ocular tissue.
9.1A	Substances that are very ecotoxic in the aquatic environment.
9.3B	Substances that are ecotoxic to terrestrial vertebrates.

HAZARD STATEMENTS

H301	Toxic if swallowed.
H432	Toxic to terrestrial vertebrates.
H317	May cause an allergic skin reaction.
H400	Very toxic to aquatic life.
H314	Causes severe skin burns and eye damage.
H318	Causes serious eye damage.

PRECAUTIONARY STATEMENTS

P102	Keep out of reach of children.
P260	Do not breathe mist/vapours/spray.
P272	Contaminated work clothing should not be allowed out of the workplace.
P264	Wash hand thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P273	Avoid release to the environment.
P280	Wear protective gloves, protective clothing and eye/face protection.
P301+P310	IF SWALLOWED: Immediately call a POISON CENTRE or doctor/physician.
P303+P361+P353	IF ON SKIN (or hair): Remove/take off immediately all contaminated clothing. Rinse skin with water.
P333+P313	If skin irritation or rash occurs: Get medical advice/attention.
P304+P340	IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing.
P305+P351+P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P321	See label for specific treatment.
P330	Rinse mouth.
P363	Wash contaminated clothing before reuse.
P391	Collect spillage.
P405	Store locked up.

2. HAZARDS IDENTIFICATION

NOT CLASSIFIED AS A DANGEROUS GOOD ACCORDING TO LAND TRANSPORT RULE: DANGEROUS GOODS 2005; NZS 5433: 1999, UN, IMDG OR IATA

UN No.	2810	**DG Class**	6.1	**Subsidiary Risk(s)**	None Allocated
Pkg Group	III	**Hazchem Code**	2X	**EPG**	6A1

3. COMPOSITION / INFORMATION ON INGREDIENTS

Ingredient	**CAS No.**	**Content**
TETRAKIS(HYDROXYMETHYL)PHOSPHONIUM SULPHATE	55566-30-8	>60%

4. FIRST AID MEASURES

Eye	If in eyes, hold eyelids apart and flush the eye continuously with running water. Continue flushing until advised to stop by the PIC or a doctor, or for at least 15 minutes.
Inhalation	Leave area of exposure immediately. If assisting a victim avoid becoming a casualty, wear an Air-line respirator where an inhalation risk exists. Remove victim from exposure area & keep warm. If victim is not breathing apply artificial respiration & seek urgent medical attention.
Skin	Remove contaminated clothing and gently flush affected areas with water. Seek medical attention if irritation develops. Launder clothing before reuse.
Ingestion	For advice, contact a Poison Information Centre on 0800 764 766 (0800 POISON) or +643 479 7248 (New Zealand) or a doctor. If swallowed, do not induce vomiting.
Advice to Doctor	Treat symptomatically

5. FIRE FIGHTING MEASURES

Flammability	Non flammable. May evolve toxic gases if strongly heated.
Fire and Explosion	Non flammable. Treat as per requirements for Surrounding Fires: Evacuate area and contact emergency services. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.
Extinguishing	Non flammable. Prevent contamination of drains or waterways, absorb runoff with sand or similar.
Hazchem Code	2X

6. ACCIDENTAL RELEASE MEASURES

Spillage	If spilt (bulk), contact emergency services where appropriate. Wear splash-proof goggles, PVC/rubber gloves, a Type AB (Organic vapour, Inorganic and acid gas) respirator, coveralls and boots. Ventilate and clear area of all unprotected personnel. Absorb spill with sand or similar, collect and place in sealable containers for disposal.

7. STORAGE AND HANDLING

Storage Store in cool, dry, well ventilated area, removed from oxidising agents, metals, acids, heat sources and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use. Check regularly for leaks or spills.

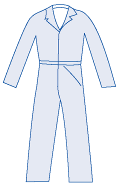
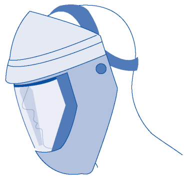
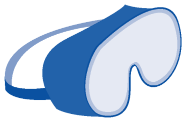
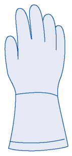
Handling Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Stds No exposure standard(s) allocated.

Engineering Controls Do not inhale vapours (solutions) or dusts. Use in well ventilated areas. In poorly ventilated areas, mechanical extraction ventilation is recommended.

PPE Wear splash-proof goggles, rubber or PVC gloves, coveralls and a faceshield. Where heavy contamination is likely, wear an apron and boots. Where an inhalation risk exists, wear a Type AB (Organic vapour, Inorganic and acid gas) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	CLEAR COLOURLESS LIQUID	**Solubility (water)**	SOLUBLE
Odour	PUNGENT ODOUR	**Specific Gravity**	1.363 to 1.375
pH	3.1 to 3.3 (Neat)	**% Volatiles**	NOT AVAILABLE
Vapour Pressure	16.7 mm Hg @ 21°C	**Flammability**	NON FLAMMABLE
Vapour Density	> 1 (Air = 1)	**Flash Point**	> 93.4°C (cc)
Boiling Point	108°C	**Upper Explosion Limit**	NOT RELEVANT
Melting Point	NOT AVAILABLE	**Lower Explosion Limit**	NOT RELEVANT
Evaporation Rate	NOT AVAILABLE	**Autoignition Temperature**	NOT AVAILABLE

10. STABILITY AND REACTIVITY

Chemical Stability Stable under recommended conditions of storage.

Conditions to Avoid Avoid heat, sparks, open flames and other ignition sources.

Material to Avoid Incompatible with oxidising agents (eg. peroxides), acids (eg. sulphuric acid), active metals (eg. aluminium, potassium, magnesium), and heat and ignition sources.

Decomposition May evolve toxic gases if heated to decomposition.

Polymerization Polymerization will not occur. Polymerization is not expected to occur.

11. TOXICOLOGICAL INFORMATION

Health Hazard Summary Slightly corrosive - irritant. This product has the potential to cause adverse health effects with over exposure. Use safe work practices to avoid eye or skin contact and vapour or mist generation or inhalation. When diluted, the potential for adverse health effects is reduced.

Eye Slightly corrosive. Contact may result in lacrimation, pain, redness and conjunctivitis, with possible burns.

Inhalation Slightly corrosive - irritant. Over exposure may result in mucous membrane irritation of the throat, coughing, and possible mucous membrane burns. However, due to low product volatility, the inhalation hazard is reduced.

Skin Slightly corrosive. Contact may result in itching, pain, redness, rash and dermatitis. Prolonged contact may result in burns and possible sensitisation.

Ingestion Slightly corrosive. Ingestion may result in ulceration to the mouth and throat with nausea and vomiting.

Toxicity Data TETRAKIS(HYDROXYMETHYL)PHOSPHONIUM SULPHATE (55566-30-8)
LD50 (Ingestion): 248 mg/kg (rat)

12. ECOLOGICAL INFORMATION

Environment	Limited ecotoxicity data was available for this product at the time this report was prepared. Ensure appropriate measures are taken to prevent this product from entering the environment.

13. DISPOSAL CONSIDERATIONS

Waste Disposal	Neutralise with dilute acid (eg. 3 mol/L hydrochloric acid) or similar. For small amounts absorb with sand or similar and dispose of to an approved landfill site. Contact the manufacturer for additional information.
Legislation	Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD ACCORDING TO LAND TRANSPORT RULE: DANGEROUS GOODS 2005; NZS 5433: 1999, UN, IMDG OR IATA

Shipping Name	TOXIC LIQUID, ORGANIC, N.O.S.				
UN No.	2810	**DG Class**	6.1	**Subsidiary Risk(s)**	None Allocated
Pkg Group	III	**Hazchem Code**	2X	**EPG**	6A1

IATA

Shipping Name	TOXIC LIQUID, ORGANIC, N.O.S.				
UN No.	2810	**DG Class**	6.1	**Subsidiary Risk(s)**	None Allocated
Pkg Group	III				

IMDG

Shipping Name	TOXIC LIQUID, ORGANIC, N.O.S.				
UN No.	2810	**DG Class**	6.1	**Subsidiary Risk(s)**	None Allocated
Pkg Group	III				

15. REGULATORY INFORMATION

Approval Code	HSR003992	
Group Name	Tetrakis(hydroxymethyl)phosphonium sulphate	
HSNO Controls	**AH1**	- Approved Handler requirements (including test certificate and qualification requirements). Refer to the New Zealand Hazardous Substances and New Organisms (Personnel Qualifications) Regulations 2001, Regulations 4 - 6 for more information.
	T3	- Requirements for keeping records of use. Refer to the New Zealand Hazardous Substances (Classes 6, 8, and 9 Controls) Regulations 2001, Regulations 5(1), 6 for more information.
	TR1	- General tracking requirements. Refer to the New Zealand Hazardous Substances (Tracking) Regulations 2001, Regulations 4(1), 5, 6 for more information.

Refer to the ERMA website for more information: www.ermanz.govt.nz

16. OTHER INFORMATION

Additional Information

EXPOSURE CONTROL: If utilised in a closed system the potential for over exposure is reduced. If not used in a closed system, local exhaust ventilation is recommended to control exposure. Provide eye wash and safety shower in close proximity to points of potential exposure. Where the potential for an inhalation risk exists, an approved respirator may be required. Do not eat, store, consume food, tobacco or drink in areas where product is used.

RESPIRATORS: In general the use of respirators should be limited and engineering controls employed to avoid exposure. If respiratory equipment must be worn ensure correct respirator selection and training is undertaken. Remember that some respirators may be extremely uncomfortable when used for long periods. The use of air powered or air supplied respirators should be considered where prolonged or repeated use is necessary.

ABBREVIATIONS:
ADB - Air-Dry Basis.
BEI - Biological Exposure Indice(s)
CAS# - Chemical Abstract Service number - used to uniquely identify chemical compounds.
CNS - Central Nervous System.
IARC - International Agency for Research on Cancer.
M - moles per litre, a unit of concentration.
mg/m3 - Milligrams per cubic metre.
NOS - Not Otherwise Specified.
pH - relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm - Parts Per Million.
TWA/ES - Time Weighted Average or Exposure Standard.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a Chem Alert report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this Chem Alert report is provided as a guide only. Factors such as method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

Report Status

This document has been compiled by RMT on behalf of the manufacturer of the product and serves as the manufacturer's Material Safety Data Sheet ('MSDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer.

While RMT has taken all due care to include accurate and up-to-date information in this MSDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this MSDS.

Prepared By

Risk Management Technologies
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Western Australia 6005
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Email: info@rmt.com.au
Web: www.rmt.com.au

MSDS Date: 03 August 2007

End of Report

Safety Data Sheet

PRODUCT NAME **CLAY TREAT-3C**

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Supplier Name	**BJ SERVICES COMPANY (NEW ZEALAND) LTD**
Address	Level 5 Tasman Towers, PO Box 333 Fitzroy, New Plymouth, NEW ZEALAND, 4341
Telephone	+646 759 0059
Fax	+646 759 0039
Emergency	+646 759 0059
Synonym(s)	488137 - ITEM NUMBER • CLAYTREAT 3C • 488163 - ITEM NUMBER • 488195 - ITEM NUMBER
Use(s)	CLAY CONTROL
MSDS Date	30 July 2007

2. HAZARDS IDENTIFICATION

CLASSIFIED AS HAZARDOUS ACCORDING TO HS (MIN DEG OF HAZ) REGS 2001

HAZARD CLASSIFICATION

6.1C	Substances that are acutely toxic.
9.3B	Substances that are ecotoxic to terrestrial vertebrates.

HAZARD STATEMENTS

H301	Toxic if swallowed.
H432	Toxic to terrestrial vertebrates.

PRECAUTIONARY STATEMENTS

P102	Keep out of reach of children.
P264	Wash hand thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P273	Avoid release to the environment.
P301+P310	IF SWALLOWED: Immediately call a POISON CENTRE or doctor/physician.
P321	Specific treatment (see first aid instructions on label).
P330	Rinse mouth.
P391	Collect spillage.
P405	Store locked up.

CLASSIFIED AS A DANGEROUS GOOD ACCORDING TO NZS 5433: 1999, UN, IMDG or IATA

UN No.	2810	**DG Class**	6.1	**Subsidiary Risk(s)**	None Allocated
Pkg Group	III	**Hazchem Code**	2X	**EPG**	6A1

3. COMPOSITION / INFORMATION ON INGREDIENTS

Ingredient	CAS No.	Content
TETRAMETHYLAMMONIUM CHLORIDE	75-57-0	40-60%
NON HAZARDOUS INGREDIENTS	Not Available	remainder

4. FIRST AID MEASURES

Eye	Hold eyelids apart and flush continuously with water. Continue until advised to stop by the Poisons Information Centre, a doctor, or for at least 15 minutes. Keep patient calm.
Inhalation	If over exposure occurs leave exposure area immediately. If irritation persists, seek medical attention.

Skin	Remove contaminated clothing and gently flush affected areas with water. Seek medical attention if irritation develops. Launder clothing before reuse.
Ingestion	DO NOT induce vomiting. Immediately wash out mouth with water, and then give water to drink. Seek medical attention.
Advice to Doctor	Treat symptomatically
First Aid Facilities	Eye wash facilities should be available.

5. FIRE FIGHTING MEASURES

Flammability	Non flammable. May evolve toxic gases (carbon/ nitrogen oxides, ammonia, chlorides, hydrocarbons) when heated to decomposition. May also evolve hydrochloric acid when when heated to decomposition.
Fire and Explosion	Non flammable. Evacuate area and contact emergency services. Toxic gases (carbon/ nitrogen oxides, ammonia, hydrocarbons, chlorides) may be evolved when heated. Remain upwind & notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers & nearby storage areas.
Extinguishing	Non flammable. Prevent contamination of drains or waterways, absorb runoff with sand or similar.
Hazchem Code	2X

6. ACCIDENTAL RELEASE MEASURES

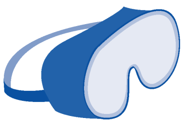
Spillage	If spilt (bulk), collect and reuse where possible. Wear splash-proof goggles, PVC/rubber gloves, coveralls or protective clothing and boots. Where an inhalation risk exists, wear a Type A (Organic vapour) respirator. Prevent spill entering drains or waterways. Absorb with sand or similar and place in sealable containers for disposal.

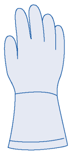
7. STORAGE AND HANDLING

Storage	Store in cool, dry, well ventilated area, removed from strong oxidising agents (eg. hypochlorites, peroxides, nitrates), anionic detergents (eg. soaps), heat sources and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use. Check regularly for leaks or spills. Protect from low temperatures (>3°C). Do not store in stainless steel, carbon steel or copper containers.
Handling	Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Standards	No exposure standard(s) allocated.
Biological Limit Values	No biological limit allocated.
Engineering Controls	Ensure adequate natural ventilation.
PPE	Wear splash-proof goggles and rubber or PVC gloves. When using large quantities or where heavy contamination is likely, wear viton (R) gloves and coveralls. Where an inhalation risk exists, wear a Type A (Organic vapour) Respirator.





9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	COLOURLESS TO LIGHT YELLOW LIQUID	**Solubility (water)**	SOLUBLE
Odour	SLIGHT ODOUR	**Specific Gravity**	1.02
pH	5 to 10	**% Volatiles**	NOT AVAILABLE
Vapour Pressure	NOT AVAILABLE	**Flammability**	NON FLAMMABLE

Vapour Density	NOT AVAILABLE	**Flash Point**	NOT RELEVANT
Boiling Point	102°C (Approximately)	**Upper Explosion Limit**	NOT RELEVANT
Melting Point	NOT AVAILABLE	**Lower Explosion Limit**	NOT RELEVANT
Evaporation Rate	NOT AVAILABLE	**Autoignition Temperature**	NOT AVAILABLE

10. STABILITY AND REACTIVITY

Chemical Stability	Stable under recommended conditions of storage.
Material to Avoid	Incompatible with strong oxidising agents (eg. peroxides, nitrates, hypochlorites) and anionic detergents (eg. soaps).
Decomposition	May evolve toxic gases (carbon/ nitrogen oxides, ammonia, chlorides, hydrocarbons) when heated to decomposition. May also evolve hydrochloric acid when when heated to decomposition.
Polymerization	Polymerization is not expected to occur.

11. TOXICOLOGICAL INFORMATION

Health Hazard Summary	This product has the potential to cause adverse health effects with over exposure. Use safe work practices to avoid eye or skin contact and vapour/ mist inhalation. Dilution will substantially reduce potential hazard. Individuals with pre-existing respiratory impairment (eg. asthma) or skin sensitivities may be more susceptible to adverse effects.
Eye	Exposure may result in lacrimation, irritation, pain and redness.
Inhalation	Over exposure to vapours/mists may result in respiratory irritation, nausea, and headache. Occupational exposure to quaternary ammonium compounds has been reported to cause asthma, although rare. Due to the low vapour pressure, an inhalation hazard is not anticipated, unless sprayed.
Skin	Prolonged contact may result in skin rash, drying and defatting of the skin which may result in dermatitis. Potential sensitising agent.
Ingestion	Ingestion may result in gastrointestinal irritation, nausea, vomiting and abdominal pain.
Toxicity Data	TETRAMETHYLAMMONIUM CHLORIDE (75-57-0) LD50 (Ingestion): 50 mg/kg (rat)

12. ECOLOGICAL INFORMATION

Environment	Benzalkonium chloride derivatives/quaternary ammonium compounds are commonly used as disinfectants, indicating toxicity to microorganisms. Benzalkonium chloride is toxic to trout above 2 ppm.

13. DISPOSAL CONSIDERATIONS

Waste Disposal	For small amounts absorb with sand, vermiculite or similar and dispose of to an approved landfill site. Contact the manufacturer for additional information if larger amounts are involved. Prevent contamination of drains and waterways as aquatic life may be threatened and environmental damage may result.
Legislation	Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

CLASSIFIED AS A DANGEROUS GOOD ACCORDING TO NZS 5433: 1999, UN, IMDG or IATA

Shipping Name	TOXIC LIQUID, ORGANIC, N.O.S.				
UN No.	2810	**DG Class**	6.1	**Subsidiary Risk(s)**	None Allocated
Pkg Group	III	**Hazchem Code**	2X	**EPG**	6A1

IATA

Shipping Name	TOXIC LIQUID, ORGANIC, N.O.S.				
UN No.	2810	**DG Class**	6.1	**Subsidiary Risk(s)**	None Allocated
Pkg Group	III				

IMDG
Shipping Name TOXIC LIQUID, ORGANIC, N.O.S.

UN No. 2810 **DG Class** 6.1 **Subsidiary Risk(s)** None Allocated

Pkg Group III

15. REGULATORY INFORMATION

Approval Code HSR004714

Group Name Tetramethylammonium chloride, >33% in a non hazardous diluent

HSNO Controls **AH1** - Approved Handler requirements (including test certificate and qualification requirements). Refer to the New Zealand Hazardous Substances and New Organisms (Personnel Qualifications) Regulations 2001, Regulations 4 - 6 for more information.

T3 - Requirements for keeping records of use. Refer to the New Zealand Hazardous Substances (Classes 6, 8, and 9 Controls) Regulations 2001, Regulations 5(1), 6 for more information.

TR1 - General tracking requirements. Refer to the New Zealand Hazardous Substances (Tracking) Regulations 2001, Regulations 4(1), 5, 6 for more information.

Refer to the ERMA website for more information: www.ermanz.govt.nz

16. OTHER INFORMATION

Additional Information ABBREVIATIONS:
ADB - Air-Dry Basis.
CAS# - Chemical Abstract Service number - used to uniquely identify chemical compounds.
CNS - Central Nervous System.
IARC - International Agency for Research on Cancer.
M - moles per litre, a unit of concentration.
mg/m3 - Milligrams per cubic metre.
NOS - Not Otherwise Specified.
pH - relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm - Parts Per Million.
TWA/ES - Time Weighted Average or Exposure Standard.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this Chem Alert report is provided as a guide only. Factors such as method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a Chem Alert report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Report Status This document has been compiled by RMT on behalf of the manufacturer of the product and serves as the manufacturer's Material Safety Data Sheet ('MSDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer.

While RMT has taken all due care to include accurate and up-to-date information in this MSDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this MSDS.

Prepared By
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MSDS Date: 30 July 2007

End of Report

SAFETY DATA SHEET

GasFlo G2

BAKER HUGHES

Section 1. Identification

Product name : GasFlo G2

Product code : 488555

Product type : Liquid.

Recommended use of the chemical

Surfactant

Restrictions on use

None identified.

Supplier's details : Baker Hughes
Badentoy Avenue, Badentoy Park
Portlethen, Aberdeen
Scotland, UK
AB12 4YB

Emergency telephone number (with hours of operation) : CHEMTREC Emergency Telephone within UK: 0203 318 0470
CHEMTREC Emergency Telephone outside UK: +44 203 318 0470

e-mail address of person responsible for this SDS : paul.chapman2@bakerhughes.com

Section 2. Hazards identification

HSNO Classification : 6.1 - ACUTE TOXICITY: ORAL - Category D
6.1 - ACUTE TOXICITY: INHALATION - Category E
6.3 - SKIN IRRITATION - Category A
6.4 - EYE IRRITATION - Category A (Irritant)

This material is classified as hazardous according to criteria in the Hazardous Substances (Minimum Degrees of Hazard) Regulations 2001 and has been classified according to the Hazardous Substances (Classifications) Regulations 2001.

This material is classified as a dangerous good according to criteria in New Zealand Standard 5433:2007 Transport of Dangerous Goods on Land.

GHS label elements

Signal word : Warning

Hazard statements : Harmful if swallowed.
May be harmful if inhaled.
Causes skin irritation.
Causes serious eye irritation.

Precautionary statements

Prevention : Wear protective gloves: >8 hours (breakthrough time): Nitrile gloves.. Wear eye or face protection. Do not eat, drink or smoke when using this product. Wash thoroughly after handling.

Response : IF SWALLOWED: Rinse mouth. IF ON SKIN: Take off contaminated clothing and wash before reuse. Wash with plenty of soap and water. If skin irritation occurs, seek medical advice/attention. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists, get medical advice/attention. Wash hands after handling. IF INHALED: Call a POISON CENTER or doctor/physician if you feel unwell.

Storage : Not applicable.

Disposal : Dispose of contents and container in accordance with all local, regional, national and international regulations.

Symbol :

Section 2. Hazards identification

Other hazards which do not result in classification : Defatting to the skin.

Section 3. Composition/information on ingredients

Substance/mixture : Mixture

Ingredient name	%	CAS number
Amphoteric Surfactant	60 - 100	

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Inhalation : Move exposed person to fresh air. Keep person warm and at rest. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway.

Ingestion : Wash out mouth with water. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Get medical attention. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway.

Skin contact : Wash skin thoroughly with soap and water or use recognized skin cleanser. Remove contaminated clothing and shoes. Continue to rinse for at least 15 minutes. Get medical attention. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 15 minutes. Get medical attention.

Notes to physician : No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable : Use an extinguishing agent suitable for the surrounding fire.

Not suitable : None known.

Specific hazards arising from the chemical : In a fire or if heated, a pressure increase will occur and the container may burst.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

Hazchem code : Not available.

Special precautions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Section 5. Fire-fighting measures

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment (see Section 8).

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see section 1 for emergency contact information and section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Do not ingest. Avoid contact with eyes, skin and clothing. Avoid breathing vapor or mist. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Empty containers retain product residue and can be hazardous. Do not reuse container.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see section 10) and food and drink. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

None.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment.

Appropriate engineering controls : Use only with adequate ventilation. If user operations generate dust, fumes, gas, vapor or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Section 8. Exposure controls/personal protection

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Hand protection : >8 hours (breakthrough time): Nitrile gloves.

Eye protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts.

Skin protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Section 9. Physical and chemical properties

Appearance

Physical state : Liquid. [Clear.]

Color : Light Yellow.

Odor : Mild.

Odor threshold : Not available.

pH : 8

Melting point : -15°C (5°F)

Boiling point : Not available.

Flash point : Closed cup: >93.33°C (>200°F)

Burning rate : Not applicable.

Burning time : Not applicable.

Evaporation rate : Not available.

Flammability (solid, gas) : Slightly flammable in the presence of the following materials or conditions: open flames, sparks and static discharge and heat.

Lower and upper explosive (flammable) limits : Not available.

Vapor pressure : Not available.

Vapor density : Not available.

Relative density : 1.18

Solubility : Easily soluble in the following materials: cold water and hot water.

Partition coefficient: n-octanol/water : Not available.

Auto-ignition temperature : Not available.

Decomposition temperature : Not available.

SADT : Not available.

Viscosity : Not available.

Section 10. Stability and reactivity

Chemical stability	The product is stable.
Possibility of hazardous reactions	Under normal conditions of storage and use, hazardous reactions will not occur.
Conditions to avoid	No specific data.
Incompatible materials	No specific data.
Hazardous decomposition products	Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 11. Toxicological information

Information on the likely routes of exposure

Inhalation	May be harmful if inhaled.
Ingestion	Harmful if swallowed. Irritating to mouth, throat and stomach.
Skin contact	Causes skin irritation. Defatting to the skin.
Eye contact	Causes serious eye irritation.

Symptoms related to the physical, chemical and toxicological characteristics

Inhalation	No specific data.
Ingestion	No specific data.
Skin contact	Adverse symptoms may include the following: irritation redness dryness cracking
Eye contact	Adverse symptoms may include the following: pain or irritation watering redness

Delayed and immediate effects and also chronic effects from short and long term exposure

Acute toxicity

Not available.

Irritation/Corrosion

Not available.

Sensitization

Not available.

Potential chronic health effects

General	No known significant effects or critical hazards.
Inhalation	No known significant effects or critical hazards.
Ingestion	No known significant effects or critical hazards.
Skin contact	Prolonged or repeated contact can defat the skin and lead to irritation, cracking and/or dermatitis.
Eye contact	No known significant effects or critical hazards.
Carcinogenicity	No known significant effects or critical hazards.
Mutagenicity	No known significant effects or critical hazards.
Teratogenicity	No known significant effects or critical hazards.
Developmental effects	No known significant effects or critical hazards.
Fertility effects	No known significant effects or critical hazards.

Chronic toxicity

Not available.

Carcinogenicity

Not available.

Mutagenicity

Section 11. Toxicological information

Not available.

Teratogenicity

Not available.

Reproductive toxicity

Not available.

Specific target organ toxicity

Not available.

Aspiration hazard

Not available.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Ecotoxicity : No known significant effects or critical hazards.

Aquatic and terrestrial toxicity

Not available.

Persistence/degradability

Not available.

Bioaccumulative potential

Not available.

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Section 14. Transport information

Regulatory information	UN number	Proper shipping name	Classes	PG*	Label	Additional information
New Zealand Class	Not regulated.	-	-	-		-
ADG Class	Not regulated.	-	-	-		-
UN Class	Not regulated.	-	-	-		-
ADR/RID Class	Not regulated.	-	-	-		-
IATA Class	Not regulated.	-	-	-		-

Section 14. Transport information

IMDG Class	Not regulated.	-	-	-		-

PG* : Packing group

Section 15. Regulatory information

New Zealand Inventory of Chemicals (NZIoC) : Not determined.

HSNO Approval Number : HSR002508

HSNO Group Standard : Additives, Process Chemicals and Raw Materials

HSNO Classification : 6.1 - ACUTE TOXICITY: ORAL - Category D
6.1 - ACUTE TOXICITY: INHALATION - Category E
6.3 - SKIN IRRITATION - Category A
6.4 - EYE IRRITATION - Category A (Irritant)

Australia inventory (AICS) : Not determined.

National regulations : **"Preparation of Safety Data Sheets" - Approved Code of Practice Under the HSNO Act 1996. HSNO CoP 8-1 09-06 (New Zealand Chemical Industry Council September 2006).**

Section 16. Other information

History

Date of printing : 11/25/2011.

Date of issue/Date of revision : 11/25/2011.

Date of previous issue : No previous validation.

Version : 1

References : Not available.

◤ **Indicates information that has changed from previously issued version.**

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

SAFETY DATA SHEET

Product Name **GS-1L**

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Supplier Name	**BAKER HUGHES PRESSURE PUMPING**
Address	108 Poole st , Welshpool , WA, AUSTRALIA, 6106
Telephone	+61 8 9350 3800
Fax	+61 8 9350 5453
Emergency	1800 988 778
Web Site	http://www.bakerhughes.com
Synonym(s)	GS 1L
Use(s)	GEL STABILIZER
SDS Date	27 Oct 2011

2. HAZARDS IDENTIFICATION

NOT CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE

UN No.	None Allocated	**DG Class**	None Allocated	**Subsidiary Risk(s)**	None Allocated
Packing Group	None Allocated	**Hazchem Code**	None Allocated		

3. COMPOSITION/ INFORMATION ON INGREDIENTS

Ingredient	**Formula**	**CAS No.**	**Content**
SODIUM THIOSULPHATE	$O_3\text{-}S_2.2Na$	7772-98-7	30-35%
WATER	H_2O	7732-18-5	remainder

4. FIRST AID MEASURES

Eye	If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.
Inhalation	If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.
Skin	If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.
Ingestion	For advice, contact a Poison Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If swallowed, do not induce vomiting.
Advice to Doctor	Treat symptomatically.
First Aid Facilities	Eye wash facilities should be available.

5. FIRE FIGHTING MEASURES

Flammability	Non flammable. May evolve toxic gases (sulphur oxides) when heated to decomposition.
Fire and Explosion	Evacuate area and contact emergency services. Toxic gases may be evolved in a fire situation. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.
Extinguishing	Prevent contamination of drains or waterways.

6. ACCIDENTAL RELEASE MEASURES

Spillage	Contact emergency services where appropriate. Use personal protective equipment. Clear area of all unprotected personnel. Ventilate area where possible. Contain spillage, then cover / absorb spill with non-combustible absorbent material (vermiculite, sand, or similar), collect and place in suitable containers for disposal.

7. STORAGE AND HANDLING

Storage	Store in a cool, dry, well ventilated area, removed from oxidising agents, acids, active metals, heat or ignition sources and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use.
Handling	Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

8. EXPOSURE CONTROLS/ PERSONAL PROTECTION

Exposure Stds	No exposure standard(s) allocated.
Biological Limits	No biological limit allocated.
Engineering Controls	Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended.
PPE	Wear splash-proof goggles and rubber or PVC gloves. When using large quantities or where heavy contamination is likely, wear: coveralls. In a laboratory situation, wear: a laboratory coat.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	CLEAR COLOURLESS LIQUID	**Solubility (water)**	SOLUBLE
Odour	ODOURLESS	**Specific Gravity**	NOT AVAILABLE
pH	8.5 to 9.5	**% Volatiles**	NOT AVAILABLE
Vapour Pressure	NOT AVAILABLE	**Flammability**	NON FLAMMABLE
Vapour Density	NOT AVAILABLE	**Flash Point**	NOT RELEVANT
Boiling Point	NOT AVAILABLE	**Upper Explosion Limit**	NOT RELEVANT
Melting Point	NOT AVAILABLE	**Lower Explosion Limit**	NOT RELEVANT
Evaporation Rate	NOT AVAILABLE		
Autoignition Temperature	NOT AVAILABLE	**Decomposition Temperature**	NOT AVAILABLE
Partition Coefficient	NOT AVAILABLE	**Viscosity**	NOT AVAILABLE

10. STABILITY AND REACTIVITY

Chemical Stability	Stable under recommended conditions of storage.
Conditions to Avoid	Avoid heat, sparks, open flames and other ignition sources.
Material to Avoid	Incompatible with oxidising agents (eg. hypochlorites), acids (eg. nitric acid), metals, heat and ignition sources.
Hazardous Decomposition Products	May evolve toxic gases (sulphur oxides) when heated to decomposition.
Hazardous Reactions	Polymerization is not expected to occur.

11. TOXICOLOGICAL INFORMATION

Health Hazard Summary	Low toxicity - irritant. Use safe work practices to avoid eye or skin contact and inhalation. Over exposure may result in irritation.
Eye	Irritant. Contact may result in irritation, lacrimation, pain and redness.
Inhalation	Low to moderate irritant. Over exposure may result in irritation of the nose and throat, with coughing. High level exposure may result in dizziness, nausea and headache. Due to the low vapour pressure, an inhalation hazard is not anticipated with normal use.
Skin	Irritant. Contact may result in irritation, redness, rash and dermatitis.
Ingestion	Low toxicity. Ingestion may result in nausea, abdominal pain and vomiting.
Toxicity Data	SODIUM THIOSULPHATE (7772-98-7) LD50 (Intraperitoneal): 5200 mg/kg (mouse) LDLo (Intravenous): > 2500 mg/kg (rat) LDLo (Subcutaneous): 4000 mg/kg (rabbit)

12. ECOLOGICAL INFORMATION

Environment	Limited ecotoxicity data was available for this product at the time this report was prepared. Ensure appropriate measures are taken to prevent this product from entering the environment.

13. DISPOSAL CONSIDERATIONS

Waste Disposal	For small amounts absorb with sand, vermiculite or similar and dispose of to an approved landfill site. Contact the manufacturer for additional information if larger amounts are involved. Prevent contamination of drains and waterways as aquatic life may be threatened and environmental damage may result.
Legislation	Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE

Shipping Name	None Allocated				
UN No.	None Allocated	**DG Class**	None Allocated	**Subsidiary Risk(s)**	None Allocated
Packing Group	None Allocated	**Hazchem Code**	None Allocated		

15. REGULATORY INFORMATION

Poison Schedule	A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP).
AICS	All chemicals listed on the Australian Inventory of Chemical Substances (AICS).

16. OTHER INFORMATION

Additional Information

RESPIRATORS: In general the use of respirators should be limited and engineering controls employed to avoid exposure. If respiratory equipment must be worn ensure correct respirator selection and training is undertaken. Remember that some respirators may be extremely uncomfortable when used for long periods. The use of air powered or air supplied respirators should be considered where prolonged or repeated use is necessary.

EXPOSURE STANDARDS - TIME WEIGHTED AVERAGE (TWA) or WES (WORKPLACE EXPOSURE STANDARD) (NZ): Exposure standards are established on the premise of an 8 hour work period of normal intensity, under normal climatic conditions and where a 16 hour break between shifts exists to enable the body to eliminate absorbed contaminants. In the following circumstances, exposure standards must be reduced: strenuous work conditions; hot, humid climates; high altitude conditions; extended shifts (which increase the exposure period and shorten the period of recuperation).

ABBREVIATIONS:
ACGIH - American Conference of Industrial Hygienists.
ADG - Australian Dangerous Goods.
BEI - Biological Exposure Indice(s).
CAS# - Chemical Abstract Service number - used to uniquely identify chemical compounds.
CNS - Central Nervous System.
EC No - European Community Number.
HSNO - Hazardous Substances and New Organisms.
IARC - International Agency for Research on Cancer.

mg/m³ - Milligrams per Cubic Metre.
NOS - Not Otherwise Specified.
pH - relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm - Parts Per Million.
RTECS - Registry of Toxic Effects of Chemical Substances.
STEL - Short Term Exposure Limit.
SWA - Safe Work Australia.
TWA - Time Weighted Average.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a ChemAlert report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this ChemAlert report is provided as a guide only. Factors such as method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

Report Status This document has been compiled by RMT on behalf of the manufacturer of the product and serves as the manufacturer's Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

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Western Australia 6005
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Fax: +61 8 9322 1794
Email: info@rmt.com.au
Web: www.rmt.com.au

SDS Date 27 Oct 2011

End of Report

SAFETY DATA SHEET

Product Name GLFC-5

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Supplier Name	**BJ SERVICES COMPANY (NEW ZEALAND) LTD**
Address	54 Corbett Road , Bell Block , New Plymouth, NEW ZEALAND, 4341
Telephone	+64 6 759 0059
Fax	+64 6 759 0039
Emergency	0800 CHEMCALL [243 622]
Synonym(s)	398370 - ITEM NUMBER • BJ SERVICES GLFC-5
Use(s)	GELLANT - WATER
SDS Date	28 Feb 2011

2. HAZARDS IDENTIFICATION

CLASSIFIED AS HAZARDOUS ACCORDING TO HAZARDOUS SUBSTANCES [CLASSIFICATION] REGULATIONS 2001

HSNO CLASSIFICATION

6.1E	Substances that are acutely toxic.
6.3B	Substances that are mildly irritating to the skin.
6.5A	Substances that are respiratory sensitisers.
6.5B	Substances that are contact sensitisers.
9.1D	Substances that are slightly harmful to the aquatic environment or are otherwise designed for biocidal action.

HAZARD STATEMENT

H303	May be harmful if swallowed.
H316	Causes mild skin irritation.
H317	May cause an allergic skin reaction.
H334	May cause allergy or asthma symptoms or breathing difficulties if inhaled.
H401	Toxic to aquatic life.
H402	Harmful to aquatic life.
H413	May cause long lasting harmful effects to aquatic life.

PREVENTION STATEMENT

P102	Keep out of reach of children (applies only where the substance is available to the general public).
P103	Read label before use (applies only where the substance is available to the general public).
P261	Avoid breathing dust/fume/gas/mist/vapours/spray.
P272	Contaminated work clothing should not be allowed out of the workplace.
P273	Avoid release to the environment. This statement does not apply where this is the intended use.
P280	Wear protective gloves/protective clothing/eye protection/face protection.
P285	In case of inadequate ventilation wear respiratory protection.

RESPONSE STATEMENT

P101	If medical advice is needed, have product container or label at hand (applies only where the substance is available to the general public).
P312	Call a POISON CENTER or doctor/physician if you feel unwell.
P321	Specific treatment is advised - see first aid instructions.
P363	Wash contaminated clothing before reuse.

P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P341	IF INHALED: If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P333 + P313	If skin irritation or rash occurs: Get medical advice/attention.
P342 + P311	If experiencing respiratory symptoms: Call a POISON CENTER or doctor/physician.

DISPOSAL STATEMENT

P501	In the case of a substance that is in compliance with a HSNO approval other than a Part 6A (Group Standards) approval, a label must provide a description of one or more appropriate and achievable methods for the disposal of a substance in accordance with the Hazardous Substances (Disposal) Regulations 2001. This may also include any method of disposal that must be avoided.

NOT CLASSIFIED AS A DANGEROUS GOOD ACCORDING TO LAND TRANSPORT RULE: DANGEROUS GOODS 2005; NZS 5433:2007, UN, IMDG OR IATA

UN No.	None Allocated	**DG Class**	None Allocated	**Subsidiary Risk(s)**	None Allocated
Packing Group	None Allocated	**Hazchem Code**	None Allocated		

3. COMPOSITION/ INFORMATION ON INGREDIENTS

Ingredient	CAS No.	Content
C9 TO C21 ALKANES, LINEAR AND BRANCHED	90622-53-0	45-50%
GUAR GUM	9000-30-0	45-50%

4. FIRST AID MEASURES

Eye	If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.
Inhalation	If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.
Skin	If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.
Ingestion	For advice, contact the National Poisons Centre at 0800 764 766 (0800 POISON) or +643 479 7248 or a doctor (at once). If swallowed, do not induce vomiting.
Advice to Doctor	Treat symptomatically.
First Aid Facilities	Eye wash facilities should be available.

5. FIRE FIGHTING MEASURES

Flammability	Combustible. May evolve toxic gases (carbon oxides, hydrocarbons) when heated to decomposition.
Fire and Explosion	Evacuate area and contact emergency services. Toxic gases may be evolved in a fire situation. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.
Extinguishing	Dry agent, carbon dioxide or foam. Prevent contamination of drains or waterways.
Hazchem Code	None Allocated

6. ACCIDENTAL RELEASE MEASURES

Spillage	Contact emergency services where appropriate. Use personal protective equipment. Clear area of all unprotected personnel. Ventilate area where possible. Contain spillage, then cover / absorb spill with non-combustible absorbant material (vermiculite, sand, or similar), collect and place in suitable containers for disposal. Eliminate all ignition sources.

7. STORAGE AND HANDLING

Storage	Store in a cool, dry, well ventilated area, removed from oxidising agents, acids, heat or ignition sources and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use. Large storage areas should have appropriate ventilation systems. Store as a Class C1 Combustible Liquid (AS1940).
Handling	Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

8. EXPOSURE CONTROLS/ PERSONAL PROTECTION

Exposure Stds GUAR GUM

ES-TWA: 10 mg/m^3

Engineering Controls Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended.

PPE Wear splash-proof goggles and neoprene or nitrile gloves. When using large quantities or where heavy contamination is likely, wear: coveralls. Where an inhalation risk exists, wear: a Type A (Organic vapour) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	LIGHT BROWN TO TAN COLOURED LIQUID	**Solubility (water)**	INSOLUBLE
Odour	MILD HYDROCARBON ODOUR	**Specific Gravity**	1.03 to 1.04
pH	NOT AVAILABLE	**% Volatiles**	NOT AVAILABLE
Vapour Pressure	NOT AVAILABLE	**Flammability**	CLASS C1 COMBUSTIBLE
Vapour Density	NOT AVAILABLE	**Flash Point**	> 93°C
Boiling Point	NOT AVAILABLE	**Upper Explosion Limit**	NOT AVAILABLE
Melting Point	NOT AVAILABLE	**Lower Explosion Limit**	NOT AVAILABLE
Evaporation Rate	NOT AVAILABLE		
Autoignition Temperature	NOT AVAILABLE	**Decomposition Temperature**	NOT AVAILABLE
Partition Coefficient	NOT AVAILABLE	**Viscosity**	NOT AVAILABLE

10. STABILITY AND REACTIVITY

Chemical Stability Stable under recommended conditions of storage.

Conditions to Avoid Avoid heat, sparks, open flames and other ignition sources.

Material to Avoid Incompatible with oxidising agents (eg. hypochlorites), acids (eg. nitric acid), heat and ignition sources.

Hazardous Decomposition Products May evolve toxic gases (carbon oxides, hydrocarbons) when heated to decomposition.

Polymerization Polymerization is not expected to occur.

11. TOXICOLOGICAL INFORMATION

Health Hazard Summary Low to moderate toxicity - irritant. This product has the potential to cause adverse health effects with over exposure. Use safe work practices to avoid eye or skin contact and inhalation. Over exposure may result in central nervous system (CNS) effects.

Eye Irritant. Contact may result in irritation, lacrimation, pain and redness.

Inhalation Irritant. Over exposure may result in irritation of the nose and throat, coughing and headache. High level exposure may result in nausea, dizziness and drowsiness.

Skin Irritant. Contact may result in drying and defatting of the skin, rash and dermatitis.

Ingestion Low to moderate toxicity. Ingestion may result in nausea, vomiting, abdominal pain, diarrhoea, dizziness and drowsiness. Aspiration may result in chemical pneumonitis and pulmonary oedema.

Toxicity Data GUAR GUM (9000-30-0)
LD50 (Ingestion): 6000 mg/kg (Hamster)
TDLo (Ingestion): 228,000 mg/kg/13 weeks continuous (rat)

12. ECOLOGICAL INFORMATION

Environment Aliphatic hydrocarbons behave differently in the environment depending on their size. WATER: Light aliphatics volatilise rapidly from water (half life - few hours). Bioconcentration should not be significant. SOIL: Light aliphatics biodegrade quickly in soil and water, heavy aliphatics biodegrade very slowly. ATMOSPHERE: Vapour-phase aliphatics will degrade by reaction with hydroxyl radicals.

13. DISPOSAL CONSIDERATIONS

Waste Disposal Incinerate where available. For small amounts absorb with sand, vermiculite or similar and dispose of to approved landfill site.

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD ACCORDING TO LAND TRANSPORT RULE: DANGEROUS GOODS 2005; NZS 5433:2007, UN, IMDG OR IATA

Shipping Name	None Allocated				
UN No.	None Allocated	**DG Class**	None Allocated	**Subsidiary Risk(s)**	None Allocated
Packing Group	None Allocated	**Hazchem Code**	None Allocated		

15. REGULATORY INFORMATION

Approval Code HSR002503

Group Name Additives, Intermediates, Process Chemicals and Raw Materials (Subsidiary Hazard)

HSNO Controls **Refer to the ERMA website for more information: www.ermanz.govt.nz**

16. OTHER INFORMATION

Additional Information RESPIRATORS: In general the use of respirators should be limited and engineering controls employed to avoid exposure. If respiratory equipment must be worn ensure correct respirator selection and training is undertaken. Remember that some respirators may be extremely uncomfortable when used for long periods. The use of air powered or air supplied respirators should be considered where prolonged or repeated use is necessary.

WORK PRACTICES - SOLVENTS: Organic solvents may present both a health and flammability hazard. It is recommended that engineering controls should be adopted to reduce exposure where practicable (for example, if using indoors, ensure explosion proof extraction ventilation is available). Flammable or combustible liquids with explosive limits have the potential for ignition from static discharge. Refer to AS 1020 (The control of undesirable static electricity) and AS 1940 (The storage and handling of flammable and combustible liquids) for control procedures.

ABBREVIATIONS:
ACGIH - American Conference of Industrial Hygienists.
ADG - Australian Dangerous Goods.
BEI - Biological Exposure Indice(s).
CAS# - Chemical Abstract Service number - used to uniquely identify chemical compounds.
CNS - Central Nervous System.
EC No - European Community Number.
HSNO - Hazardous Substances and New Organisms.
IARC - International Agency for Research on Cancer.
mg/m^3 - Milligrams per Cubic Metre.
NOS - Not Otherwise Specified.
pH - relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm - Parts Per Million.
RTECS - Registry of Toxic Effects of Chemical Substances.
STEL - Short Term Exposure Limit.
SWA - Safe Work Australia.
TWA - Time Weighted Average.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a Chem Alert report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this Chem Alert report is provided as a guide only. Factors such as method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

Report Status

This document has been compiled by RMT on behalf of the manufacturer of the product and serves as the manufacturer's Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

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SDS Date 28 Feb 2011

End of Report

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PH: (09) 571 0712 FAX: (09) 525 2755
Emergency Response: +800 2436 2255 (CHEMCALL)

CAUSTIC SODA LIQUID 25%[SODIUM HYDROXIDE 25%]
(Chemwatch name: Sodium Hydroxide 25%)

Hazard Alert Code: EXTREME

Chemwatch Material Safety Data Sheet
Issue Date: 29-Jan-2010
X9317SP

CHEMWATCH 4550-7
Version No:3
Page 1 of 8

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME
CAUSTIC SODA LIQUID 25%[SODIUM HYDROXIDE 25%]

PROPER SHIPPING NAME
SODIUM HYDROXIDE SOLUTION

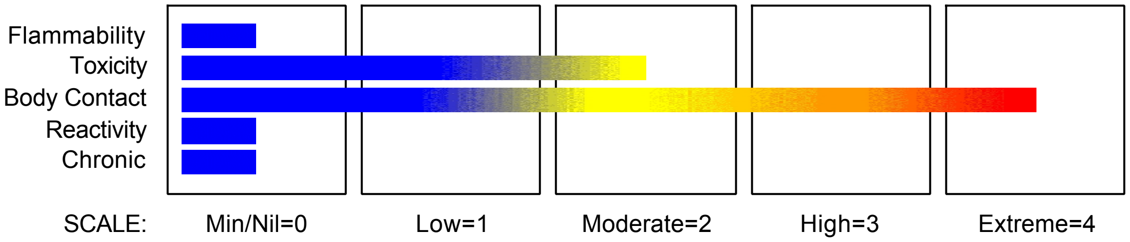
PRODUCT USE
General purpose (alkaline) catalyst.

SUPPLIER
Company: ConsolidatedChemicals (N.Z.) Ltd.
Address:
Building 10, Central Park,
666 Great South Road, Penrose, Auckland
P.O. Box 62- 568, Kalmia Street, Auckland, 1544
New Zealand
Telephone: (09) 571 0712
Emergency Tel:**0800 2436 2255**
Fax: (09) 525 2755

Section 2 - HAZARDS IDENTIFICATION

STATEMENT OF HAZARDOUS NATURE
HAZARDOUS SUBSTANCE. DANGEROUS GOODS. According to the Criteria of NOHSC, and the ADG Code.

CHEMWATCH HAZARD RATINGS



RISK
- Causes severe burns.
- Risk of serious damage to eyes.

SAFETY
- Keep locked up.
- Do not breathe gas/fumes/vapour/spray.

continued...

■ Ingestion may produce health damage*.
■ Cumulative effects may result following exposure*.
* (limited evidence).

- Avoid contact with skin.
- Avoid contact with eyes.
- Wear suitable protective clothing.
- Wear suitable gloves.
- Wear eye/face protection.
- To clean the floor and all objects contaminated by this material, use water.
- Take off immediately all contaminated clothing.
- In case of contact with eyes, rinse with plenty of water and contact Doctor or Poisons Information Centre.
- In case of accident or if you feel unwell IMMEDIATELY contact Doctor or Poisons Information Centre (show label if possible).
- This material and its container must be disposed of as hazardous waste.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
sodium hydroxide	1310-73-2	25
water	7732-18-5	75

Section 4 - FIRST AID MEASURES

SWALLOWED
■ DO NOT delay.
Rinse mouth out with plenty of water.
If poisoning occurs, contact a doctor or Poisons Information Centre.
- If swallowed do NOT induce vomiting.
- If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.
- Observe the patient carefully.
- Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious.

EYE
■ DO NOT delay.
If this product comes in contact with the eyes:
- Immediately hold eyelids apart and flush the eye continuously with running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- Continue flushing until advised to stop by the Poisons Information Centre or a doctor, or for at least 15 minutes.
- Transport to hospital or doctor without delay.

SKIN
■ DO NOT delay.
If skin or hair contact occurs:
- Immediately flush body and clothes with large amounts of water, using safety shower if available.
- Quickly remove all contaminated clothing, including footwear.
- Wash skin and hair with running water. Continue flushing with water until advised to stop by the Poisons Information Centre.
- Transport to hospital, or doctor.

INHALED
- If fumes or combustion products are inhaled remove from contaminated area.
- Lay patient down. Keep warm and rested.
- Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
- Apply artificial respiration if not breathing, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary.

continued...

NOTES TO PHYSICIAN

■ For acute or short-term repeated exposures to highly alkaline materials:
- Respiratory stress is uncommon but present occasionally because of soft tissue edema.
- Unless endotracheal intubation can be accomplished under direct vision, cricothyroidotomy or tracheotomy may be necessary.
- Oxygen is given as indicated.
- The presence of shock suggests perforation and mandates an intravenous line and fluid administration.

Section 5 - FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

- Water spray or fog.
- Foam.
- Dry chemical powder.
- BCF (where regulations permit).

FIRE FIGHTING

- Alert Fire Brigade and tell them location and nature of hazard.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.
- Use fire fighting procedures suitable for surrounding area.

FIRE/EXPLOSION HAZARD

■ Non combustible liquid.
Not considered to be a significant fire risk.
Heating may cause expansion or decomposition leading to violent rupture of containers.
- Reacts with aluminium / zinc producing flammable, explosive hydrogen gas.

FIRE INCOMPATIBILITY

■ acids., ammonium salts, strong oxidisers and organic materials / compounds.
- Reacts with aluminium / zinc producing flammable, explosive hydrogen gas.

HAZCHEM

2R

Section 6 - ACCIDENTAL RELEASE MEASURES

MINOR SPILLS

- DO NOT touch the spill material.

Slippery when spilt.
Clean up all spills immediately.
Control personal contact by using protective equipment.
Contain and absorb spill with sand, earth, inert material or vermiculite.
Place spilled material in clean, dry, sealable, labelled container.

MAJOR SPILLS

- DO NOT touch the spill material.

.
Slippery when spilt.
- Clear area of personnel and move upwind.
- Alert Fire Brigade and tell them location and nature of hazard.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.

Personal Protective Equipment advice is contained in Section 8 of the MSDS.

continued...

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING

■ Avoid generating and breathing mist.
- DO NOT allow clothing wet with material to stay in contact with skin.
- Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of exposure occurs.
- Use in a well-ventilated area.
- WARNING: To avoid violent reaction, ALWAYS add material to water and NEVER water to material.

SUITABLE CONTAINER

- Polyethylene or polypropylene container.
- Packing as recommended by manufacturer.
- Check all containers are clearly labelled and free from leaks.
- DO NOT use aluminium, galvanised or tin-plated containers.

STORAGE INCOMPATIBILITY

■ Segregate from acids, ammonium salts, strong oxidisers and organic materials / compounds.

STORAGE REQUIREMENTS

- DO NOT use aluminium, galvanised or tin-plated containers.
- Store in original containers.
- Keep containers securely sealed.
- Store in a cool, dry, well-ventilated area.
- Store away from incompatible materials and foodstuff containers.

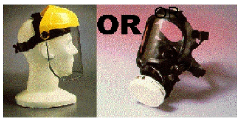
Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

Source	Material	TWA ppm	TWA mg/m^3	STEL ppm	STEL mg/m^3	Peak ppm	Peak mg/m^3	TWA F/CC	Notes
Australia Exposure Standards	sodium hydroxide (Sodium hydroxide)						2		

The following materials had no OELs on our records
- water: CAS:7732- 18- 5

PERSONAL PROTECTION



RESPIRATOR

•Particulate. (AS/NZS 1716 & 1715, EN 143:2000 & 149:2001, ANSI Z88 or national equivalent)

EYE

- Full face shield.
- Chemical goggles.
- Contact lenses may pose a special hazard; soft contact lenses may absorb and concentrate irritants. A written policy document, describing the wearing of lens or restrictions on use, should be created for each workplace or task. This should include a review of lens absorption and adsorption for the class of chemicals in use and an account of injury experience. Medical and first-aid personnel should be trained in their removal and suitable equipment should be readily available. In the event of chemical exposure, begin eye irrigation immediately and remove contact lens as soon as practicable. Lens should be removed at the first signs of eye redness or irritation - lens should be removed in a clean environment only after workers have washed hands thoroughly. [CDC NIOSH Current Intelligence Bulletin 59], [AS/NZS 1336 or national equivalent].

continued...

HANDS/FEET

- Barrier cream and • Butyl rubber gloves or • PVC gloves.
- When handling corrosive liquids, wear trousers or overalls outside of boots, to avoid spills entering boots.
- PVC safety gumboots.

OTHER

■ Overalls and PVC apron.
Ensure there is ready access to an emergency shower.
- Ensure that there is ready access to eye wash unit.

ENGINEERING CONTROLS

■ Use in a well-ventilated area.
Engineering controls are used to remove a hazard or place a barrier between the worker and the hazard. Well-designed engineering controls can be highly effective in protecting workers and will typically be independent of worker interactions to provide this high level of protection.
The basic types of engineering controls are:
Process controls which involve changing the way a job activity or process is done to reduce the risk.
Enclosure and/or isolation of emission source which keeps a selected hazard "physically" away from the worker and ventilation that strategically "adds" and "removes" air in the work environment.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE

Clear colourless strongly alkaline liquid with no odour; mixes with water.

PHYSICAL PROPERTIES

Liquid.
Mixes with water.
Corrosive.
Alkaline.

State	Liquid	Molecular Weight	Not applicable
Melting Range (°C)	Not available	Viscosity	Not available
Boiling Range (°C)	Not available	Solubility in water (g/L)	Miscible
Flash Point (°C)	Not applicable	pH (1% solution)	Not available
Decomposition Temp (°C)	Not available	pH (as supplied)	>13
Autoignition Temp (°C)	Not applicable	Vapour Pressure (kPa)	Not available
Upper Explosive Limit (%)	Not applicable	Specific Gravity (water=1)	1.3 approx.
Lower Explosive Limit (%)	Not applicable	Relative Vapour Density (air=1)	Not available
Volatile Component (%vol)	Not available	Evaporation Rate	Not available

Section 10 - STABILITY AND REACTIVITY

CONDITIONS CONTRIBUTING TO INSTABILITY

- Presence of incompatible materials.
- Product is considered stable.
- Hazardous polymerisation will not occur.

For incompatible materials - refer to Section 7 - Handling and Storage.

Section 11 - TOXICOLOGICAL INFORMATION

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

continued...

SWALLOWED

- ■ Accidental ingestion of the material may be damaging to the health of the individual.
- ■ The material can produce severe chemical burns within the oral cavity and gastrointestinal tract following ingestion.

EYE

- ■ The material can produce severe chemical burns to the eye following direct contact. Vapours or mists may be extremely irritating.
- ■ If applied to the eyes, this material causes severe eye damage.

SKIN

- ■ The material can produce severe chemical burns following direct contactwith the skin.

INHALED

- ■ If inhaled, this material can irritate the throat andlungs of some persons.

CHRONIC HEALTH EFFECTS

■ The material is considered to be harmful by all exposure routes.
Principal routes of exposure are usually by skin contact with the material, eye contact.
with the material and accidental ingestion.
A prompt response to all contact is imperative to minimise damage.

TOXICITY AND IRRITATION

- ■ Not available. Refer to individual constituents.

Section 12 - ECOLOGICAL INFORMATION

This material and its container must be disposed of as hazardous waste.

Ecotoxicity

Ingredient	Persistence: Water/Soil	Persistence: Air	Bioaccumulation	Mobility
sodium hydroxide	LOW	No Data Available	LOW	HIGH

Section 13 - DISPOSAL CONSIDERATIONS

- Recycle wherever possible or consult manufacturer for recycling options.
- Consult State Land Waste Management Authority for disposal.
- Treat and neutralise with dilute acid at an effluent treatment plant.
- Recycle containers, otherwise dispose of in an authorised landfill.

Section 14 - TRANSPORTATION INFORMATION

Labels Required: CORROSIVE

HAZCHEM:
2R (ADG7)

Land Transport UNDG:

Class or division:	8	Subsidiary risk:	None
UN No.:	1824	UN packing group:	II

Shipping Name:SODIUM HYDROXIDE SOLUTION

continued...

Air Transport IATA:

ICAO/IATA Class:	8	ICAO/IATA Subrisk:	None
UN/ID Number:	1824	Packing Group:	II
Special provisions:	A3		
Cargo Only			
Packing Instructions:	855	Maximum Qty/Pack:	30 L
Passenger and Cargo		Passenger and Cargo	
Packing Instructions:	851	Maximum Qty/Pack:	1 L
Passenger and Cargo Limited Quantity		Passenger and Cargo Limited Quantity	
Packing Instructions:	Y840	Maximum Qty/Pack:	0.5 L

Shipping name:SODIUM HYDROXIDE SOLUTION

Maritime Transport IMDG:

IMDG Class:	8	IMDG Subrisk:	None
UN Number:	1824	Packing Group:	II
EMS Number:	F-A,S-B	Special provisions:	None
Limited Quantities:	1 L		

Shipping name:SODIUM HYDROXIDE SOLUTION

Section 15 - REGULATORY INFORMATION

POISONS SCHEDULE None

REGULATIONS

Regulations for ingredients

sodium hydroxide (CAS: 1310-73-2,12200-64-5) is found on the following regulatory lists;
"Australia Exposure Standards","Australia Hazardous Substances","Australia High Volume Industrial Chemical List (HVICL)", "Australia Illicit Drug Reagents/Essential Chemicals - Category III","Australia Inventory of Chemical Substances (AICS)", "Australia Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP) - Appendix C","Australia Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP) - Appendix E (Part 2)","Australia Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP) - Appendix F (Part 3)","Australia Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP) - Schedule 5","Australia Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP) - Schedule 6","CODEX General Standard for Food Additives (GSFA) - Additives Permitted for Use in Food in General, Unless Otherwise Specified, in Accordance with GMP", "GESAMP/EHS Composite List - GESAMP Hazard Profiles","IMO IBC Code Chapter 17: Summary of minimum requirements","International Council of Chemical Associations (ICCA) - High Production Volume List","International Fragrance Association (IFRA) Survey: Transparency List"

water (CAS: 7732-18-5) is found on the following regulatory lists;
"Australia Inventory of Chemical Substances (AICS)","IMO IBC Code Chapter 18: List of products to which the Code does not apply", "International Fragrance Association (IFRA) Survey: Transparency List","OSPAR National List of Candidates for Substitution – Norway"

No data for Sodium Hydroxide 25% (CW: 4550-7)

Section 16 - OTHER INFORMATION

INGREDIENTS WITH MULTIPLE CAS NUMBERS

Ingredient Name	CAS	
sodium hydroxide	1310-73-2,	12200-64-5

■ Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.
A list of reference resources used to assist the committee may be found at:
www.chemwatch.net/references.

■ The (M)SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings.

continued...

Issue Date: 29-Jan-2010
Print Date: 7-Dec-2011

This is the end of the MSDS.

Baker Hughes	Baker Hughes Canada Company MATERIAL SAFETY DATA SHEET	Region Canada

1 PRODUCT AND COMPANY IDENTIFICATION

Product Name:	**XLW-30AG**
Product Use:	Crosslinker
Chemical Family:	Borate

Supplier:
Baker Hughes Canada Company
1000, 401 - 9th Avenue SW
Calgary, Alberta, Canada T2P 3C5
Phone: (403) 531-5151

IN CASE OF EMERGENCY CALL: (403) 531-5151 (24 hrs)

2 COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient CAS#	%	ACGIH TWA	ACGIH STEL
Hydrotreated light distillate 064742-47-8	40-70	NA	NA
Sodium tetraborate 001330-43-4	15-40	2 mg/m3 (inhalable fraction of the aerosol)	6 mg/m3 (inhalable fraction of the aerosol)

3 HAZARDS IDENTIFICATION

PRIMARY ROUTES OF EXPOSURE: Inhalation. Ingestion. Eye contact. Skin contact.

ACUTE OVEREXPOSURE EFFECTS:

INHALATION: Inhalation of solution vapor or mist may cause respiratory tract irritation. May cause central nervous system depression. Vapors may cause drowsiness and dizziness.

INGESTION: May cause nausea, vomiting and diarrhea. Minute amounts aspirated into the lungs during ingestion or vomiting may cause severe pulmonary injury.

EYE CONTACT: May cause eye irritation.

SKIN CONTACT: Prolonged contact may cause mild irritation. May cause skin defatting with prolonged exposure.

4 FIRST AID MEASURES

INHALATION:
If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

INGESTION:
DO NOT induce vomiting. Obtain medical assistance immediately.

EYES:
Flush eyes immediately with large amounts of water for at least 15 minutes. Lift upper and lower lids occasionally. Get medical attention.

SKIN:
Wash with soap and water. Remove contaminated clothing and launder before reuse. Seek medical attention if irritation persists.

5 FIRE FIGHTING MEASURES

FLASHPOINT (METHOD):	> 93°C (PMCC)
LOWER EXPLOSION LIMIT (% v/v):	1.3%
UPPER EXPLOSION LIMIT (% v/v):	8.1%

AUTO-IGNITION TEMPERATURE: > 210 °C

SPECIAL HAZARDS:
May form combustible vapor-air mixtures at or above the flashpoint.
EXTINGUISHING MEDIA:
Water fog, carbon dioxide, foam, dry chemical.
SPECIAL FIREFIGHTING PROCEDURES:
Fire-fighters should wear self-contained breathing apparatus and full protective clothing when fighting chemical fires. Cool exposed containers with water spray.
HAZARDOUS COMBUSTION PRODUCTS:
See Hazardous Thermal Decomposition Products.

SENSITIVITY TO STATIC DISCHARGE:	Yes (vapor)
SENSITIVITY TO MECHANICAL IMPACT:	No

6 ACCIDENTAL RELEASE MEASURES

Wear specified protective equipment. Remove sources of ignition. Small spills -, Cover spill with absorbent material. Scoop absorbed material into a suitable container for disposal. Large spills -, Dike to contain. Prevent from entering sewers or waterways. Recover product to suitable containers or vessel for reuse, if possible, or for disposal. Use only explosion proof transfer equipment.

7 HANDLING AND STORAGE

HANDLING:
Use only in a well ventilated area. Use only spark-proof and explosion-proof tools and equipment. Static ignition hazard can result from handling and use. Electrically ground/bond during pumping or transfer to avoid static accumulation/discharge. Avoid contact with skin and eyes.

STORAGE REQUIREMENTS:
Keep container tightly closed, in a cool, well ventilated place. Keep away from heat. Keep away from ignition sources. Keep away from incompatible materials.

8 EXPOSURE CONTROLS/PERSONAL PROTECTION

SPECIFIC ENGINEERING CONTROLS:
Use only in a well ventilated area. Mechanical ventilation.

PERSONAL PROTECTIVE EQUIPMENT:
Appropriate respiratory protection shall be worn when applied engineering controls are not adequate to protect against inhalation exposure. (Cartridge respirator), Chemical resistant goggles. Chemical resistant gloves. Coveralls. Rubber apron. Rubber boots.

9 PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE:	Liquid
COLOR:	Off-white
ODOR:	Hydrocarbon
ODOR THRESHOLD:	Not available
SPECIFIC GRAVITY:	1.03-1.07 @ 20°C
VAPOR PRESSURE:	Not available
VAPOR DENSITY (air = 1):	Not available
EVAPORATION RATE:	Not available
BOILING POINT:	Not available
FREEZING POINT:	-15°C (pour point)
pH:	Not available
VISCOSITY (C):	Not available
SOLUBILITY IN WATER:	Insoluble
COEFFICIENT OF WATER/OIL DISTRIBUTION:	Not available

10 STABILITY AND REACTIVITY

STABILITY:
Stable under normal conditions of use.
INCOMPATIBILITY/CONDITIONS OF REACTIVITY:
Avoid contact with acidic, basic or oxidizing agents. Chlorine. Strong oxidizers.

HAZARDOUS THERMAL DECOMPOSITION PRODUCTS:
Organic compounds. Oxides of carbon.
HAZARDOUS POLYMERIZATION:
Will not occur.

11 TOXICOLOGICAL PROPERTIES

ACUTE TOXICITY:

Ingredient CAS#	%	LC50 (inhalation)	LD50 (oral)
Sodium tetraborate 001330-43-4	15-40	NA	1200 mg/kg rat

CHRONIC EFFECTS:
Prolonged or repeated over exposure may cause central nervous system depression.

SENSITIZATION:
Not known.
CARCINOGENICITY:
None of the components of this product have been listed as carcinogenic by IARC, NTP or OSHA. (IARC-International Agency for Research on Cancer) (NTP - National Toxicology Program) (OSHA - Occupational Safety & Health Administration (US))
MUTAGENICITY:
Not known.
REPRODUCTIVE TOXICITY:
High-dose animal feeding studies in various species, indicate that borates cause reproductive and developmental effects. A human study of occupational exposure to borate dust showed no adverse effect on reproduction.

12 ECOLOGICAL INFORMATION

No specific information available.

13 DISPOSAL CONSIDERATIONS

WASTE DISPOSAL:
Consult local waste authorities for direction and/or approvals prior to disposal. Disposal should be made in accordance with national and local regulations.

14 TRANSPORT INFORMATION

TDG

Proper Shipping Name:	NOT RESTRICTED
UN No.:	NA
Hazard Class - Primary:	
Hazard Class - Secondary:	
Packing Group:	

AIR TRANSPORT (ICAO/IATA)

Proper Shipping Name:	NOT RESTRICTED
UN No.:	NA - Packing Group : NOT RESTRICTED
Hazard Class - Primary:	
Hazard Class - Secondary:	
Packing Group:	

MARINE TRANSPORT (IMDG/IMO)

Proper Shipping Name:	NOT RESTRICTED
UN No.:	NA
Hazard Class - Primary:	
Hazard Class - Secondary:	
Packing Group:	
EmS:	

15 REGULATORY INFORMATION

WHMIS:
D-2A (See Section 11)
D-2B (See Sections 3 and 11)

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

16 OTHER INFORMATION

ISSUE DATE: 10/09/2010
PREPARED BY: Chemical Technology Centre

The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in his use of the material.

SAFETY DATA SHEET

Product Name	**SCALETROL 720**

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Supplier Name	**BJ SERVICES COMPANY (NEW ZEALAND) LTD**
Address	54 Corbett Road , Bell Block , New Plymouth, NEW ZEALAND, 4341
Telephone	+64 6 759 0059
Fax	+64 6 759 0039
Emergency	0800 CHEMCALL [243 622]
Synonym(s)	488265 - ITEM NUMBER
Use(s)	SCALE INHIBITOR
SDS Date	27 Oct 2010

2. HAZARDS IDENTIFICATION

CLASSIFIED AS HAZARDOUS ACCORDING TO HAZARDOUS SUBSTANCES [CLASSIFICATION] REGULATIONS 2001

HSNO CLASSIFICATION

6.1E (oral)	Substances that are acutely toxic.
6.4A	Substances that are irritating to the eye.
6.9A (Single exposure)	Substances that are toxic to human target organs or systems.

HAZARD STATEMENT

H303	May be harmful if swallowed.
H319	Causes serious eye irritation.
H370	Causes damage to organs.

PREVENTION STATEMENT

P102	Keep out of reach of children (applies only where the substance is available to the general public).
P103	Read label before use (applies only where the substance is available to the general public).
P260	Do not breathe dust/fume/gas/mist/vapours/spray.
P264	Wash thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P280	Wear protective gloves/protective clothing/eye protection/face protection.

RESPONSE STATEMENT

P101	If medical advice is needed, have product container or label at hand (applies only where the substance is available to the general public).
P312	Call a POISON CENTER or doctor/physician if you feel unwell.
P321	Specific treatment is advised - see first aid instructions.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P307 + P311	IF exposed: Call a POISON CENTER or doctor/physician.
P337 + P313	If eye irritation persists: Get medical advice/attention.

STORAGE STATEMENT

P405	Store locked up.

DISPOSAL STATEMENT

P501	In the case of a substance that is in compliance with a HSNO approval other than a Part 6A (Group Standards) approval, a label must provide a description of one or more appropriate and achievable methods for the disposal of a substance in accordance with the Hazardous Substances (Disposal) Regulations 2001. This may also include any method of disposal that must be avoided.

CLASSIFIED AS A DANGEROUS GOOD ACCORDING TO LAND TRANSPORT RULE: DANGEROUS GOODS 2005; NZS 5433:2007, UN, IMDG OR IATA

UN No.	3082	**DG Class**	9	**Subsidiary Risk(s)**	None Allocated
Packing Group	III	**Hazchem Code**	2X		

3. COMPOSITION/ INFORMATION ON INGREDIENTS

Ingredient	CAS No.	Content
ETHYLENE GLYCOL	107-21-1	<45%
DIETHYLENE GLYCOL	111-46-6	<5%

4. FIRST AID MEASURES

Eye	If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.
Inhalation	If inhaled, remove from contaminated area. To protect rescuer, use a Type A (Organic vapour) respirator or an Air-line respirator (in poorly ventilated areas). Apply artificial respiration if not breathing.
Skin	If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.
Ingestion	For advice, contact the National Poisons Centre at 0800 764 766 (0800 POISON) or +643 479 7248 or a doctor (at once).
Advice to Doctor	Treat symptomatically.
First Aid Facilities	Eye wash facilities and safety shower should be available.

5. FIRE FIGHTING MEASURES

Flammability	Combustible. May evolve toxic gases (carbon oxides, hydrocarbons) when heated to decomposition. Vapour may form explosive mixtures with air.
Fire and Explosion	Evacuate area and contact emergency services. Toxic gases may be evolved in a fire situation. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.
Extinguishing	Dry agent, carbon dioxide or foam. Prevent contamination of drains or waterways.
Hazchem Code	2X

6. ACCIDENTAL RELEASE MEASURES

Spillage	Contact emergency services where appropriate. Use personal protective equipment. Clear area of all unprotected personnel. Ventilate area where possible. Contain spillage, then cover / absorb spill with non-combustible absorbant material (vermiculite, sand, or similar), collect and place in suitable containers for disposal. Prevent spill entering drains or waterways.

7. STORAGE AND HANDLING

Storage	Store in a cool, dry, well ventilated area, removed from oxidising agents, acids, phosphorus pentasulphide, sodium hydroxide, heat or ignition sources and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use. Check regularly for leaks or spills. Store as a Class C1 Combustible Liquid (AS1940).
Handling	Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

8. EXPOSURE CONTROLS/ PERSONAL PROTECTION

Exposure Stds

Ingredient	Reference	TWA		STEL	
Diethylene glycol	WES (NZ)	23 ppm	101 mg/m3	--	--
Ethylene glycol vapour & mist	WES (NZ)	50 ppm	127 mg/m3	--	--

Engineering Controls	Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended. Maintain vapour levels below the recommended exposure standard.
PPE	Wear splash-proof goggles, neoprene or butyl or rubber gloves and coveralls. Where an inhalation risk exists, wear: a Type A (Organic vapour) respirator. If spraying, wear: a Type A-Class P1 (Organic gases/vapours and Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	COLOURLESS OR PALE YELLOW LIQUID	**Solubility (water)**	SOLUBLE
Odour	MILD ODOUR	**Specific Gravity**	1.18
pH	6.5 to 8.5	**% Volatiles**	NOT AVAILABLE
Vapour Pressure	NOT AVAILABLE	**Flammability**	CLASS C1 COMBUSTIBLE
Vapour Density	NOT AVAILABLE	**Flash Point**	> 93.3°C (cc)
Boiling Point	> 100°C	**Upper Explosion Limit**	NOT AVAILABLE
Melting Point	NOT AVAILABLE	**Lower Explosion Limit**	NOT AVAILABLE
Evaporation Rate	NOT AVAILABLE		
Freezing Point	-37.2°C		

10. STABILITY AND REACTIVITY

Chemical Stability	Stable under recommended conditions of storage.
Conditions to Avoid	Avoid shock, friction, heavy impact, heat, sparks, open flames and other ignition sources.
Material to Avoid	Incompatible with oxidising agents (eg. hypochlorites), acids (eg. nitric acid), alkalis (eg. hydroxides) and phosphorus pentasulphide.
Hazardous Decomposition Products	May evolve toxic gases (carbon oxides, hydrocarbons) when heated to decomposition.
Polymerization	Polymerization is not expected to occur.

11. TOXICOLOGICAL INFORMATION

Health Hazard Summary	Moderate toxicity. This product has the potential to cause adverse health effects with over exposure. Use safe work practices to avoid eye or skin contact and inhalation. At room temperature ethylene glycol has a low vapour pressure and therefore an inhalation hazard is not anticipated unless heated or sprayed. Chronic exposure may result in kidney and central nervous system (CNS) damage.
Eye	Low to moderate irritant. Contact may result in irritation, lacrimation, pain and redness.
Inhalation	Low irritant. Over exposure may result in mild respiratory irritation. High level exposure may result in headache, nausea, dizziness and central nervous system (CNS) depression. Due to the low vapour pressure, an inhalation hazard is not anticipated with normal use.
Skin	Irritant. Contact may result in drying and defatting of the skin, rash and dermatitis.
Ingestion	Moderate toxicity. Ingestion may result in nausea, vomiting, abdominal pain, diarrhoea, drowsiness and unconsciousness. Chronic exposure may result in kidney damage. Aspiration may result in chemical pneumonitis and pulmonary oedema.
Toxicity Data	ETHYLENE GLYCOL (107-21-1) LC50 (Inhalation): 10 876 mg/kg (rat) LD50 (Ingestion): 1650 mg/kg (cat) LD50 (Skin): 9530 ug/kg (rabbit) LDLo (Ingestion): 398 mg/kg (human)

TCLo (Inhalation): 10,000 mg/m3 (human - cough)
TDLo (Ingestion): 5500 mg/kg (child - anaesthesia)

DIETHYLENE GLYCOL (111-46-6)
LCLo (Inhalation): 130 mg/m3/2 hours (mouse)
LD50 (Ingestion): 3300 mg/kg (cat)
LD50 (Intraperitoneal): 7700 mg/kg (mouse)
LD50 (Intravenous): 6565 mg/kg (rat)
LD50 (Skin): 11890 mg/kg (rabbit)
LDLo (Ingestion): 1000 mg/kg (human)
LDLo (Intraperitoneal): 2236 mg/kg (rabbit)
LDLo (Subcutaneous): 5000 mg/kg (mouse)
TDLo (Ingestion): 2400 mg/kg (child)

12. ECOLOGICAL INFORMATION

Environment Ethylene glycol will mainly exist in the vapour phase in the ambient atmosphere where it will be degraded by reaction with hydroxyl radicals. Expected to be very highly mobile in soil. Not anticipated to volatilise from moist soil or water surfaces. Biodegradation in both soil and water is expected to be a major fate process for this compound. Not expected to bioconcentrate in aquatic organisms.

13. DISPOSAL CONSIDERATIONS

Waste Disposal Dispose of by controlled incineration, by licensed or competent personnel. Contact the manufacturer for additional information. Prevent contamination of drains and waterways as aquatic life may be threatened and environmental damage may result.

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

CLASSIFIED AS A DANGEROUS GOOD ACCORDING TO LAND TRANSPORT RULE: DANGEROUS GOODS 2005; NZS 5433:2007, UN, IMDG OR IATA

Shipping Name	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S.				
UN No.	3082	**DG Class**	9	**Subsidiary Risk(s)**	None Allocated
Packing Group	III	**Hazchem Code**	2X		

IATA

Shipping Name	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S.				
UN No.	3082	**DG Class**	9	**Subsidiary Risk(s)**	None Allocated
Packing Group	III				

IMDG

Shipping Name	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S.				
UN No.	3082	**DG Class**	9	**Subsidiary Risk(s)**	None Allocated
Packing Group	III				

15. REGULATORY INFORMATION

Approval Code HSR002546

Group Name Corrosion Inhibitors (Combustible) Group Standard 2006

HSNO Controls **Refer to the ERMA website for more information: www.ermanz.govt.nz**

16. OTHER INFORMATION

Additional Information ETHYLENE GLYCOL: Has been reported to cause teratogenic and mutagenic effects, however the doses recorded for these effects are extremely high. For example experimental rat studies by the oral route have shown that ingestion of 8.5 g/kg by pregnant rats in their 6-15 day of gestation caused teratogenic effects. This equates to the ingestion of 500 ml of ethylene glycol by a 60 kg women for similar effects to occur. Exposure at such levels is not reported in industry.

RESPIRATORS: In general the use of respirators should be limited and engineering controls employed to avoid exposure. If respiratory equipment must be worn ensure correct respirator selection and training is undertaken. Remember that some respirators may be extremely uncomfortable when used for long periods. The use of air powered or air supplied respirators should be considered where prolonged or repeated use is necessary.

STORAGE OF COMBUSTIBLE LIQUIDS. Combustible liquids with a flash point between 61°C and 150°C are required to be stored as for flammable liquids (Dangerous Goods Class 3) under AS 1940. [Refer to Australian Standard 1940, Storage and Handling of Flammable and Combustible Liquids, for full storage guidelines].

ABBREVIATIONS:
ACGIH - American Conference of Industrial Hygienists.
ADG - Australian Dangerous Goods.
BEI - Biological Exposure Indice(s).
CAS# - Chemical Abstract Service number - used to uniquely identify chemical compounds.
CNS - Central Nervous System.
EC No - European Community Number.
HSNO - Hazardous Substances and New Organisms.
IARC - International Agency for Research on Cancer.
mg/m3 - Milligrams per Cubic Metre.
NOS - Not Otherwise Specified.
pH - relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm - Parts Per Million.
RTECS - Registry of Toxic Effects of Chemical Substances.
STEL - Short Term Exposure Limit.
SWA - Safe Work Australia.
TWA - Time Weighted Average.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a Chem Alert report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this Chem Alert report is provided as a guide only. Factors such as method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

Report Status

This document has been compiled by RMT on behalf of the manufacturer of the product and serves as the manufacturer's Safety Data Sheet ('SDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer.

While RMT has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS.

Prepared By

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SDS Date 27 Oct 2010

End of Report

Safety Data Sheet

PRODUCT NAME **GBW-41L**

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Supplier Name	**BJ SERVICES COMPANY (NEW ZEALAND) LTD**
Address	Level 5 Tasman Towers, PO Box 333 Fitzroy, New Plymouth, New Zealand, 4341
Telephone	+646 759 0059
Fax	+646 759 0039
Emergency	+646 759 0059
Synonym(s)	AQUEOUS SOLUTION OF OXIDISING AGENTS • GBW41L
Use(s)	FRAC GEL BREAKER
MSDS Date	17 April 2007

2. HAZARDS IDENTIFICATION

CLASSIFIED AS HAZARDOUS ACCORDING TO THE CRITERIA IN THE HS (MIN DEG OF HAZ) REGS 2001

HAZARD CLASSIFICATION

5.1.1C	Oxidising substances that are liquids or solids: low hazard.
6.1E	Substances that are acutely toxic.
6.3A	Substances that are irritating to the skin.
6.9B	Substances that are harmful to human target organs or systems.
8.3A	Substances that are corrosive to ocular tissue.
9.1D	Substances that are slightly harmful to the aquatic environment or are otherwise designed for biocidal action.

HAZARD STATEMENTS

H272	May intensify fire; oxidizer.
H303	May be harmful if swallowed.
H315	Causes skin irritation.
H371	May cause damage to organs.
H318	Causes serious eye damage.
H401	Toxic to aquatic life.

PRECAUTIONARY STATEMENTS

P103	Read label before use.
P104	Read safety data sheet before use.
P210	Keep away from flames and hot surfaces. No smoking.
P264	Wash hands thoroughly after use.
P280	Wear protective gloves and eye/face protection.
P312	Call a POISON CENTER or doctor/physician if you feel unwell.
P221	Take any precaution to avoid mixing with combustibles.
P362	Take off contaminated clothing and wash before re-use.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P305 + 351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P309 + P311	IF exposed or you feel unwell: Call a POISON CENTER or doctor/physician.
P331	Do NOT induce vomiting.
P362	Take off contaminated clothing and wash before reuse.
P405	Store locked up.

2. HAZARDS IDENTIFICATION

CLASSIFIED AS A DANGEROUS GOOD ACCORDING TO LAND TRANSPORT RULE: DANGEROUS GOODS 2005; NZS 5433:1999, UN, IMDG and IATA

UN No.	2984	**Hazchem Code**	2P	**Pkg Group**	III
DG Class	5.1	**Subsidiary Risk(s)**	None Allocated		

3. COMPOSITION / INFORMATION ON INGREDIENTS

Ingredient	Formula	Conc.	CAS No.
HYDROGEN PEROXIDE	H2-O2	5-15%	7722-84-1
WATER	H2O	remainder	7732-18-5

4. FIRST AID MEASURES

Eye	Hold eyelids apart and flush continuously with water. Continue until advised to stop by the Poisons Information Centre, a doctor, or for at least 15 minutes. Keep patient calm.
Inhalation	If over exposure occurs leave exposure area immediately. If irritation persists, seek medical attention.
Skin	Gently flush affected areas with water.
Ingestion	DO NOT induce vomiting. Immediately wash out mouth with water, and then give water to drink. Seek medical attention.
Medical Advice	Treat symptomatically

5. FIRE FIGHTING MEASURES

Flammability	Non flammable - oxidiser - will aid combustion. May evolve toxic gases when heated to decomposition. May ignite in contact with incompatible materials.
Fire and Explosion	Non flammable - aids combustion - oxidising agent. Evacuate area and contact emergency services. Toxic gases may be evolved when heated. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.
Extinguishing	Non flammable.
Hazchem Code	2P

6. ACCIDENTAL RELEASE MEASURES

Spillage	If spilt, absorb with sand or similar. Wear splash-proof goggles, PVC/rubber gloves, coveralls and rubber boots. Collect and place in sealable containers for disposal. Caution: Spill site may be slippery.

7. STORAGE AND HANDLING

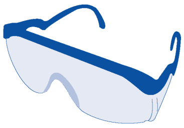
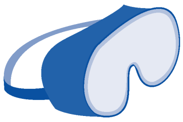
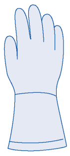
Storage	Store in cool, dry, well ventilated area, preferably in outdoor or detached store, removed from direct sunlight, reducing agents (eg. nitromethane), acids, alkalis, combustibles (eg organic compounds) and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use. Check regularly for leaks.
Handling	Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Standards
HYDROGEN PEROXIDE (7722-84-1)
ES-TWA: 1 ppm (1.4 mg/m3)
WES-TWA: 1 ppm (1.4 mg/m3)

Engineering Controls Do not inhale vapours. Use in well ventilated areas. In poorly ventilated areas, mechanical extraction ventilation is recommended. Maintain vapour levels below the recommended exposure standard.

PPE Wear safety glasses, splash-proof goggles and rubber or PVC gloves. When using large quantities or where heavy contamination is likely, wear coveralls.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	COLOURLESS LIQUID	**Solubility (water)**	SOLUBLE
Odour	SHARP ODOUR	**Specific Gravity**	1.01
pH	2 - 3	**% Volatiles**	NOT AVAILABLE
Vapour Pressure	NOT AVAILABLE	**Flammability**	NON FLAMMABLE
Vapour Density	NOT AVAILABLE	**Flash Point**	NOT RELEVANT
Melting Point	NOT AVAILABLE	**Upper Explosion Limit**	NOT RELEVANT
Boiling Point	NOT AVAILABLE	**Lower Explosion Limit**	NOT RELEVANT
Evaporation Rate	NOT AVAILABLE	**Autoignition Temperature**	NOT AVAILABLE

10. STABILITY AND REACTIVITY

Stability Stable under recommended conditions of storage.

Conditions to Avoid Avoid heat, sparks, open flames and other ignitions sources.

Material to Avoid Oxidising agent. Incompatible (violently) with reducing agents (eg. nitromethane, amines), acids, alkalis and combustibles (eg organics, oils, solvents).

Decomposition May evolve toxic gases (hydrocarbons, carbon oxides) when heated to decomposition.

Polymerization Polymerization is not expected to occur.

11. TOXICOLOGICAL INFORMATION

Health Hazard Summary This product may present a hazard with eye contact, prolonged and repeated skin contact or with inhalation at high levels. Upon dilution, the potential for adverse health effects will be reduced.

Eye Exposure may result in lacrimation, irritation, pain, redness, conjunctivitis and possible corneal burns with prolonged contact.

Inhalation Over exposure to vapours or mists may result in upper respiratory tract irritation, nausea and headache. Due to the low vapour pressure of this product an inhalation hazard is not anticipated unless sprayed.

Skin Contact may result in irritation, itching, dermatitis and possible burns.

Ingestion Ingestion may result in gastrointestinal irritation, possible burns to the mouth and throat, nausea, vomiting, abdominal pain and diarrhoea.

Toxicity Data
HYDROGEN PEROXIDE (7722-84-1)
LC50 (Inhalation): 2000 mg/m3/4 hours (rat)
LD50 (Ingestion): 2000 mg/kg (mouse)
LD50 (Skin): 1200 mg/kg (mouse)

12. ECOLOGICAL INFORMATION

Environment	Limited ecotoxicity data was available for this product at the time this report was prepared. Ensure appropriate measures are taken to prevent this product from entering the environment.

13. DISPOSAL CONSIDERATIONS

Waste Disposal	Reuse where possible. Alternatively, absorb with sand or similar and dispose of to an approved landfill site. Contact the manufacturer for additional information.
Legislation	Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

CLASSIFIED AS A DANGEROUS GOOD ACCORDING TO LAND TRANSPORT RULE: DANGEROUS GOODS 2005; NZS 5433:1999, UN, IMDG and IATA

Shipping Name	HYDROGEN PEROXIDE, AQUEOUS SOLUTION with not less than 8 % but less than 20 % hydrogen peroxide (stabilized as necessary)				
UN No.	2984	**DG Class**	5.1	**Subsidiary Risk(s)**	None Allocated
Pkg Group	III	**Hazchem Code**	2P	**EPG**	5A1

IATA

Shipping Name	HYDROGEN PEROXIDE, AQUEOUS SOLUTION with not less than 8 % but less than 20 % hydrogen peroxide (stabilized as necessary)				
UN No.	2984	**DG Class**	5.1	**Subsidiary Risk(s)**	None Allocated
Pkg Group	III				

IMDG

Shipping Name	HYDROGEN PEROXIDE, AQUEOUS SOLUTION with not less than 8 % but less than 20 % hydrogen peroxide (stabilized as necessary)				
UN No.	2984	**DG Class**	5.1	**Subsidiary Risk(s)**	None Allocated
Pkg Group	III				

15. REGULATORY INFORMATION

Approval Code	HSR001450
HSNO Controls	**Refer to the ERMA website for more information: www.ermanz.govt.nz**

16. OTHER INFORMATION

Additional Information

WORKPLACE CONTROLS AND PRACTICES: Unless a less toxic chemical can be substituted for a hazardous substance, ENGINEERING CONTROLS are the most effective way of reducing exposure. The best protection is to enclose operations and/or provide local exhaust ventilation at the site of chemical release. Isolating operations can also reduce exposure. Using respirators or protective equipment is less effective than the controls mentioned above, but is sometimes necessary.

ABBREVIATIONS:
mg/m3 - Milligrams per cubic metre
ppm - Parts Per Million
TWA/ES - Time Weighted Average or Exposure Standard.
CNS - Central Nervous System
NOS - Not Otherwise Specified
pH - relates to hydrogen ion concentration - this value will relate to a scale of 0 - 14, where 0 is highly acidic and 14 is highly alkaline.
CAS# - Chemical Abstract Service number - used to uniquely identify chemical compounds.
M - moles per litre, a unit of concentration.
IARC - International Agency for Research on Cancer.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this Chem Alert report is provided as a guide only. Factors such as method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a Chem Alert report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

Report Status

This document has been compiled by RMT on behalf of the manufacturer of the product and serves as the manufacturer's Material Safety Data Sheet ('MSDS').

It is based on information concerning the product which has been provided to RMT by the manufacturer or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer.

While RMT has taken all due care to include accurate and up-to-date information in this MSDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this MSDS.

Prepared By

Risk Management Technologies
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Email: info@rmt.com.au
Web: www.rmt.com.au

MSDS Date: 17 April 2007

End of Report

SAFETY DATA SHEET

Product Name **HIGH PERM CRB**

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Supplier Name	**BJ SERVICES COMPANY (NEW ZEALAND) LTD**
Address	54 Corbett Road , Bell Block , New Plymouth, NEW ZEALAND, 4341
Telephone	+64 6 759 0059
Fax	+64 6 759 0039
Emergency	0800 CHEMCALL [243 622]
Synonym(s)	488157 - ITEM NUMBER • AMMONIUM PERSULFATE
Use(s)	BREAKER - WATER • WATER TREATMENT
SDS Date	23 Nov 2010

2. HAZARDS IDENTIFICATION

CLASSIFIED AS HAZARDOUS ACCORDING TO HAZARDOUS SUBSTANCES [CLASSIFICATION] REGULATIONS 2001

HSNO CLASSIFICATION

5.1.1C	Oxidising substances that are liquids or solids: low hazard.
6.1D (oral)	Substances that are acutely toxic.
6.3A	Substances that are irritating to the skin.
6.4A	Substances that are irritating to the eye.
6.5A	Substances that are respiratory sensitisers.
6.5B	Substances that are contact sensitisers.
9.1D	Substances that are slightly harmful to the aquatic environment or are otherwise designed for biocidal action.
9.3C	Substances that are harmful to terrestrial vertebrates.

HAZARD STATEMENT

H272	May intensify fire; oxidizer.
H302	Harmful if swallowed.
H315	Causes skin irritation.
H317	May cause an allergic skin reaction.
H319	Causes serious eye irritation.
H334	May cause allergy or asthma symptoms or breathing difficulties if inhaled.
H401	Toxic to aquatic life.
H402	Harmful to aquatic life.
H413	May cause long lasting harmful effects to aquatic life.
H433	Harmful to terrestrial vertebrates.

PREVENTION STATEMENT

P102	Keep out of reach of children (applies only where the substance is available to the general public).
P103	Read label before use (applies only where the substance is available to the general public).
P210	Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P220	Keep/Store away from clothing/incompatible materials/combustible materials.
P221	Take any precaution to avoid mixing with combustibles/incompatible materials.
P261	Avoid breathing dust/fume/gas/mist/vapours/spray.
P264	Wash thoroughly after handling.

P270	Do not eat, drink or smoke when using this product.
P272	Contaminated work clothing should not be allowed out of the workplace.
P273	Avoid release to the environment. This statement does not apply where this is the intended use.
P280	Wear protective gloves/protective clothing/eye protection/face protection.
P285	In case of inadequate ventilation wear respiratory protection.

RESPONSE STATEMENT

P101	If medical advice is needed, have product container or label at hand (applies only where the substance is available to the general public).
P321	Specific treatment is advised - see first aid instructions.
P330	Rinse mouth.
P362	Take off contaminated clothing and wash before re-use.
P363	Wash contaminated clothing before reuse.
P301 + P312	IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P341	IF INHALED: If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P333 + P313	If skin irritation or rash occurs: Get medical advice/attention.
P337 + P313	If eye irritation persists: Get medical advice/attention.
P342 + P311	If experiencing respiratory symptoms: Call a POISON CENTER or doctor/physician.
P370 + P378	In case of fire: Use appropriate media for extinction (applies if water increases risk).

DISPOSAL STATEMENT

P501	In the case of a substance that is in compliance with a HSNO approval other than a Part 6A (Group Standards) approval, a label must provide a description of one or more appropriate and achievable methods for the disposal of a substance in accordance with the Hazardous Substances (Disposal) Regulations 2001. This may also include any method of disposal that must be avoided.

CLASSIFIED AS A DANGEROUS GOOD ACCORDING TO LAND TRANSPORT RULE: DANGEROUS GOODS 2005; NZS 5433:2007, UN, IMDG OR IATA

UN No.	1444	**DG Class**	5.1	**Subsidiary Risk(s)**	None Allocated
Packing Group	III	**Hazchem Code**	1Z		

3. COMPOSITION/ INFORMATION ON INGREDIENTS

Ingredient	CAS No.	Content
AMMONIUM PERSULPHATE	7727-54-0	>60%
QUARTZ (SILICA CRYSTALLINE)	14808-60-7	10-15%

4. FIRST AID MEASURES

Eye	If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.
Inhalation	If inhaled, remove from contaminated area. Apply artificial respiration if not breathing.
Skin	If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.
Ingestion	For advice, contact the National Poisons Centre at 0800 764 766 (0800 POISON) or +643 479 7248 or a doctor (at once).
Advice to Doctor	Treat symptomatically.
First Aid Facilities	Eye wash facilities and safety shower are recommended.

5. FIRE FIGHTING MEASURES

Flammability Oxidising agent - supports combustion. May evolve toxic gases (sulphur oxides) when heated to decomposition or in the presence of moisture.

Fire and Explosion Evacuate area and contact emergency services. Toxic gases may be evolved in a fire situation. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

Extinguishing Prevent contamination of drains or waterways.

Hazchem Code 1Z

6. ACCIDENTAL RELEASE MEASURES

Spillage Contact emergency services where appropriate. Use personal protective equipment. Clear area of all unprotected personnel. Eliminate all ignition sources. Collect without generating dust. Contain spillage, then cover / absorb spill with non-combustible absorbant material (vermiculite, sand, or similar), collect and place in suitable containers for disposal. Only trained personnel should undertake clean up.

7. STORAGE AND HANDLING

Storage Store in a cool, dry, well ventilated area, removed from combustible materials, oxidising agents, acids, alkalis, reducing agents, powdered metals, heat or ignition sources and foodstuffs. Contamination with incompatibles may cause fire or explosion. Ensure packages are adequately labelled, protected from physical damage and sealed when not in use.

Handling Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

8. EXPOSURE CONTROLS/ PERSONAL PROTECTION

Exposure Stds

Ingredient	Reference	TWA		STEL	
Silica, Crystalline Quartz	WES (NZ)	--	0.2 mg/m3	--	--

AMMONIUM PERSULPHATE

ES-TWA: 0.01 mg/m3 Ammonium persulphate

Engineering Controls Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended. Maintain dust levels below the recommended exposure standard.

PPE Wear dust-proof goggles and PVC or rubber gloves. When using large quantities or where heavy contamination is likely, wear: coveralls. At high dust levels, wear: an Air-line or a Full-face Class P3 (Particulate) respirator. Where an inhalation risk exists, wear: a Class P1 (Particulate) respirator.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	OFF-WHITE SOLID	**Solubility (water)**	SLIGHTLY SOLUBLE
Odour	SLIGHT ACRID ODOUR	**Specific Gravity**	1.72
pH	4.5 to 5 (1 % solution)	**% Volatiles**	NOT AVAILABLE
Vapour Pressure	NOT AVAILABLE	**Flammability**	NON FLAMMABLE
Vapour Density	NOT AVAILABLE	**Flash Point**	NOT RELEVANT
Boiling Point	NOT AVAILABLE	**Upper Explosion Limit**	NOT RELEVANT
Melting Point	NOT AVAILABLE	**Lower Explosion Limit**	NOT RELEVANT
Evaporation Rate	NOT AVAILABLE		
Autoignition Temperature	NOT AVAILABLE	**Decomposition Temperature**	NOT AVAILABLE
Partition Coefficient	NOT AVAILABLE	**Viscosity**	NOT AVAILABLE

10. STABILITY AND REACTIVITY

Chemical Stability	Stable under recommended conditions of storage.
Conditions to Avoid	Avoid contact with incompatible substances.
Material to Avoid	Oxidising agent. Incompatible with combustible materials, reducing agents (eg. amines), acids (eg. nitric acid), alkalis (eg. hydroxides), metals, heat and ignition sources.
Hazardous Decomposition Products	May evolve toxic gases (sulphur oxides) when heated to decomposition or in the presence of moisture.
Polymerization	Polymerization is not expected to occur.

11. TOXICOLOGICAL INFORMATION

Health Hazard Summary	Moderate toxicity - slightly corrosive. This product has the potential to cause adverse health effects with over exposure. Use safe work practices to avoid eye or skin contact and inhalation. Potential skin and respiratory sensitising agent. Individuals with pre-existing respiratory impairment (eg asthmatics) may be more susceptible to adverse health effects. Crystalline silica is classified as carcinogenic to humans (IARC Group 1).
Eye	Slightly corrosive - irritant. Contact may result in irritation, lacrimation, pain, redness, conjunctivitis and possible burns.
Inhalation	Slightly corrosive - irritant. Over exposure may result in irritation of the nose and throat, coughing, burning sensation, breathing difficulties and pulmonary oedema. Over exposure may result in breathing difficulties (with asthma-like symptoms). Chronic exposure to crystalline silica may result in silicosis (lung fibrosis). May cause sensitisation by inhalation.
Skin	Slightly corrosive. Contact may result in irritation, redness, pain, rash, dermatitis and possible burns. May cause sensitisation by skin contact.
Ingestion	Slightly corrosive. Ingestion may result in burns to the mouth and throat, nausea, vomiting, abdominal pain and diarrhoea. Ingestion is considered an unlikely exposure route.
Toxicity Data	AMMONIUM PERSULPHATE (7727-54-0) LCLo (Inhalation): 3800 ug/m3/23 hours/7 days intermittently (rat) LD50 (Ingestion): 689 mg/kg (rat) LD50 (Skin): 2000 mg/kg (rat) QUARTZ (SILICA CRYSTALLINE) (14808-60-7) LCLo (Inhalation): 300 ug/m3/10 years (human) LDLo (Intratracheal): 200 mg/kg (rat) LDLo (Intravenous): 20 mg/kg (dog) TCLo (Inhalation): 16 000 000 particles/ft3/8 hours/17.9 years (human-fibrosis)

12. ECOLOGICAL INFORMATION

Environment	Limited ecotoxicity data was available for this product at the time this report was prepared. Ensure appropriate measures are taken to prevent this product from entering the environment.

13. DISPOSAL CONSIDERATIONS

Waste Disposal	Wearing personal protective equipment, cover with a WEAK reducing agent (eg. sodium bisulphite, thiosulphate, or ferrous salt; but NOT sulphur, carbon or strong reducing agent). Mix well and spray with water. Add 3M sulphuric acid if sulphite or ferrous salt is used. Add to container of water and neutralise with soda ash. Collect and dispose of to approved landfill site. Contact the manufacturer for additional information.
Legislation	Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

CLASSIFIED AS A DANGEROUS GOOD ACCORDING TO LAND TRANSPORT RULE: DANGEROUS GOODS 2005; NZS 5433:2007, UN, IMDG OR IATA

Shipping Name	AMMONIUM PERSULFATE				
UN No.	1444	**DG Class**	5.1	**Subsidiary Risk(s)**	None Allocated
Packing Group	III	**Hazchem Code**	1Z		

IATA

Shipping Name	AMMONIUM PERSULFATE				
UN No.	1444	**DG Class**	5.1	**Subsidiary Risk(s)**	None Allocated
Packing Group	III				

IMDG

Shipping Name	AMMONIUM PERSULFATE				
UN No.	1444	**DG Class**	5.1	**Subsidiary Risk(s)**	None Allocated
Packing Group	III				

15. REGULATORY INFORMATION

Approval Code HSR002683

Group Name Water Treatment Chemicals (Oxidising [5.1.1]) Group Standard 2006

HSNO Controls **AH1** - Approved Handler requirements (including test certificate and qualification requirements). Refer to the New Zealand Hazardous Substances and New Organisms (Personnel Qualifications) Regulations 2001, Regulations 4 - 6 for more information.

Refer to the ERMA website for more information: www.ermanz.govt.nz

16. OTHER INFORMATION

Additional Information

RESPIRATORS: In general the use of respirators should be limited and engineering controls employed to avoid exposure. If respiratory equipment must be worn ensure correct respirator selection and training is undertaken. Remember that some respirators may be extremely uncomfortable when used for long periods. The use of air powered or air supplied respirators should be considered where prolonged or repeated use is necessary.

EXPOSURE STANDARDS - TIME WEIGHTED AVERAGE (TWA) or WES (WORKPLACE EXPOSURE STANDARD) (NZ): Exposure standards are established on the premise of an 8 hour work period of normal intensity, under normal climatic conditions and where a 16 hour break between shifts exists to enable the body to eliminate absorbed contaminants. In the following circumstances, exposure standards must be reduced: strenuous work conditions; hot, humid climates; high altitude conditions; extended shifts (which increase the exposure period and shorten the period of recuperation).

ABBREVIATIONS:
ACGIH - American Conference of Industrial Hygienists.
ADG - Australian Dangerous Goods.
BEI - Biological Exposure Indice(s).
CAS# - Chemical Abstract Service number - used to uniquely identify chemical compounds.
CNS - Central Nervous System.
EC No - European Community Number.
HSNO - Hazardous Substances and New Organisms.
IARC - International Agency for Research on Cancer.
mg/m3 - Milligrams per Cubic Metre.
NOS - Not Otherwise Specified.
pH - relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm - Parts Per Million.
RTECS - Registry of Toxic Effects of Chemical Substances.
STEL - Short Term Exposure Limit.
SWA - Safe Work Australia.
TWA - Time Weighted Average.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a Chem Alert report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this Chem Alert report is provided as a guide only. Factors such as method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

Report Status This document has been compiled by RMT on behalf of the manufacturer of the product and serves as the manufacturer's Safety Data Sheet ('SDS').

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Prepared By

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SDS Date 23 Nov 2010

End of Report

Appendix 7

MSDS of Tracer Components

PROTECHNICS **4/16/07**
(Div. of Core Laboratories Ltd.)
6316 Windfern
HOUSTON, TEXAS 77040
PHONE: (713) 328-2320
24 HOUR EMERGENCY RESPONSE:
(Within US) 1 800 535 5053 (Outside US) 1 352 323 3500 Collect

MATERIAL SAFETY DATA SHEET

	IDENTIFICATION
PRODUCT NAME	**SPECTRASCAN SPECTRAL TOOL**
RADIONUCLIDE	**AMERICIUM 241**
CHEMICAL FORM	**OXIDE**
PHYSICAL FORM	**SPECIAL FORM (SEALED SOURCE)**

TOXICITY HAZARDS

AMERICIUM 241 has severe long term toxicity hazards if ingested. Data on lethal concentrations and doses are not presently available. Emergency actions listed below are necessary if the sealed source is ruptured.

HEALTH HAZARD DATA

ACUTE EFFECTS (Americium 241)

May cause skin irritation.
May cause Eye and Mucous membrane irritation.
Should not be inhaled or allowed to absorb through the skin.

PREGNANT WOMEN SHOULD NOT BE ALLOWED TO WORK WITH THIS MATERIAL OR BE IN THE EXPOSURE AREA.

FIRST AID

IF SWALLOWED, OBTAIN COMPETENT MEDICAL ATTENTION IMMEDIATELY. The physician should be qualified in Nuclear Medicine and/or Health Physics.

In case of skin contact wash area vigorously with detergent (or RADCON, CONTRAD ETC.) SURVEY contaminated area with a Geiger-Muller meter with end window or pancake G-M probe to determine cleaning efficiency. Use of an abrasive cleaner such as Lava, Comet, or Ajax with a brush may be required. Remove all contaminated clothing and hold for decay or treat as RAD WASTE. SURVEY THE AREA near the spill and the areas the contaminated worker has been transferred to for RADIOACTIVE CONTAMINATION. Survey all personnel who had contact with the contaminated worker for RADIOACTIVE CONTAMINATION.

In case of contact with eyes, flush with copious amounts of water for at least 15 minutes. Assure that adequate flushing occurs by separating eyelids with fingers. Obtain services of a qualified physician.

PHYSICAL DATA

APPEARANCE AND ODOR	White Powder. No Odor (when not in sealed source container)
HALF LIFE	458 Years

FIRE AND EXPLOSION HAZARD DATA

Fire and Explosion Hazard is Negligible
Autoignition Temperature not Applicable
EXTINGUISHING MEDIA - Carbon Dioxide or Halon (This reduces spread of radioactive contamination).

SPECIAL FIRE FIGHTING PROCEDURES

Wear Self Contained Breathing Apparatus and Protective Clothing To Prevent Inhalation and Contact With Skin and Eyes.

UNUSUAL FIRE AND EXPLOSION HAZARDS

NONE

REACTIVITY DATA

STABILITY: STABLE
CONDITION TO AVOID: Concentrated Acids (e.g. 12N HCI)
INCOMPATIBILITIES: NONE

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS: NONE

HAZARDOUS POLYMERIZATIONS: NONE

SPILL AND LEAK PROCEDURES

(IF SOURCE RUPTURES)

SPILL PROCEDURES

CONTROL THE AREA. Do Not Move Personnel from the area until they have been surveyed using a G-M meter. The personnel may survey themselves and if not contaminated leave the area. This will help eliminate spread or radioactive contamination. **WEAR RESPIRATORY PROTECTION, PROTECTIVE CLOTHING, CHEMICAL SAFETY GOGGLES, IMPERVIOUS BOOTS, AND RUBBER GLOVES.** Clean up spill area by scooping up spilled material and transfer to a lined drum. It may be necessary to remove earth or other contaminated material. Remove all contaminated clothing and hold for decay or treat as RAD WASTE. Contain all spilled material and treat as radioactive waster as per N.R.C. OR Agreement State Regulations. Contact Health Physics prior to release of area following spill cleanup.

PROTECHNICS
(Div. of Core Laboratories Ltd.)
6316 Windfern
HOUSTON, TEXAS 77040
PHONE: (713) 328-2320
24 HOUR EMERGENCY RESPONSE:
(Within US) 1 800 535 5053 (Outside US) 1 352 323 3500 Collect

4/16/07

MATERIAL SAFETY DATA SHEET

	IDENTIFICATION
PRODUCT NAME	**COMPLETION PROFILER TOOL and GRAVEL PACK TOOL**
RADIONUCLIDE	**BARIUM 133**
CHEMICAL FORM	**BARIUM CHLORIDE IN CERAMIC MATRIX**
PHYSICAL FORM	**SPECIAL FORM (SEALED SOURCE)**

TOXICITY HAZARDS

BARIUM 133 has severe long term toxicity hazards if ingested. Data on lethal concentrations and doses are not presently available. Emergency actions listed below are necessary if the sealed source is ruptured.

HEALTH HAZARD DATA

ACUTE EFFECTS

May cause skin irritation.
May cause Eye and Mucous membrane irritation.
Should not be inhaled or allowed to absorb through the skin.

PREGNANT WOMEN SHOULD NOT BE ALLOWED TO WORK WITH THIS MATERIAL OR BE IN THE EXPOSURE AREA.

FIRST AID

IF SWALLOWED, OBTAIN COMPETENT MEDICAL ATTENTION IMMEDIATELY. The physician should be qualified in Nuclear Medicine and/or Health Physics.

In case of skin contact wash area vigorously with detergent (or RADCON, CONTRAD ETC.) SURVEY contaminated area with a Geiger-Muller meter with end window or pancake G-M probe to determine cleaning efficiency. Use of an abrasive cleaner such as Lava, Comet, or Ajax with a brush may be required. Remove all contaminated clothing and hold for decay or treat as RAD WASTE. SURVEY THE AREA near the spill and the areas the contaminated worker has been transferred to for RADIOACTIVE CONTAMINATION. Survey all personnel who had contact with the contaminated worker for RADIOACTIVE CONTAMINATION.

In case of contact with eyes, flush with copious amounts of water for at least 15 minutes. Assure that adequate flushing occurs by separating eyelids with fingers. Obtain services of a qualified physician.

PHYSICAL DATA

APPEARANCE AND ODOR	White Crystals. No Odor (outside sealed source container)
HALF LIFE	10.57 Years

FIRE AND EXPLOSION HAZARD DATA

Fire and Explosion Hazard is Negligible
Autoignition Temperature not Applicable
EXTINGUISHING MEDIA - Carbon Dioxide or Halon (This reduces spread of radioactive contamination).

SPECIAL FIRE FIGHTING PROCEDURES
Wear Self Contained Breathing Apparatus and Protective Clothing To Prevent Inhalation and Contact With Skin and Eyes.

UNUSUAL FIRE AND EXPLOSION HAZARDS
NONE

REACTIVITY DATA

STABILITY - STABLE
CONDITION TO AVOID - Concentrated Acids (e.g. 12N HCI)
INCOMPATIBILITIES - NONE

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS - NONE

HAZARDOUS POLYMERIZATIONS - NONE

SPILL AND LEAK PROCEDURES

(IF SOURCE RUPTURES)

SPILL PROCEDURES
CONTROL THE AREA. Do Not Move Personnel from the area until they have been surveyed using a G-M meter. The personnel may survey themselves and if not contaminated leave the area. This will help eliminate spread or radioactive contamination. **WEAR RESPIRATORY PROTECTION, PROTECTIVE CLOTHING, CHEMICAL SAFETY GOGGLES, IMPERVIOUS BOOTS, AND RUBBER GLOVES.** Clean up spill area by scooping up spilled material and transfer to a lined drum. It may be necessary to remove earth or other contaminated material. Remove all contaminated clothing and hold for decay or treat as RAD WASTE. Contain all spilled material and treat as radioactive waster as per N.R.C. OR Agreement State Regulations. Contact Health Physics prior to release of area following spill cleanup.

MANUFACTURER **7/26/06**
SPECTRATEK SERVICES
2726 AZTEC N.E. BUILDING B
ALBUQUERQUE, NM 87107
PHONE : (505) 888-0144
24 HOUR EMERGENCY RESPONSE:
(Within US) 1 800 535 5053 (Outside US) 1 352 323 3500 Collect

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT NAME	**IRIDIUM ZERO WASH® BEAD TRACER**
RADIONUCLIDE	**IRIDIUM-192 (IR-192)**
CHEMICAL FORM	**IRIDIUM OXIDE**
PHYSICAL FORM	**SOLID**

TOXICITY HAZARDS

IRIDIUM 192 Bead Tracer has short term toxicity hazards if ingested. Data on lethal concentrations and doses are not presently available.

HEALTH HAZARD DATA

ACUTE EFFECTS

May cause Eye and Mucous membrane irritation.
ZERO WASH particle is too large to inhale. Ingestion is the only method of internal consumption.

PREGNANT WOMEN SHOULD NOT BE ALLOWED TO WORK WITH RADIOACTIVE MATERIAL OR BE IN THE EXPOSURE AREA.

FIRST AID

IF SWALLOWED, OBTAIN COMPETENT MEDICAL ATTENTION IMMEDIATELY. The physician should be qualified in Nuclear Medicine and/or Health Physics.

In case of skin contact, wash area with water and a detergent. SURVEY skin area with a Geiger-Mueller instrument and end-window G-M probe to determine cleaning effectiveness. Survey all personnel who may have come in contact with ZERO WASH Bead Tracer. Locate the ZERO WASH bead using GM survey instrument. Use adhesive tape to remove bead from clothing. Treat tape containing bead as RAD WASTE. If numerous beads are found on clothing, remove and place in a container for later cleaning or disposal. SURVEY THE AREA near the spill and the areas the worker has been transferred to for the presence of radioactive material.

In case of contact with eyes, flush with copious amounts of water for at least 15 minutes. Assure that adequate flushing occurs by separating eyelids with fingers. Obtain services of a qualified physician.

PHYSICAL DATA

SPECIFIC GRAVITY	1.25 grams/ml - Low Density ZERO WASH bead 2.65 grams/ml - ZERO WASH bead
WASHOFF	< 0.005% Washoff
APPEARANCE	black/dark brown (low density ZW) and gray to beige spheres (ZW)
ODOR	no odor
HALF LIFE	74.2 Days

FIRE AND EXPLOSION HAZARD DATA

Fire and Explosion Hazard is Negligible
Autoignition Temperature not Applicable
EXTINGUISHING MEDIA - Carbon Dioxide or Halon (This reduces the spread of radioactive material).

SPECIAL FIRE FIGHTING PROCEDURES

Self Contained Breathing Apparatus and fire protective clothing is sufficient when extinguishing a fire involving this product.

UNUSUAL FIRE AND EXPLOSION HAZARDS

NONE

REACTIVITY DATA

STABILITY - STABLE
CONDITION TO AVOID - NONE
INCOMPATIBILITIES - NONE

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS – IRIDIUM 192 MAY CONTAIN VAPORS OR PARTICULATES

HAZARDOUS POLYMERIZATIONS - NONE

SPILL AND LEAK PROCEDURES

SPILL PROCEDURES

CONTROL THE AREA. Do Not Move Personnel from the area until they have been surveyed using a G-M survey instrument. The personnel may survey themselves and if no radioactive material is indicated they may leave the area. This will help eliminate spread of radioactive material. **WEAR PROTECTIVE CLOTHING, SAFETY EYEWEAR, IMPERVIOUS BOOTS, AND RUBBER GLOVES.** Clean up spill area by scooping up spilled material and transfer to a container. It may be necessary to remove some soil or other items indicating the presence of radioactive material. If clothing indicates the presence of radioactive material, remove the bead with adhesive tape, hold tape containing bead for decay in proper storage area and treat as RAD WASTE. If numerous beads are found on clothing, remove clothing and place in a container for later cleaning or disposal. Contain all spilled material and treat as radioactive waste as per regulatory requirements.

The material presented above is believed to be correct, but does not purport to be all inclusive and shall be used as a guide only. SpectraTek shall not be liable for any damage resulting from the use of this information.

MANUFACTURER **7/26/06**

SPECTRATEK SERVICES
2726 AZTEC N.E. BUILDING B
ALBUQUERQUE, NM 87107
PHONE : (505) 888-0144
24 HOUR EMERGENCY RESPONSE:
(Within US) 1 800 535 5053 (Outside US) 1 352 323 3500 Collect

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT NAME	**ANTIMONY ZERO WASH® BEAD TRACER**
RADIONUCLIDE	**ANTIMONY-124 (Sb-124)**
CHEMICAL FORM	**ANTIMONY OXIDE**
PHYSICAL FORM	**SOLID**

TOXICITY HAZARDS

ANTIMONY 124 Bead Tracer has short term toxicity hazards if ingested. Data on lethal concentrations and doses are not presently available.

HEALTH HAZARD DATA

ACUTE EFFECTS

May cause Eye and Mucous membrane irritation.
ZERO WASH particle is too large to inhale. Ingestion is the only method of internal consumption.

PREGNANT WOMEN SHOULD NOT BE ALLOWED TO WORK WITH RADIOACTIVE MATERIAL OR BE IN THE EXPOSURE AREA.

FIRST AID

IF SWALLOWED, OBTAIN COMPETENT MEDICAL ATTENTION IMMEDIATELY. The physician should be qualified in Nuclear Medicine and/or Health Physics.

In case of skin contact, wash area with water and a detergent. SURVEY skin area with a Geiger-Mueller instrument and end-window G-M probe to determine cleaning effectiveness. Survey all personnel who may have come in contact with ZERO WASH Bead Tracer. Locate the ZERO WASH bead using GM survey instrument. Use adhesive tape to remove bead from clothing. Treat tape containing bead as RAD WASTE. If numerous beads are found on clothing, remove and place in a container for later cleaning or disposal. SURVEY THE AREA near the spill and the areas the worker has been transferred to for the presence of radioactive material.

In case of contact with eyes, flush with copious amounts of water for at least 15 minutes. Assure that adequate flushing occurs by separating eyelids with fingers. Obtain services of a qualified physician.

PHYSICAL DATA

SPECIFIC GRAVITY	1.25 grams/ml - Low Density ZERO WASH bead 2.65 grams/ml - ZERO WASH bead
WASHOFF	< 0.1% Washoff
APPEARANCE	black/dark brown (low density ZW) and gray to beige spheres (ZW)
ODOR	no odor
HALF LIFE	60.4 Days

FIRE AND EXPLOSION HAZARD DATA

Fire and Explosion Hazard is Negligible
Autoignition Temperature not Applicable
EXTINGUISHING MEDIA - Carbon Dioxide or Halon (This reduces the spread of radioactive material).

SPECIAL FIRE FIGHTING PROCEDURES

Self Contained Breathing Apparatus and fire protective clothing is sufficient when extinguishing a fire involving this product.

UNUSUAL FIRE AND EXPLOSION HAZARDS

NONE

REACTIVITY DATA

STABILITY - STABLE
CONDITION TO AVOID - NONE
INCOMPATIBILITIES - NONE

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS – IRIDIUM 192 MAY CONTAIN VAPORS OR PARTICULATES

HAZARDOUS POLYMERIZATIONS - NONE

SPILL AND LEAK PROCEDURES

SPILL PROCEDURES

CONTROL THE AREA. Do Not Move Personnel from the area until they have been surveyed using a G-M survey instrument. The personnel may survey themselves and if no radioactive material is indicated they may leave the area. This will help eliminate spread of radioactive material. **WEAR PROTECTIVE CLOTHING, SAFETY EYEWEAR, IMPERVIOUS BOOTS, AND RUBBER GLOVES.** Clean up spill area by scooping up spilled material and transfer to a container. It may be necessary to remove some soil or other items indicating the presence of radioactive material. If clothing indicates the presence of radioactive material, remove the bead with adhesive tape, hold tape containing bead for decay in proper storage area and treat as RAD WASTE. If numerous beads are found on clothing, remove clothing and place in a container for later cleaning or disposal. Contain all spilled material and treat as radioactive waste as per regulatory requirements.

MANUFACTURER **7/27/06**
SPECTRATEK SERVICES
2726 AZTEC N.E. BUILDING B
ALBUQUERQUE, NM 87107
PHONE : (505) 888-0144
24 HOUR EMERGENCY RESPONSE:
(Within US) 1 800 535 5053 (Outside US) 1 352 323 3500 Collect

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT NAME	**SCANDIUM ZERO WASH® BEAD TRACER**
RADIONUCLIDE	**SCANDIUM-46 (Sc-46)**
CHEMICAL FORM	**SCANDIUM OXIDE**
PHYSICAL FORM	**SOLID**

TOXICITY HAZARDS

SCANDIUM 46 Bead Tracer has short term toxicity hazards if ingested. Data on lethal concentrations and doses are not presently available.

HEALTH HAZARD DATA

ACUTE EFFECTS

May cause Eye and Mucous membrane irritation.
ZERO WASH particle is too large to inhale. Ingestion is the only method of internal consumption.

PREGNANT WOMEN SHOULD NOT BE ALLOWED TO WORK WITH RADIOACTIVE MATERIAL OR BE IN THE EXPOSURE AREA.

FIRST AID

IF SWALLOWED, OBTAIN COMPETENT MEDICAL ATTENTION IMMEDIATELY. The physician should be qualified in Nuclear Medicine and/or Health Physics.

In case of skin contact, wash area with water and a detergent. SURVEY skin area with a Geiger-Mueller instrument and end-window G-M probe to determine cleaning effectiveness. Survey all personnel who may have come in contact with ZERO WASH Bead Tracer. Locate the ZERO WASH bead using GM survey instrument. Use adhesive tape to remove bead from clothing. Treat tape containing bead as RAD WASTE. If numerous beads are found on clothing, remove and place in a container for later cleaning or disposal. SURVEY THE AREA near the spill and the areas the worker has been transferred to for the presence of radioactive material.

In case of contact with eyes, flush with copious amounts of water for at least 15 minutes. Assure that adequate flushing occurs by separating eyelids with fingers. Obtain services of a qualified physician.

PHYSICAL DATA

SPECIFIC GRAVITY	1.25 grams/ml - Low Density ZERO WASH bead 2.65 grams/ml - ZERO WASH bead
WASHOFF	< 0.005% Washoff
APPEARANCE	black/dark brown (low density ZW) and gray to beige spheres (ZW)
ODOR	no odor
HALF LIFE	84 Days

FIRE AND EXPLOSION HAZARD DATA

Fire and Explosion Hazard is Negligible
Autoignition Temperature not Applicable
EXTINGUISHING MEDIA - Carbon Dioxide or Halon (This reduces the spread of radioactive material).

SPECIAL FIRE FIGHTING PROCEDURES

Self Contained Breathing Apparatus and fire protective clothing is sufficient when extinguishing a fire involving this product.

UNUSUAL FIRE AND EXPLOSION HAZARDS

NONE

REACTIVITY DATA

STABILITY - STABLE
CONDITION TO AVOID - NONE
INCOMPATIBILITIES - NONE

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS – IRIDIUM 192 MAY CONTAIN VAPORS OR PARTICULATES

HAZARDOUS POLYMERIZATIONS - NONE

SPILL AND LEAK PROCEDURES

SPILL PROCEDURES

CONTROL THE AREA. Do Not Move Personnel from the area until they have been surveyed using a G-M survey instrument. The personnel may survey themselves and if no radioactive material is indicated they may leave the area. This will help eliminate spread of radioactive material. **WEAR PROTECTIVE CLOTHING, SAFETY EYEWEAR, IMPERVIOUS BOOTS, AND RUBBER GLOVES.** Clean up spill area by scooping up spilled material and transfer to a container. It may be necessary to remove some soil or other items indicating the presence of radioactive material. If clothing indicates the presence of radioactive material, remove the bead with adhesive tape, hold tape containing bead for decay in proper storage area and treat as RAD WASTE. If numerous beads are found on clothing, remove clothing and place in a container for later cleaning or disposal. Contain all spilled material and treat as radioactive waste as per regulatory requirements.

PROTECHNICS INTERNATIONAL, INC. **1/01/05**
6316 Windfern
HOUSTON, TEXAS 77040
PHONE: (713) 496-3734
24 HOUR EMERGENCY RESPONSE:
(Within US) 1 800 535 5053 (Outside US) 1 352 323 3500 Collect

MATERIAL SAFETY DATA SHEET

	IDENTIFICATION
PRODUCT NAME	**THORIUM CALIBRATION BLANKET**
RADIONUCLIDE	**THORIUM (TH-232)**
CHEMICAL FORM	**THORIUM SILICATE ($ThSiO_4$)**
PHYSICAL FORM	**SOLID**

TOXICITY HAZARDS

THORIUM 232 has severe long term toxicity hazards if ingested. Data on lethal concentrations and doses are not presently available.

HEALTH HAZARD DATA

ACUTE EFFECTS

May cause skin irritation.

May cause Eye and Mucous membrane irritation.

Should not be inhaled or allowed to absorb through the skin.

PREGNANT WOMEN SHOULD NOT BE ALLOWED TO WORK WITH THIS MATERIAL OR BE IN THE EXPOSURE AREA.

FIRST AID

IF SWALLOWED, OBTAIN COMPETENT MEDICAL ATTENTION IMMEDIATELY. The physician should be qualified in Nuclear Medicine and/or Health

Physics.

In case of skin contact wash area vigorously with detergent (or RADCON, CONTRAD ETC.) SURVEY contaminated area with a Geiger-Muller meter with end window or pancake G-M probe to determine cleaning efficiency. Use of an abrasive cleaner such as Lava, Comet, or Ajax with a brush may be required. Remove all contaminated clothing and hold for decay or treat as RAD WASTE. SURVEY THE AREA near the spill and the areas the contaminated worker has been transferred to for RADIOACTIVE CONTAMINATION. Survey all personnel who had contact with the contaminated worker for RADIOACTIVE CONTAMINATION.

In case of contact with eyes, flush with copious amounts of water for at least 15 minutes. Assure that adequate flushing occurs by separating eyelids with fingers. Obtain services of a qualified physician.

PHYSICAL DATA

SPECIFIC GRAVITY	4.5 - 5
APPEARANCE AND ODOR	Greyish White Sand Particle. No Odor
HALF LIFE	1.41E10$_4$ Years

FIRE AND EXPLOSION HAZARD DATA

Fire and Explosion Hazard is Negligible

Autoignition Temperature not Applicable

EXTINGUISHING MEDIA - Carbon Dioxide or Halon (This reduces spread of radioactive contamination).

SPECIAL FIRE FIGHTING PROCEDURES

Wear Self Contained Breathing Apparatus and Protective Clothing To Prevent Inhalation and Contact With Skin and Eyes.

UNUSUAL FIRE AND EXPLOSION HAZARDS

NONE

REACTIVITY DATA

STABILITY - STABLE

CONDITION TO AVOID - Concentrated Acids (e.g. 12N HCl)

INCOMPATIBILITIES - NONE

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS -THORIUM 232 CONTAINING PARTICULATES

HAZARDOUS POLYMERIZATIONS - NONE

SPILL AND LEAK PROCEDURES

SPILL PROCEDURES

CONTROL THE AREA. Do Not Move Personnel from the area until they have been surveyed using a G-M meter. The personnel may survey themselves and if not contaminated leave the area. This will help eliminate spread or radioactive contamination. **WEAR RESPIRATORY PROTECTION, PROTECTIVE CLOTHING, CHEMICAL SAFETY GOGGLES, IMPERVIOUS BOOTS, AND RUBBER GLOVES.** Clean up spill area by scooping up spilled material and transfer to a lined drum. It may be necessary to remove earth or other contaminated material. Remove all contaminated clothing and hold for decay or treat as RAD WASTE. Contain all spilled material and treat as radioactive waster as per N.R.C. OR Agreement State Regulations. Contact Health Physics prior to release of area following spill cleanup.

The material presented above is believed to be correct, but does not purport to be all inclusive and shall be used as a guide only. ProTechnics International, Inc. shall not be liable for any damage resulting from the use of this information.