Simmonds & Bristow
Established 1965 ACN 010 252 418 Pty Ltd

DANGEROUS GOODS AND COMBUSTIBLE LIQUIDS ASSESSMENT

QCLNG PROJECT

ELP C/-Queensland Gas Company

April 2009

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1. INTRODUCTION

Environmental and Licensing Professionals (EL&P), C/- Queensland Gas Company (QGC) commissioned Simmonds & Bristow to prepare a Dangerous Goods Assessment of water treatment chemicals for coal seam gas associated water from the Queensland Curtis Liquefied Natural Gas Project (QCLNG Project).

Dangerous goods are substances that are potentially dangerous to people, property and the environment. Types of dangerous goods include flammable, oxidising and corrosive substances. The major type of water treatment chemicals that will be used is corrosives (e.g. sodium hypochlorite and sulphuric acid). Other materials that are used in the production process include diesel fuel for engines and triethylene glycol for dehydrator units in the Central Processing Plants. These materials have been assessed in this report.

The objectives of this report were to determine whether the identified materials constitute dangerous goods, the premises classification based on prescribed quantities in the *Dangerous Goods Safety Management Regulation* 2001 and potential hazards and risks. A qualitative risk assessment was conducted to ensure any risks are appropriately managed.

2. SCOPE OF WORK

The scope of work was defined by Queensland Gas Company (QGC) and is provided below.

1. Establish whether the chemicals listed (list provided by QGC) constitute dangerous goods;
2. Determine what type of dangerous goods location (or major hazard facility) may be triggered by the type of chemical or volume of chemical;
3. Provide a sensitivity analysis for different water treatment scenarios;
4. Clarify whether triethylene glycol (TEG) or diesel are dangerous goods; and
5. Provide a qualitative risk assessment, with controls to mitigate any identified risks for the listed chemicals and chemical volumes.

This assessment assumes that the site is not governed under the *Petroleum Act 1923* and therefore the provisions of the *Dangerous Goods Safety Management Act* 2001 (*DGSM Act*) and *DGSM Regulation* 2001 apply. It is noted that the DGSM Act does not apply to land that is used for obtaining, mining or transporting petroleum under the *Petroleum Act* 1923 (it is noted this Act includes provisions for coal seam gas). This assessment refers to the storage of dangerous goods and not the transport of dangerous goods to the site.

This assessment assumes that the 'place' at which the chemicals are stored is not a 'rural place'. A 'place' is not a dangerous goods location if it is a 'rural place'. A rural place is defined as 5ha or more and used for agricultural, horticultural, floricultural, aquaculture or pastoral purposes and there are no stated dangerous goods or combustible liquids stored for resale.

Specific information on the type of scale inhibitor to be used for water treatment was unavailable at the time of this assessment and the risk analysis was based on a review of MSDS for typical anti-scalant products.

This is a qualitative risk analysis only and a full HAZOP (Hazard and Operability) Study should be conducted once the storage requirements and facility layout are finalised.

3. DANGEROUS GOODS INVENTORY

3.1. List of Chemicals

A summary of the water treatment chemicals and maximum quantities for treatment of 20ML/day and treatment of 40ML/day was provided by Queensland Gas Company. The list of chemicals and maximum quantities based on a base case treatment scenario (100ML/day)[1] is shown in Table 1. It has been assumed that all water treatment chemicals will be stored in liquid form. Storage quantities of diesel fuel and triethylene glycol (TEG) are also provided in this table.

Specific information on the type of scale inhibitor to be used for water treatment was unavailable at the time of this assessment. However a search of Material Safety Data Sheets (MSDS) of products used for scaling control indicated they are primarily alkali or acid based products or mixtures of alkali salts, fatty alcohols and/or polymers.

Table 1: List of Chemical Substances

Material	Use	Estimated storage quantity (L) Base Case (note 1)
Water treatment		
Sulphuric acid	pH Adjustment	188600
Scale inhibitor	Scaling control	3900
Sodium hydroxide	pH adjustment	1900
Ferric Chloride	Coagulant	16200
Sodium Hypochlorite	Biofouling and disinfection	20400
Aqueous Ammonia	Biofouling	3100
Fuel		
Diesel	Fuel	10000
Process chemical		
Triethylene glycol	Dehydration coal seam gas	5000

Note 1 Storage for 30 days, the base case = treatment of 100ML/day

3.2. Dangerous Goods Inventory

A hazardous material is a material which, in sufficient quantities, has the potential to cause harm to people, property or the environment because of its chemical, physical or biological qualities.

Dangerous goods are chemicals that have the potential to present an immediate threat to people, property or the environment if not properly controlled. They are classified according to the nature of the hazard into nine classes, some of which are divided into sub-classes. A summary of these classes is provided in Appendix A.

3.2.1. Dangerous Goods Classes

The dangerous goods classifications of the water treatment chemicals, diesel fuel and TEG are shown in Table 2. The solution strengths of the water treatment chemicals were unknown at the time of this assessment. The approach therefore was to review a range of Material Safety Data Sheets (MSDS) for these compounds and determine typical strengths for water treatment purposes (see Appendix B). The UN numbers listed in Table 2 for sulphuric acid and aqueous ammonia are specific to the solution strengths (ADG Code 7th Edition). It was considered unlikely that highly concentrated solutions of these chemicals would be used for water treatment purposes.

Many products used for scaling control were classified as non dangerous goods. However, products that were mainly composed of alkali salts or acids were classified as Class 8 dangerous goods and this classification has been adopted for this report.

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[1] Water treatment scenarios are discussed in further detail in Section 3.3.1.

Diesel produced for sale in Queensland is not classified as a dangerous good. It is classified as a combustible C1 liquid with a flash point >61.5°C. Combustible liquids are liquids that burn, but are more difficult to ignite than flammable liquids. However, in some colder climates, diesel formulations may be made with a lower flash point. In these circumstances, the diesel fuel is classified as Dangerous Goods Class 3 PGIII. For this assessment, it is assumed the diesel supplied is typical of that for Queensland and therefore is not a dangerous good. However both dangerous goods and combustible liquids are evaluated when classifying premises in terms of the *DGSM Regulation* 2001.

Triethylene glycol is not a dangerous good but it is combustible. It is classified as a combustible C2 liquid because it has a flash point greater than 150°C.

Table 2: Summary of Dangerous Goods Classes

Material	Use	Solution strength (%)	UN Number	DG[1] Class	PG (note 1)
Water treatment					
Sulphuric acid	pH Adjustment	≤51	2796	8	II
Scale inhibitor	Scaling control	na	mixture	8	II
Sodium hydroxide	pH adjustment	All solutions	1824	8	II
Ferric Chloride	Coagulant	All solutions	2582	8	III
Sodium Hypochlorite	Biofouling and disinfection	All solutions	1791	8	III
Aqueous Ammonia	Biofouling	10 – 35	2672	8	III
Fuel					
Diesel	Fuel		na	na	na
Process chemical					
Triethylene glycol	Dehydration coal seam gas		na	na	na

[1] DG Class = Dangerous Goods Class

Note 1 Packing Group: The degree of risk presented by the Dangerous goods is represented by the Packing Group (PG), which is expressed in Roman numerals: PG I = high risk PG II = moderate risk PG III = low risk

3.2.2. Dangerous Goods Properties

The basic properties of the dangerous goods to be stored for water treatment purposes have been summarised in Table 3. The Class 8 corrosives comprise a mixture of non-combustible, low flammability and combustible products. While some products may be combustible, they are still classified as Class 8 corrosives (not as Combustible Liquids such as diesel).

The specific gravity or relative density of these compounds was required to derive quantities in terms of volume (e.g. L) from data provided in terms of weight (e.g. kg). It is related to the concentration of active ingredient discussed in the previous section. The specific gravity values used in this assessment are provided in Table 4.

In terms of health and safety, most chemicals will cause health effects following inhalation, skin contact or eye exposure. Most Class 8 corrosives are incompatible with acids and may produce flammable and toxic gases on contact.

The toxicities of the water treatment chemicals vary, but most MSDSs have identified the products as harmful to aquatic organisms, with the potential to cause long-term effects (the MSDS refers to the raw product only, not the final treated water product). The potential for water, soil and groundwater contamination primarily depends on the water solubility, mobility in soil and biodegradation rates of individual compounds.

Combustible liquids will burn but are harder to ignite than flammable liquids. The physico-chemical properties and therefore environmental fate of TEG and diesel vary. TEG, for example, is completely soluble in water whereas diesel has low solubility. Diesel fuel will generate vapours whereas vapour generation from TEG is expected to be low. Both chemicals present low toxicity risks to humans but are harmful to the aquatic environment.

Table 3: Basic Properties of Dangerous Goods and Combustible Liquids

Dangerous Goods Class	Physico-chemical	Health and safety	Environment	Incompatibilities	Combustion products
Class 8 corrosives	Mixture of non-combustible, low flammability and combustible products. Heating can release hazardous gases. Dust clouds or mists may form an explosive mixture with air.	Cause burns to skin and damage to eyes. Vapours may be irritating and/or toxic.	Harmful to aquatic organisms.	Flammable and toxic gases may be produced on contact with acids. React with strong bases and oxidising agents. Exothermic reaction when mixed with water.	Oxides of carbon, nitrogen and sulphur. Hydrogen chloride. Ammonia.
Combustible Liquids	Combustible. Mild odour. Diesel slightly soluble in cold water. TEG completely soluble in water. Diesel vapours may cause fire or explosion. Diesel vapours may accumulate in low or confined areas resulting in travel and flashback.	TEG may cause skin and eye irrigation and respiratory effects (vapours or mists). Diesel may cause irritation of respiratory tract.	TEG – ecotoxicity information not available but likely to impact on aquatic ecosystems (soluble in water). Diesel – adverse effects in the aquatic environment, may accumulate in sediments, spillages may penetrate soil causing groundwater contamination.	Strong oxidising agents and strong acids.	Carbon monoxide and carbon dioxide.

Table 4: Specific Gravity or Relative Density of Dangerous Goods and Combustible Liquids

Material	UN Number	DG Class	PG	Physical form	Specific gravity (g/mL)
Dangerous Goods					
Sulphuric acid	2796	8	II	Liquid	1.4
Scale inhibitor	mixture	8	II	Liquid	1.15
Sodium hydroxide	1824	8	II	Liquid	1.35
Ferric Chloride	2582	8	III	Liquid	1.45
Sodium Hypochlorite	1791	8	III	Liquid	1.16
Aqueous Ammonia	2672	8	III	Liquid	0.92
Combustible liquids					
Diesel	na	na	na	Liquid	0.84
Triethylene glycol	na	na	na	Liquid	1.125

3.3. Premises Classification

The *Dangerous Goods Safety Management* (*DGSM*) *Act* 2001 and *DGSM Regulation 2001* specify the safety obligations for everyone involved in the storage and/or handling of dangerous goods. The requirements of the DGSM legislation increase as the quantity of dangerous goods stored at any premises exceeds specified amounts. Premises are classified into one of four categories as the quantity of dangerous goods or hazardous materials increases, namely:

- Small quantities – minor storage workplaces (a minor storage workplace refers to ‘a workplace that is not a major hazard facility or a dangerous goods location, where stated dangerous goods or combustible liquids are stored or handled’);
- Medium quantities – dangerous goods locations (DGLs);
- Large quantities – large dangerous goods locations (Large DGLs); and
- Very large quantities – major hazard facilities (MHFs).

The threshold quantities for DGLs, Large DGLs and MHFs are detailed in Schedules 1 and 2 of the *DGSM Regulation*.

3.3.1. Water Treatment Scenarios

Queensland Gas Company provided chemical sizing information and dosing rates for treatment of 20ML/day and 40ML/day (see Appendix C). Using this information, the premises classification of three water treatment scenarios was evaluated:

1. Base case = 100ML/day (1*20+2*40ML/day);
2. Low case = 60ML/day (3*20ML/day); and
3. High case = 160ML/day (3*40=2*20).

Two location scenarios were also evaluated:

1. Storage of all water treatment chemicals at one location; and
2. Storage of water treatment chemicals at three locations.

The maximum quantities of dangerous goods (Class 8 corrosives) and combustible liquids, for the base case scenario to be stored at one location, are summarised in Table 5.

3.3.2. Classification

The premises were classified by comparing the aggregate quantity of each packing group (for Class 8 corrosives) or combustible liquids class with the prescribed quantities specified in the *DGSM Regulation*. The first step was to compare these quantities with the prescribed quantities for a Dangerous Goods Location (DGL) and Large Dangerous Goods Location (LDGL). For the purposes of this assessment it was assumed that the total quantity of chemicals would be stored at one location but storage across three sites has also been evaluated.

The second stage, if prescribed quantities were exceeded, was to determine whether the storage of these chemicals triggered the notification requirement for a possible Major Hazard Facility. The number of MHFs operating in Queensland is expected to be much lower than LDGLs. The Narangba Industrial Estate, for example, contained 2 MHFs but 15 LDGLs (2007 estimate). The total number of MHFs in Queensland was reported to be 32 in 2008 (Queensland Department of Emergency Services, 2008).

The premises classification based on the base case of water treatment at a rate of 100ML/day, and storage at one location, is provided in Table 5. The comparison of estimated maximum quantities of dangerous goods with the prescribed quantities indicated the site would be classified as a large dangerous goods location (LDGL). The site classification would be the same for the high case water treatment scenario (i.e. treatment of 160ML/day). The comparison of estimated maximum quantities for the low case water treatment (60ML/day) is provided in Table 6. This comparison indicated the site would still be classified as a LDGL.

The premises classifications for both the base case and low case, assuming the water treatment chemicals are stored at three (3) locations are summarised in Table 7 and Table 8. If the two Class 8 packing groups were stored together, then the storage location is classified as LDGL for both the base case and the low case.

There is one case where a storage location might be classified as a DGL (rather than a LDGL). This case is treatment of 60ML/day, storage of water treatment chemicals at three (3) locations and storage of Class 8 PGIII chemicals at a separate location again. That is six (6) storage locations in total - 3 general locations and separate storages for PGII and PGIII chemicals.

If the diesel is stored at a site separate to the water treatment chemicals (i.e. Class 8 Corrosives), then this site would be classified as a dangerous goods location (DGL). This assumes that the combustible liquids are not stored near fire risk dangerous goods that burn readily or support combustion (Class 2.1, 3, 4 or 5).

The second stage was to determine whether notification of the site as a possible MHF was required. This was conducted by comparing the types of dangerous goods and combustible liquids to be stored with Tables 1 and 2 of Schedule 2 of the *DGSM Regulation* (described as hazardous materials). None of the compounds described in this report were listed in Table 1 of the *DGSM Regulation*. Table 1 does include ammonia solution (includes UN No. 1005). The information provided for this report indicates the ammonia solution to be used for water treatment purposes is less concentrated than that specified in the regulation (more than 50% ammonia) and also has a higher relative density (i.e. 0.92g/mL compared to ≤0.88g/mL specified in the regulation).

Table 2 of Schedule 2 of the DGSM Regulation provides prescribed quantities for explosives, compressed and liquefied gases, flammable liquids, oxidising materials, peroxides and toxic solids and liquids. It includes Class 8 packing Group I or II that have hazchem codes of 4WE (materials that react violently with water). A review of likely MSDS for the hazardous materials in this report showed most materials require fire extinguishment using a fine water spray (denoted by ‘2’) where ‘4’ means that water must not be allowed to come into contact with a surface.

Therefore, the dangerous goods and combustible liquids identified in this report are not listed in either Table 1 or Table 2 of Schedule 2 of the *DGSM Regulation* and therefore do not require notification as a possible MHF. The final classification was determined to be equivalent to a Large Dangerous Goods Location (LDGL), except where diesel is stored alone (in which case the site is classified as a DGL).

Table 5: Site Classification of Base Case (100ML/day – One (1) Location)

Material	Class	PG (note 1)	Max quantity (kg)	Physical form	Specific gravity (g/mL)	Max quantity (L)	Largest containment system			Prescribed quantity for DGL	Prescribed quantity for LDGL	Classification
							Quantity (T) (note 2)	T (°C)	P (kPa)			
Sulphuric acid	8	II	264000	Liquid	1.4	188571	59	Ambient	Atmospheric			
Scale inhibitor	8	II	4440	Liquid	1.15	3861	1.6	Ambient	Atmospheric			
Sodium hydroxide	8	II	2490	Liquid	1.35	1844	1.6	Ambient	Atmospheric			
Class 8 PG II						**194277**				**250 (L)**	**2500 (L)**	**LDGL**
Ferric Chloride	8	III	23400	Liquid	1.45	16138	38	Ambient	Atmospheric			
Sodium Hypochlorite	8	III	23640	Liquid	1.16	20379	43	Ambient	Atmospheric			
Aqueous Ammonia	8	III	2790	Liquid	0.92	3033	3 (note 3)	Ambient	Atmospheric			
Class 8 PG III						**39550**				**1000 (L)**	**10 000 (L)**	**LDGL**
Diesel	C1	na	8400	Liquid	0.84	10000	10 000L	Ambient	Atmospheric			
Combustible liquids C1							**10 000L**			**10 000 (L) (note 4)**	**100 000 (L) (note 4)**	**DGL**
Triethylene glycol	C2	na	5625	Liquid	1.125	5000	5000L	Ambient	Atmospheric	na	na	
Combustible liquids C2							**5000L**					**na**

Note 1	Packing Group: The degree of risk presented by the Dangerous goods is represented by the Packing Group (PG), which is expressed in Roman numerals: PG I = high risk PG II = moderate risk PG III = low risk
Note 2	Based on tank sizing provided by potential supplier except where noted
Note 3	Assumes tank sized for maximum quantity required - information provided by supplier uncertain
Note 4	The prescribed quantity is lower for (C1 and C2) combustible liquids with fire risk dangerous goods

Table 6: Site Classification of Low Case (60ML/day – One (1) Location)

Material	Class	PG (note 1)	Max quantity (kg)	Physical form	Specific gravity (g/mL)	Max quantity (L)	Largest containment system			Prescribed quantity for DGL	Prescribed quantity for LDGL	Classification
							Quantity (T) (note 2)	T (°C)	P (kPa)			
Sulphuric acid	8	II	180000	Liquid	1.4	128571	59	Ambient	Atmospheric			
Scale inhibitor	8	II	2700	Liquid	1.15	2348	1.6	Ambient	Atmospheric			
Sodium hydroxide	8	II	1530	Liquid	1.35	1133	1.6	Ambient	Atmospheric			
Class 8 PG II						**132053**				**250 (L)**	**2500 (L)**	**LDGL**
Ferric Chloride	8	III	14040	Liquid	1.45	9683	38	Ambient	Atmospheric			
Sodium Hypochlorite	8	III	14220	Liquid	1.16	12259	43	Ambient	Atmospheric			
Aqueous Ammonia	8	III	1710	Liquid	0.92	1859	3 (note 3)	Ambient	Atmospheric			
Class 8 PG III						**23800**				**1000 (L)**	**10 000 (L)**	**LDGL**
Diesel	C1	na	8400	Liquid	0.84	10000	10 000L	Ambient	Atmospheric			
Combustible liquids C1							**10 000L**			**10 000 (L) (note 4)**	**100 000 (L) (note 4)**	**DGL**
Triethylene glycol	C2	na	5625	Liquid	1.125	5000	5000L	Ambient	Atmospheric	na	na	
Combustible liquids C2							**5000L**					**na**

Table 7: Site Classification of Base Case (100ML/day – Three (3) Locations – per location)

Material	Class	PG (note 1)	Max quantity (kg)	Physical form	Specific gravity (g/mL)	Max quantity (L)	Largest containment system			Prescribed quantity for DGL	Prescribed quantity for LDGL	Classification
							Quantity (T) (note 2)	T (°C)	P (kPa)			
Sulphuric acid	8	II	88000	Liquid	1.4	62857	59	Ambient	Atmospheric			
Scale inhibitor	8	II	1480	Liquid	1.15	1287	1.6	Ambient	Atmospheric			
Sodium hydroxide	8	II	830	Liquid	1.35	615	1.6	Ambient	Atmospheric			
Class 8 PG II						**64759**				**250 (L)**	**2500 (L)**	**LDGL**
Ferric Chloride	8	III	7800	Liquid	1.45	5379	38	Ambient	Atmospheric			
Sodium Hypochlorite	8	III	7880	Liquid	1.16	6793	43	Ambient	Atmospheric			
Aqueous Ammonia	8	III	930	Liquid	0.92	1011	3 (note 3)	Ambient	Atmospheric			
Class 8 PG III						**13183**				**1000 (L)**	**10 000 (L)**	**LDGL**
Diesel	C1	na	8400	Liquid	0.84	10000	10 000L	Ambient	Atmospheric			
Combustible liquids C1							**10 000L**			**10 000 (L) (note 4)**	**100 000 (L) (note 4)**	**DGL**
Triethylene glycol	C2	na	5625	Liquid	1.125	5000	5000L	Ambient	Atmospheric	na	na	
Combustible liquids C2							**5000L**					**na**

Note 1	Packing Group: The degree of risk presented by the Dangerous goods is represented by the Packing Group (PG), which is expressed in Roman numerals: PG I = high risk PG II = moderate risk PG III = low risk
Note 2	Based on tank sizing provided by potential supplier except where noted
Note 3	Assumes tank sized for maximum quantity required - information provided by supplier uncertain
Note 4	The prescribed quantity is lower for (C1 and C2) combustible liquids with fire risk dangerous goods

Table 8: Site Classification of Low Case (60ML/day – Three (3) Locations – per location)

Material	Class	PG (note 1)	Max quantity (kg)	Physical form	Specific gravity (g/mL)	Max quantity (L)	Largest containment system			Prescribed quantity for DGL	Prescribed quantity for LDGL	Classification
							Quantity (T) (note 2)	T (°C)	P (kPa)			
Sulphuric acid	8	II	60000	Liquid	1.4	42857	59	Ambient	Atmospheric			
Scale inhibitor	8	II	900	Liquid	1.15	783	1.6	Ambient	Atmospheric			
Sodium hydroxide	8	II	510	Liquid	1.35	378	1.6	Ambient	Atmospheric			
Class 8 PG II						**44018**				**250 (L)**	**2500 (L)**	**LDGL**
Ferric Chloride	8	III	4680	Liquid	1.45	3228	38	Ambient	Atmospheric			
Sodium Hypochlorite	8	III	4740	Liquid	1.16	4086	43	Ambient	Atmospheric			
Aqueous Ammonia	8	III	570	Liquid	0.92	620	3 (note 3)	Ambient	Atmospheric			
Class 8 PG III						**7933**				**1000 (L)**	**10 000 (L)**	**DGL**
Diesel	C1	na	8400	Liquid	0.84	10000	10 000L	Ambient	Atmospheric			
Combustible liquids C1							**10 000L**			**10 000 (L) (note 4)**	**100 000 (L) (note 4)**	**DGL**
Triethylene glycol	C2	na	5625	Liquid	1.125	5000	5000L	Ambient	Atmospheric	na	na	
Combustible liquids C2							**5000L**					**na**

4. QUALITATIVE RISK ASSESSMENT

4.1. Methodology

The methodology is a qualitative multi-staged process comprising:

1. Hazard Identification;
2. Consequence analysis;
3. Estimation of the likelihood of hazardous events;
4. Risk analysis; and
5. Assessment of risk results.

4.1.1. Hazard Identification

Hazard identification is the process of identifying major hazards to determine the types of incidents that can occur. The breakdown in system elements (e.g. corrosive liquids storage) or the events that can lead to hazardous conditions (e.g. vapour generation) that may result in fire, explosion or release of toxic substances are identified.

A hazard identification analysis has been applied to the storage of dangerous goods and combustible liquids to systematically identify hazards. The nature and quantities of dangerous goods handled and stored and the site structure plan are important factors for evaluation.

4.1.2. Risk analysis

Risk analysis involves consideration of the sources of risk, their consequences and the likelihood those consequences may occur (AS/NZS 4360:2004). Consequences and likelihood are combined to produce a level of risk. Where no reliable data is available then subjective estimates are made about the occurrence of a particular outcome or event. The criteria used to classify consequences and likelihood are described in the following sections.

A consequence is an outcome or impact on a range of stakeholders and assets. Examples of consequences include fatality, injury or environmental damage. The consequence criteria used in this report are described in Table 9.

Table 9: Consequence Table

Level	Descriptor	Example Detailed Description
1	Insignificant	Health - No medical treatment required
		Environment - Insignificant impact or not detectable
2	Minor	Health – Reversible disability requiring hospitalisation
		Environment – Potentially harmful to local ecosystems with local impacts contained to the site
3	Moderate	Health – Moderate irreversible disability or impairment (<30%) to one or more persons
		Environment – Potentially harmful to regional ecosystems with local impacts primarily contained to on-site
4	Major	Health – Single fatality and/or severe irreversible disability (>30%) to one or more persons
		Environment – Potentially lethal to local ecosystem; predominantly local, but potential for off-site impacts
5	Catastrophic	Health – Multiple fatalities, or significant irreversible effects to >50 persons
		Environment – Potentially lethal to regional ecosystems or threatened species; widespread on-site and off-site impacts

Source: AS4360:2004 and NRMMC, EPHC and AHMC (2006).

Likelihood is used as a general description of probability or frequency. The indicative frequencies of the likelihood levels used in this report are shown in Table 10.

Table 10: Likelihood Table

Level	Descriptor	Detailed Description	Indicative Frequency
A	Almost certain	The event will occur on an annual basis	Once every year or more frequently
B	Likely	The event has occurred several times or more in similar developments	Once every three years
C	Possible	The event might occur once during the development	Once every ten years
D	Unlikely	The event does occur somewhere from time to time	Once every thirty years
E	Rare	Heard of something like this occurring elsewhere	Once every 100 years

Source: AS4360:2004

4.1.3. Level of risk

The likelihood of the event and its associated consequences, are assessed in the context of the effectiveness of the existing strategies and controls. Consequences and likelihood are combined to produce a level of risk (HB 4360:2004). The risk characterisation matrix adopted for use in this report is provided in Table 11.

Table 11: Risk Characterisation Matrix

Likelihood	Consequences				
	1 (Insignificant)	2 (Minor)	3 (Moderate)	4 (Major)	5 (Catastrophic)
A (Almost certain)	Medium	High	High	Extreme	Extreme
B (Likely)	Medium	Medium	High	High	Extreme
C (Possible)	Low	Medium	High	High	High
D (Unlikely)	Low	Low	Medium	Medium	High
E (Rare)	Low	Low	Medium	Medium	High

Source: AS4360:2004

4.1.4. Risk evaluation

Risk evaluation involves comparing the level of risk found during the analysis process with the risk criteria established when the context was considered. Risk evaluation therefore uses the risk levels to determine:

- Whether a risk needs treatment;
- Whether an activity should be undertaken; or
- Priorities for treatment (HB 4360:2004).

In this case, the different levels of risk determined by the risk characterisation matrix act as risk criteria. The risk characterisation matrix has been used to determine risk levels without and with proposed control measures.

The qualitative risk categories and action priorities used in this report are presented in Table 12. Any extreme or high risk event requires immediate action while a medium risk level is in the tolerable region but implies that further improvements can be made.

Table 12: Qualitative Risk Categories and Action Priorities

Assessment of Risk	Priority for Action
Low	Schedule for action after other risks.
Medium	Further improvement required. Proposed risk treatment measures reviewed in consultation with appropriate persons.
High	Immediate action required. Detailed risk analysis and management plan for specific activity or event prepared in consultation with appropriate persons.
Extreme	Suitability of proposed land use reviewed. Quantitative risk analysis or HAZOP prepared in consultation with appropriate persons.

4.2. Hazard Identification

4.2.1. Potential hazardous event scenarios

The objective of this section is to identify the hazards for each major process or storage unit, with a brief description of possible incident initiating events, possible consequences and proposed or existing safeguards. The breakdown in system elements (e.g. plant components such as storage vessels) or the events (e.g. overfilling of a tank) that can lead to hazardous conditions that may result in fire, explosion or release of toxic substances are identified.

The hazard identification was carried out using a Hazard Identification (HAZID) Word Diagram. The objectives of the diagram are to:

1. Identify hazards associated with natural and human external effects and influences;
2. Provide a framework for conservative risk assessment in the absence of detailed project information; and
3. Gain an understanding of what hazards exist, the range of accidents these hazards could lead to and what outcomes these accidents have the potential of causing.

The following potential hazardous event scenarios were evaluated:

- Unloading of product; and
- Storage and handling.

An overview of the potential hazardous events associated with these activities is provided in Figure 1. The Word Diagrams in Section 4.2.2 provide greater detail on the possible initiating events while the consequences and likelihood of events are evaluated in Sections 4.3 and 4.4.

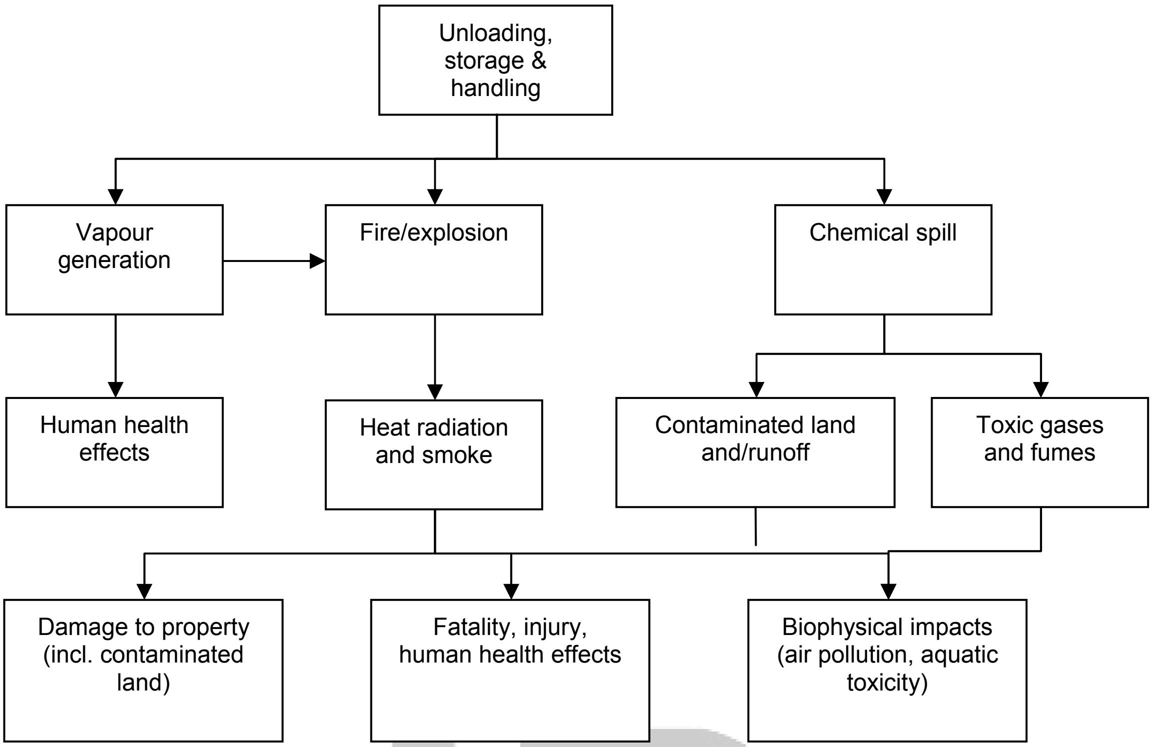

Figure 1: Potential Hazardous Event Scenarios

4.2.2. Hazard identification word diagrams

The initiating events associated with the storage and handling of dangerous goods and combustible liquids are presented in the Hazard Identification (HAZID) Word Diagrams in Table 13 and Table 14. The hazard identification process includes events such as chemical spills, fire, explosion, flooding and malicious acts. The physico-chemical properties of the types of chemicals to be stored have also been taken into account.

The HAZID Word Diagram lists each operational phase, identifies possible initiating events and consequences of these events and describes measures designed to prevent or protect persons and facilities from such events.

Table 13: Hazard Identification Word Diagram – Unloading of Materials

Function/Operation	Possible Initiating Events	Possible Consequences	Preventative/Protective Measures
Class 8 Dangerous Goods			
Transfer of chemical liquids from tanker to storage tank	Failure of filling line or connection	Liquid chemical spill: Land contamination Stormwater contamination Surface water contamination Release of toxic vapours Human injury	Training of personnel in accordance with AS 3780 – *The storage and handling of corrosive substances*: • Identification of dangerous goods. • The properties of specific substances handled and information contained in the Material Safety Data Sheet (MSDS). • Applicable safety regulations and safe-handling procedures. Transfer of liquids in accordance with AS 3780 and the ADG Code. • Hand held hoses should not be used for filling. Permanent filling lines should be constructed. • The filling connections should be liquid-tight and the filling areas bunded. • The permanent filling lines will not run across any area normally accessible to vehicles (positioned off the ground). • The permanent filling lines will be protected from contact with personnel and machinery by a suitable barrier. • The permanent filling lines will be maintained and inspected in accordance with the ADG Code. • Provision of compounds (bunded areas) for all above-ground bulk containers of corrosive substances in accordance with AS 3780. • Any spills will be contained within the bund. Suitable transfer points in accordance with AS 3780: • Suitably anchored. • Provided with a quick shut-off valve if the transfer point is positioned at or below the highest level of liquid in the container or pipework.
	Liquid chemical spill Filling wrong tank (e.g. sodium hypochlorite with sulphuric acid)	Mixture with incompatible chemicals causing release of fumes or flammable gases Human injury	Hazchem signage in accordance with the ADG Code. Segregation between incompatible substances as listed in AS 3780 and individual MSDS. This includes: • Storage of incompatible substances within separate compounds;

Function/Operation	Possible Initiating Events	Possible Consequences	Preventative/Protective Measures
			• Segregation of incompatible compounds by a distance of not less than 5m for liquids or liquids/solids and not less than 3m if both the substances are solids; and • Segregation of substances that may react dangerously in separate compounds that do not share a common drainage system, by a distance of not less than 5m. Implementation of clean-up procedures for spills described in the MSDS. Suitable compound drainage in accordance with AS 3780-1994: • Substances that react dangerously shall not be directed into a common compound, or a common drain or sump.
		Release to aquatic environment (stormwater runoff)	Prevention of spilled chemicals from entering the stormwater system. Spills contained within the bund Implementation of clean-up procedures for spills described in the MSDS. Disposal of washdown waters by a licensed waste contractor.
	Overfilling of tank	Liquid chemical spill: Land contamination Stormwater contamination Surface water contamination Release of toxic vapours Human injury	Storage in accordance with *Dangerous Goods Safety Management Regulation* 2001. Installation of level indicator on every fixed tank in accordance with AS 3780: • The safe fill level of a tank shall be clearly marked on the level-indicating device. • Level in tank to be checked prior to filling. • A sight glass may be used as a level indicator subject to conditions outlined in AS 3780. • A remote device, and two persons, will be required to ensure safe filling procedures when the tank cannot be viewed from the delivery vehicle. Installation of an overflow line on every fixed tank, in accordance with AS 3780, which discharges at ground level in full view of one of the two persons filling tank. Bulk container filling in accordance with AS 3780: • Personnel shall be trained in the product transfer procedures.

Function/Operation	Possible Initiating Events	Possible Consequences	Preventative/Protective Measures
			• A container is not to be filled in excess of its safe filling level. • Product transfer is not to commence until all essential gauges, valves, fittings and connections are illuminated to a level of at least 50 lx. • At least two persons trained in the product transfer procedures are to remain in attendance (one at the vehicle and one at the tank – with some means of communication) during the whole transfer operation.
Combustible Liquids	Failure of filling line Overfilling of tank	Combustible liquids spill Vapour generation Pool fire	Storage in accordance with *Dangerous Goods Safety Management Regulation* 2001. Training of personnel in accordance with AS 1940 – *The Storage and Handling of Flammable and Combustible Liquids*. Transfer of liquids in accordance with AS 1940 and the ADG Code. • Permanent filling lines should be constructed. • The filling areas should be bunded. • The permanent filling lines should be protected from vehicles, contact with personnel and machinery. • The permanent filling lines will be maintained and inspected in accordance with the ADG Code. • Provision of compounds (bunded areas) for all above-ground bulk containers of combustible liquids in accordance with AS 1940. • Any spills will be contained within the bund. Suitable transfer points in accordance with AS 1940: • Suitably anchored. • Provision of a quick shut-off valve.

Table 14: Hazard Identification Word Diagram – Storage and Handling of Materials

Function/Operation	Possible Initiating Events	Possible Consequences	Preventative/Protective Measures
Storage of Class 8 Dangerous Goods			
	Tank rupture or failure Process failure during dosing	Liquid chemical spill: Land contamination Stormwater contamination Surface water contamination Release of toxic vapours Human injury Mixture with incompatible chemicals causing release of toxic fumes	Storage in accordance with *Dangerous Goods Safety Management Regulation* 2001. Design of bulk containers to be resistant to all likely sources of corrosion (particularly any product spills). Container foundation that is adequate to support the direct load, including those applied by wind when empty. Provision of compounds (bunded areas) for all above-ground bulk containers of corrosive substances in accordance with AS 3780: • 110% of the largest container located within the compound. • Materials of construction shall be substantially immune to attack corrosives. This will include corrosion resistant coatings on enclosure walls. • The materials of construction shall be sufficiently impervious to retain and enable recovery of any spillage. • The bund shall comply with the minimum separation distance between a container and the bund described in AS 3780-1994. • The bund shall be designed to withstand the hydrostatic pressure exerted on it when full. • Any pipe that passes through the wall of the bund shall be sealed. Segregation of corrosive substances that are kept in bulk from incompatible goods and goods with which they may react dangerously, in accordance with AS 3780.
	Malicious acts[2]	Fire – health impacts, environmental impacts, property loss or structural damage	Ensure site security – fencing with barbed wire, access by means of an electronic gate monitored by CCTV, sensors in offices, proximity switches on all doors and random patrols. Install early detection and alarm system with direct notification to the Queensland Fire Service.

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[2] e.g. Arson

Function/Operation	Possible Initiating Events	Possible Consequences	Preventative/Protective Measures
Storage of combustible liquids	Generation of dense vapours	Vapours travel to ignition source and flashback to storage area causing fire and/or explosion	Storage in bunded area. The installation should be designed and constructed so that it is safe and suitable for conditions of use in accordance with AS 1940. This location should be clearly identified as a Hazardous Area**.** Do not store any other goods or other equipment in the bund. Implement controls to ensure that ignition sources are not introduced into, or within 3m of, the bund, except under controlled conditions. Any electrical equipment within hazardous areas should be of a type suitable for a hazardous area (e.g. flameproof or intrinsically safe). The use of a flame or other source of ignition during repairs on or adjacent to, a hazardous area is not permitted unless the relevant precautions have been taken, in accordance with NOHSC: 2017(2001). Implement a formal work permit system in accordance with NOHSC 2017(2001) for all work, except routine work of a non-hazardous nature. Minimise of the generation of static electricity in all hazardous areas and dissipation of any static that does occur from a source. Maintain fire extinguishers and personal protective equipment. Ensure personnel trained in emergency response.
	Combustible liquids spill and ignition Bushfire	Pool fire and radiated heat: Fatality/injury Fuel smoke and vapour emissions Ash deposition Propagation to other structures Vapour explosion	Storage in bunded area. The bund should be designed and constructed so that it is safe and suitable for conditions of use in accordance with AS 1940. Ensure no ignition sources in the vicinity of the bunded area. Potential ignition sources include: • Engine systems (e.g. forklift) • Flames or sparks from exhaust • Hot surface temperatures • Arcs and sparks • Sparks from discharge of static electricity or from friction • Sparks and heat from brake components • Tyres and other material can discharge static electricity Design access and egress to the bund that allows escape in an emergency as well as access for maintenance, repair or emergency work.

Function/Operation	Possible Initiating Events	Possible Consequences	Preventative/Protective Measures
			Maintain spill kits including pumps and hoses for transferring spilt liquids. Implement and provide training in Emergency Management Plan that includes pool fires and explosions from storage of flammable liquids: • Installation of smoke alarms. • Supply of fire extinguishers and personal protective equipment. • Emergency response by the Queensland Fire and Rescue Service. • Access routes for fire and rescue appliances. • The containment of leaks, spills and run-off of firefighting equipment Preparation of an emergency plan: • The criteria for contacting the emergency services, and arrangements to ensure they are alerted promptly in the event of an incident. • The actions to be taken in the event of a fire. • The names and details of relevant authorities and the emergency services, and of the specific persons to be notified in the event of an emergency. • The location of MSDS for all dangerous goods kept on the premises. • Identification of the actions to be taken in the event that an incident on a neighbouring facility affects the premises. Prevention of fire fighting waters from entering surface or groundwater.
	Liquids spill	Toxic air emissions Stormwater and surface water contamination Land contamination	Adequate bunding to contain spills. Impermeable bund floors and walls. Removal of liquids by licensed liquid waste contractor.
	Fugitive vapour emissions	Toxic air emissions: Acute health effects Chronic health effects	Estimate load of pollutants emitted on an annual basis. Implement best available technology to reduce fugitive emissions from storage tanks e.g. internal floating roof to create seal or floating roof tanks.
TEG gas dehydration[1]	TEG spill (hot and cold) Ignition and fire	Human injury Release to the environment	Bunding Spill containment measures in accordance with AS 1940.

Function/Operation	Possible Initiating Events	Possible Consequences	Preventative/Protective Measures
		Fire – toxic by-products and human injury Damage to property	Control of ignitions sources. Isolate and stop in accordance with Plant Emergency Shut Down Procedures. Blow down plant to flare. Infrared fire detection.
TEG regeneration[2]	TEG spill	Human injury Release to environment	Bunding Spill containment measures in accordance with AS 1940 Site layout
	Malicious acts[3]	Fire – health impacts, environmental impacts, property loss or structural damage	Ensure site security – fencing with barbed wire, access by means of an electronic gate monitored by CCTV, sensors in offices, proximity switches on all doors and random patrols. Install early detection and alarm system with direct notification to the Queensland Fire Service.

1 Dehydrator units to remove water vapours from gas stream. TEG is used in an absorber tower to absorb the water vapours from the gas.

2 Wet glycol is heated (e.g. >150°C) to regenerate the glycol

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[3] e.g. Arson

4.3. Consequence Analysis

4.3.1. Fires

The types of fires of greatest concern are pool fires, jet fires, flash fires and fireballs (NSW DUAP 1997). Pool fires occur if a flammable or combustible liquid accumulates in a pool on the ground and is subsequently ignited. Jet fires occur when a flammable liquid or gas, under some degree of pressure, is ignited after release, resulting in a long stable flame. A flash fire occurs when a cloud of flammable gas mixed with air is ignited and fireballs can occur when large quantities of flammable gases are released violently and ignited, resulting in a rising ball of flame. The most likely scenario in this case is a pool fire from a diesel spill – requires both a spill and presence of an ignition source.

Fires can give rise to high levels of thermal radiation as well as the evolution of toxic combustion products or toxic fumes. Thermal radiation intensity is determined by factors such as the rate and efficiency of burning, the heat of combustion, the size and orientation of the flame and the fraction of radiation transmitted through the atmosphere (Department of Planning 2008). The effects of heat radiation are shown in Table 15.

Table 15: Effects of Heat Radiation

Heat Radiation (kW/m²)	Effect
1.2	• Received from the sun at noon in summer
2.1	• Minimum to cause pain after 1 minute
4.7	• Will cause pain in 15-20 seconds and injury after 30 seconds exposure (at least second degree burns will occur)
12.6	• Significant chance of fatality for extended exposure. High chance of injury. • Causes the temperature of wood to rise to a point where it can be ignited by a naked flame after long exposure • Thin steel with insulation on the side away from the fire may reach a thermal stress level high enough to cause structural failure
23	• Likely fatality for extended exposure and chance of fatality for instantaneous exposure • Spontaneous ignition of wood after long exposure • Unprotected steel will reach thermal stress temperatures which can cause failure • Pressure vessel needs to be relieved or failure would occur
35	• Cellulosic material will pilot ignite within one minute exposure • Significant chance of fatality for people exposed instantaneously

Source: Department of Planning (2008). *Hazardous Industry Planning Advisory Paper No. 6. Hazard Analysis Consultation Draft.* Department of Planning NSW. July 2008.

Bushfire also poses a threat to the storage and handling of materials, particularly combustible materials. Bushfires can be described as the uncontrollable burning of forest or wooded areas, usually occurring over large tracts of land on multiple fronts and as the result of dry and hot weather conditions. Emergency management at the facility would be coordinated with the Queensland Fire and Rescue Service.

Areas at most risk from bushfires are generally on the urban fringe or at the interface between the bush and built up areas. Emergency Management guidelines are provided in State Planning Policy (SPP) 1/03 *Mitigating the Adverse Impacts of Flood, Bushfire and Landslide*. The proposed locations of the Central Processing Plants (and therefore diesel and TEG storage) were unknown at the time of this assessment. However, the bushfire risk is expected to be low where the surrounding countryside has been cleared for pastures and grazing or cropping. Potential pasture and crop fires need to be controlled by the local Rural Fire Service.

4.3.2. Toxicant Releases

Impacts on the aquatic environment

Pollution from industrial sources can cause biological changes in aquatic ecosystems. Environmental concerns include:

- Toxic effects;
- Nuisance aquatic plant growth;
- Maintenance of dissolved oxygen levels; and
- Effects due to changes in salinity.

'Toxicants' is a term used for chemical contaminants that have the potential to exert toxic effects at concentrations that might be encountered in the environment (ANZECC & ARMCANZ 2000). Toxic effects may be either acute (short-term) or chronic (long-term). All the dangerous goods and combustible liquids evaluated in this report are expected to impact on aquatic ecosystems.

Fire fighting water is also likely to contain toxic compounds depending on the materials involved as well as by-products such as polycyclic aromatic hydrocarbons, which are formed during combustion processes.

Impacts from smoke, vapours and gases

The release and dispersion of toxic material to the atmosphere can adversely affect exposed persons and the environment. Toxic concentrations of airborne contaminants can result from:

- The evolution of toxic combustion products during fire;
- Vapours from toxic liquids;
- Reactions of materials giving off toxic vapours or gases;
- Liquid spills entering watercourses or contaminating land or groundwater; and
- Spills of solid materials and dispersion of dusts by the wind.

The effects from exposure to toxic fumes can range from fatality or injury (e.g. damage to respiratory or nervous system) to irritation of eyes, throat or skin. Smoke inhalation leads to poisoning by carbon monoxide and other toxic products of chemical fires.

4.4. Likelihood Analysis

There is little available information on chemical incidents in the coal seam gas industry. There is more information on the chemical industry in general, but this information is spread among databases (e.g. Emergency Management Australia Disasters Database) or annual reports (e.g. Department of Emergency Services (DES) Annual Report for 2006-07.

Some industry specific information was available from the *2005 2006 Health, safety, environment and social performance report* prepared by APPEA (Australian Petroleum Production & Exploration Association Limited).

The EMA Disasters Database is a primary Australian Government database containing records of all natural and non-natural disasters within Australia (where information is available) dating from the earliest records to the present day. The EMA Disasters Database is a comprehensive historical record, and a general research resource available in the public domain.

Information recorded by the Emergency Management Australia (EMA) Disasters Database includes chemical fires and spills.

In total, there were 67 events involving chemicals (i.e. across a wide range of industries) in the ten years between 1995 and 2005. This included 8 chemical fires and 11 chemical spills. People impacted by chemical fires and toxic fumes suffered eye irritation and breathing difficulties.

The Department of Emergency Services (DES) Annual Report for 2006-07 provides some Queensland statistics on Hazardous Materials incidents:

- The Queensland Fire and Rescue Service (QFRS) responded to 16169 fires and explosions in 2006-07 (25% of total number of incident responses);
- The QFRS responded to 3132 hazardous condition incidents in 2006-07 (4.8% of total number of incident responses);
- The Department of Emergency Services (DES) audited 9 Major Hazard Facilities (MHFs) in 2006-07; and
- The DES assessed 4 MHF safety reports in 2006-07.

The NSW Fire Brigades' Australian Fire Authorities Council (AFAC) established a comprehensive data collection program, which documented statistics and information on hazardous materials incidents as they occur in NSW. Table 16 gives incident statistics from the EPA Hazardous Material Incident Database, which is an aggregation of data from the AFAC database and data collected by the EPA for the period 1 July 1993 to 30 June 1994.

Table 16: Incident Statistics, 1 July 1993 to June 1994

Category	Number of Incidents	Incident Description
0	-	Insufficient data to classify
1	167	Routine incident
2	13	Significant incident
3	8	Major incident
4	0	Major incident/emergency with significant impact
5	0	Major emergency with severe impact

Source: EPA Hazardous Material Incident Database 1994 (NSW-EPA, 1995)

Incidents are ranked according to severity, based on the nature of the material, the amount released, the amount of pollution, the type and location of the event and the time taken by the Fire Brigade to deal with the emergency. The database held a total of 391 records of which 22 contained insufficient data for analysis. The 13 significant and 8 major incidents resulted in only localised environmental impacts and were dealt with immediately. No major emergencies with significant or severe impact were reported.

The majority of Category 2 incidents related to spills caused by single vehicle accidents. Ten incidents occurred across the state, with no consistency either in location or in the nature of the hazardous substance. Spills also accounted for the majority of Category 3 incidents, many of which involved pesticides and petroleum products as shown in Table 17.

In 1994-95, the highest number of dangerous goods incidents (99) involved flammable liquids (petrol and petrol oil). While the potential risk of spillage during these incidents was in excess of 5.5 million litres, the actual amount spilled was about 78 000 litres. The maximum volume spilled in any one incident was 25 000 litres of petrol; the second largest spill was of diesel (20 000 litres). A total of 104 incidents involved non-dangerous goods with approximately 100 000 litres being spilled. A further 10 events involved poisonous substances (239 litres spilled).

Spillage was the major cause of accident (202), while leaks caused 101 incidents. Fires caused 20 accidents and a further 12 events involved the release of vapour clouds. Materials packaged in drums were implicated in the majority of accidents (107). Road tankers were involved in a further 27 events.

Table 17: Incidents-Hazardous Materials Category 3, 1 July 1993 to June 1994

Location	Chemical	Total Release	Type of Event	Cause of Event
Euston	Pesticides	5000	Fire	
Balranald	Pesticides	3000	Fire	External of fire
Rankins Springs	Pesticides	5960	Spill	Single vehicle accident
Gundagai	Formaldehyde	6000	Spill	Single vehicle accident
Peak Hill	Xylene	200	Leak	Container failure
Sylvania	Diesel	15000	Spill	
Medowie	Petrol	8000	Spill	
Ulmarra	Diesel	234000	Spill	Single vehicle accident

Source: NSW-EPA, 1995.

The APPEA 2005_2006 Report presented the following statistics:

1. There were a total of 234 environmental problems reported to APPEA in 2005 and 104 in 2006.
2. There have been very few medium and high level incidents.
3. There was one high level incident reported in 2005 (offshore incident resulting in diesel release) and none in 2006.
4. There were 159 onshore incidents reported in 2005 and 78 onshore incidents in 2006.
5. Most incidents were associated with production/processing facilities onshore (e.g. ~90 in 2005).
6. Most incidents occurred during product transport.
7. The most obvious mechanism of incident was corrosion followed by mechanical/electrical and human intervention.
8. There were 5.73 tonnes of chemicals accidentally discharged in 2005 (9 incidents) and 9.76 tonnes in 2006 (6 incidents).
9. There was 3720 litres of produced diesel accidentally discharged in 2005 (5 incidents) and 3952 litres in 2006 (3 incidents).
10. The largest single accidental discharge of crude oil was in 2005 (16 tonnes) when a tank drain value was left open during product transfer.
11. The single largest discharge in 2006 (2.8 tonnes) occurred when flooding associated with a cyclone cause production flowline breakages.

4.4.1. Probability of Events

The assessment of land use risks posed by the handling and storage of flammable liquids depends on the chance or frequency of adverse events occurring. In this case, the potential adverse events relate to the failure rates of equipment leading to the release, which are described in Table 18. This table indicates that the probability of fire is higher than the probability of failure for a storage vessel and a bund.

Table 18: Probability of Equipment Failure and Fire – Flammable and Combustible Substances

Item	Failure probability (per year per item)	Fire probability (per year per item)
Storage vessel	600×10^{-6}	1000×10^{-6}
Bund	0.1×10^{-6}	10×10^{-6}

Source: Department of Environment and Planning, Sydney (1985)

4.5. Risk Analysis

The following tables provide the outcomes of the risk analysis process. These tables show the relative level of risk for both the potential (or inherent) case (i.e. no control measures) and residual case (i.e. with control measures).

As described in Section 6, risk evaluation uses the risk levels to determine whether a risk needs treatment, whether an activity should be undertaken and the priorities for action. The risk criteria against which the relative risks have been assessed are described in Table 12. The risk profiles for the different phases of the development are discussed further in Section 13.

Table 19: Risk Analysis of Materials Unloading

Hazardous event	Consequence	Likelihood	Risk Level Estimate	
			Potential	Proposed controls
Unloading Class 8 Corrosives				
Loss of material during transfer – inhalation, dermal and eyes	Minor	Likely[1]	Medium	Low[2] (1C)
Loss of material during transfer – environmental effects	Moderate[3]	Likely[1]	High	Medium[4] (3D)
Overfilling of tank – human health effects	Minor	Possible[5]	Medium	Low[2] (1C)
Overfilling of tank – environmental effects	Moderate[3]	Possible[5]	High	Medium[4] (3D)
Filling incorrect tank and/or mixing of incompatible substances – human health[6]	Moderate	Possible	High	Medium[7] (3D)
Unloading Combustible Liquids[8]				
Loss of material during transfer – vapour effects	Minor[9]	Likely[1]	Medium	Low[10] (1C)
Loss of material during transfer – environmental effects	Moderate[11]	Likely[1]	High	Medium[4] (3D)
Overfilling of tank – human health effects	Minor[9]	Possible[5]	Medium	Low[12] (2D)
Overfilling of tank – environmental effects	Moderate[11]	Possible[5]	High	Medium[12] (3D)

1 APEAA reports 6-9 incidents per year of accidental discharge. Loss of containment of material may occur in unbunded area (e.g. transfer pipelines).

2 Reduce the consequence to insignificant if PPE is worn and the likelihood to possible if preventative measures applied, including spill kits. Need to ensure that overflow points from tanks are close to the ground and within a bunded area.

3 Greatest impact on aquatic environments.

4 Reduce the likelihood to unlikely if the liquid spill can be contained.

5 Overfilling (or conversely) totally draining a tank is usually a result of human error.

6 Primarily human health effects by generation of toxic gases, but the generation of heat may also lead to tank failure.

7 Reduce the likelihood to unlikely if the provisions of AS 3870 are implemented.

8 Scenarios assume no ignition of pooled combustible liquids.

9 Assume well ventilated area.

10 Reduce the consequence to insignificant if PPE is worn and the likelihood to possible if vapour control measures are implemented.

11 Diesel fuel is toxic to aquatic organisms, may accumulate in sediments and may penetrate soil causing groundwater contamination.

12 Reduce the likelihood to unlikely if the provisions of AS 1940 are implemented.

Table 20: Risk Analysis of Materials Storage and Handling

Hazardous event	Consequence	Likelihood	Risk Level Estimate	
			Potential	Proposed controls
Storage and handling – Class 8 Corrosives				
Tank rupture or failure – human health effects	Moderate	Possible[1]	High	Low[2] (2D)
Tank rupture or failure – environmental effects	Major[3]	Possible[1]	High	Medium[4] (3D)
Process failure (equipment malfunction) – environmental effects	Moderate[5]	Possible[6]	High	Medium[4] (3D)
Malicious acts	Moderate[7]	Unlikely	Medium	Low[8] (2E)
Storage and handling – Combustible Liquids				
Vapour generation – flashback causing fire or explosion[9]	Major	Possible[10]	High	Medium[11] (3D)
Tank rupture or failure – liquids spill and ignition – pool fire and heat radiation	Major	Possible[10]	High	Medium[11] (3D)
Liquids spill and ignition - pool fire – heat radiation[12]	Moderate[13]	Possible	High	Medium[11] (3D)
Combustible liquids release – environmental effects	Moderate[14]	Possible	High	Medium[15] (3D)
Bushfire	Catastrophic	Possible	High	Medium[16] (3D)
Malicious acts	Moderate[7]	Unlikely	Medium	Low[8] (2E)

[1] The failure of a storage vessel was assumed to be 600 x 10^{-6} per year per item (Table 18).

[2] Reduce the consequence to minor if appropriate PPE is worn and the likelihood to unlikely if the provisions of AS 3780 are applied.

[3] A large release of sulphuric acid (e.g. 40 000L) would cause major environmental impacts. This case is feasible given the reported accidental discharge (crude oil) in 2005 of ~24 000L.

[4] Reduce the likelihood to unlikely if the provisions of AS 3780 are applied and the spill is contained within a bund.

[5] Consequences less than those in Point 3 because of smaller potential release volumes.

[6] Corrosion is one of the major causes of equipment malfunction in the oil and gas industry (see Section 4.4).

[7] Assumed to be moderate because the intent is to cause damage, more likely to cause environmental impacts if executed while the site is unattended.

[8] Reduce the consequence to minor if warning systems are adequate. Reduce the likelihood to rare provided appropriate security measures are in place.

[9] Diesel vapours may accumulate in low points or confined spaces and travel to a source of ignition.

[10] The probability of fire within a storage vessel is reported to be higher than the probability of failure of a storage vessel.

[11] Reduce the likelihood to unlikely if the provisions of AS 1940 are implemented, particularly control of ignition sources. The consequences may also be reduced by emergency management procedures.

[12] Pool fire may occur if chemical temperature is above its flash point.

[13] Moderate because release of smaller volumes of liquid assumed.

[14] Diesel fuel is toxic to aquatic organisms, may accumulate in sediments and may penetrate soil causing groundwater contamination.

[15] Reduce the likelihood to unlikely if the provisions of AS 1940 are implemented and the spill is contained.

[16] Consequences reduced to moderate by emergency response planning including services provided by QFRS and likelihood to unlikely if facility located in a cleared area away from bushland.

5. RISK EVALUATION

5.1. Risk Levels

The estimated risk levels, assuming implementation of preventative measures and proposed controls, are presented in Table 21. There were no high risk hazardous events identified once standard preventive measures had been evaluated.

All identified hazards were determined to be either medium or low. These hazards have been ranked on the basis of their final score. The higher the number and letter (i.e. ‘A’ is higher than ‘C’), the higher the action priority. The highest rank is 5A (immediate action) and the lowest rank is 1E (lowest priority). These codes correlate with those shown in Table 11.

The objective of the action level is to prioritise events for further risk treatment. In some cases, the risk level may be As Low As Reasonably Possible (ALARP) (e.g. bushfire) within the control of the proposed development. However, each case could be further reviewed in consultation with appropriate persons (e.g. Department of Emergency Services).

Table 21: Risk Levels in Order of Priority

Risk Level	Aspect	Rank	Hazardous Event	Action Priority
High	-	-	-	Immediate action required. Detailed risk analysis and management plan for specific activity prepared in consultation with appropriate persons.
Medium	Unloading Class 8 corrosives	3D	Loss of material during transfer – environmental effects	Further improvement required. Proposed risk treatment measures reviewed in consultation with appropriate persons.
		3D	Overfilling of tank – environmental effects	
		3D	Filling incorrect tank and/or mixing of incompatible substances – human health	
	Unloading combustible liquids	3D	Loss of material during transfer – environmental effects	
		3D	Overfilling of tanks – environmental effects	
	Storage and handling Class 8 corrosives	3D	Tank rupture or failure – environmental effects	
		3D	Process failure (equipment malfunction) – environmental effects	
	Storage and handling combustible liquids	3D	Vapour generation, flashback – fire or explosion	
		3D	Tank rupture or failure – pool fire and heat radiation	
		3D	Liquids spill and ignition – pool fire and heat radiation	
		3D	Combustible liquids release – environmental effects	
		3D	Bushfire	
Low	Unloading combustible liquids	2D	Overfilling of tank – human health effects	Schedule for action after other risks
	Storage and handling combustible liquids	2D	Tank rupture or failure – human health effects	
	Unloading combustible liquids	2E	Malicious acts	
	Storage and handling combustible liquids	2E	Malicious acts	
	Unloading Class 8 corrosives	1C	Loss of material during transfer – inhalation, dermal and eyes	
		1C	Overfilling of tank – human health effects	
	Unloading combustible liquids	1C	Loss of material during transfer – vapour effects	

5.2. Major Recommendations for Preventative Measures

The recommended preventative measures for the hazardous scenarios identified were summarised in Table 13 and Table 14. The primary preventative measures to be implemented, based on the risk analysis are:

- Training of personnel in accordance with AS 3870 – *The storage and handling of corrosive substances.*
- Training of personnel in accordance with AS 1940 – *The storage and handling of flammable and combustible liquids.*
- Implementation of design considerations in accordance with AS 3870 and AS 1940.
- Installation of permanent filling lines for bulk tank storage for both Class 8 corrosives and combustible liquids.
- Provision of suitable transfer points.
- Installation of level indicators on fixed tanks.
- Installation of overflow line on every fixed tank.
- Segregation of incompatible substances in accordance with AS 3870, AS 1940 and the ADG Code.
- Sulphuric acid and sodium hypochlorite should be segregated.
- Combustible (organic) liquids should also be segregated from acids, alkalis and other strong oxidising materials.
- Bunding to ensure containment of 110% of the largest container located within the compound.
- Tank construction and bund materials in accordance with AS 3870 and AS 1940, including resistance to corrosives.
- Exclude ignition sources from combustible liquids storage areas and implement a formal work permit system.
- Locate all bulk chemical storage tanks away from surface waters, wetlands or springs or drainage lines.
- Prepare a Bushfire Management Plan as part of the overall Safety Management System.
- Prepare a HAZOP analysis of all transfer and storage processes, including chemical dosing for water treatment purposes.

6. CONCLUSIONS

- The water treatment chemicals assessed in this report were classified as Class 8 corrosives according to the Australian Dangerous Goods (ADG) Code. The types of chemicals to be used and stored cover PG II (moderate risk) and PG III (low risk) packing groups.
- Class 8 corrosives are generally non-flammable.
- Other hazardous materials associated with CSG production and included in this report were diesel fuel and triethylene glycol (TEG).
- Diesel fuel is a Class C1 combustible liquid (most diesel fuel used in Queensland) and TEG is a Class C2 combustible liquid. These materials are not classified as dangerous goods under the ADG Code.
- Both the quantities of dangerous goods and combustible liquids were evaluated when classifying premises in accordance with the *Dangerous Goods Safety Management Regulation* (requirement of the regulation).
- The maximum quantities of chemicals to be stored (based on a 30 day storage period) exceeded the prescribed quantities for a Large Dangerous Goods Location (LDGL).
- This classification was the same for all water treatment scenarios (i.e. treatment of 60, 100 and 160 ML/day).
- The storage of Class 8 PGIII water treatment chemicals separately, for the 60ML/day treatment scenario only, was classified as a DGL.
- The quantity of diesel to be stored would be classified as a Dangerous Goods Location (DGL) if it is located at premises separate to that of the water treatment chemicals (i.e. Central Processing Plant). There is no requirement for C2 combustible liquids (i.e. TEG) unless they are stored with fire risk dangerous goods.
- The dangerous goods and combustible liquids identified in this report are not listed in either Table 1 or Table 2 of Schedule 2 of the *DGSM Regulation* and therefore do not trigger the requirement for notification as a possible MHF.
- The major recommendations to reduce risk from the storage and handling of Class 8 corrosives and combustible liquids are to ensure the implementation of *Dangerous Goods and Safety Management Regulation*, AS 3780, AS 1940 and the ADG Code through all phases of the development including design and training.
- A HAZOP analysis of all transfer and storage processes, including chemical dosing for water treatment purposes, should be conducted once the layout and water treatment process design is finalised.

7. REFERENCES

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APPENDIX A:

Dangerous Goods Classes

Australian Dangerous Goods Code

Dangerous Goods Classes

Class	Dangerous Good	Description
1	Explosives	Information on the classification of Class I Explosives is included in the Australian Explosives Code.
2.1	Flammable gas	Gases that can ignite in air on contact with a source of ignition.
2.2	Non-flammable gas	Gases that are non-flammable but may cause suffocation.
2.2 Sub-risk 5.1	Oxidising gases	Gases that are non-flammable and non-toxic but which contribute to combustion, such as oxygen and nitrous oxide.
2.3	Toxic gas	Gases likely to cause death or serious injury if inhaled.
3	Flammable liquid	Liquids, the vapours of which can ignite in air on contact with a source of ignition.
4.1	Flammable solid	Substances that are easily ignited by external sources, such as sparks and flames.
4.2	Spontaneously combustible	Substances likely to heat spontaneously and catch fire.
4.3	Dangerous when wet	Substances that produce dangerous quantities of flammable gas when in contact with water. Heat from this reaction may cause these gases to spontaneously ignite.
5.1	Oxidising agent	Substances not necessarily combustible by themselves, but which produce oxygen, which increases the risk and intensity of fire in other materials with which they may come into contact.
5.2	Organic peroxide	Organic substances containing bivalent oxygen that are thermally unstable and likely to react dangerously with other substances.
6.1	Toxic	Substances likely to cause death or serious injury if ingested, inhaled or brought into contact with the skin.
6.2	Infectious	Substances known or likely to contain micro-organisms which can cause disease.
7	Radioactive	Material for which the specific activity exceeds 70kBq/kg.
8	Corrosive	Solid and liquid substances that can severely damage living tissue or attack other materials such as metals.
9	Miscellaneous	Substances and articles that present a danger, but are not covered by other classes.

APPENDIX B:

Example MSDS

MINTECH CHEMICAL INDUSTRIES PTY LTD

MATERIAL SAFETY DATA SHEET

Product Name **SULPHURIC ACID 10% (MINTECH)**

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Supplier Name	**MINTECH CHEMICAL INDUSTRIES**
Address	33 Butcher Street, Kwinana, WA, AUSTRALIA, 6167
Telephone	08 9419 5300
Fax	08 9419 5333
Emergency	1300 869 3733
Web Site	http://www.mintechchemical.com.au/
Synonym(s)	BABCOCK ACID • MINTECH SULPHURIC ACID • OIL OF VITRIOL • SULPHURIC ACID 10% W/W AQUEOUS SOLUTION • SULPHURIC ACID WITH LESS THAN 51% ACID
Use(s)	BATTERY ACID • FOOD INDUSTRY • LABORATORY APPLICATIONS • METAL INDUSTRY • WASTE WATER TREATMENT • WATER TREATMENT DEIONISATION
MSDS Date	24 Mar 2009

2. HAZARDS IDENTIFICATION

CLASSIFIED AS HAZARDOUS ACCORDING TO ASCC CRITERIA

RISK PHRASES

R35	Causes severe burns.

SAFETY PHRASES

S1/2	Keep locked up and out of reach of children.
S26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice
S30	Never add water to this product.
S45	In case of accident or if you feel unwell seek medical advice immediately (show the label where possible).

CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE

UN No.	1830	**DG Class**	8	**Subsidiary Risk(s)**	None Allocated
Packing Group	II	**Hazchem Code**	2P	**EPG**	8A2

3. COMPOSITION/ INFORMATION ON INGREDIENTS

Ingredient	Formula	CAS No.	Content
SULPHURIC ACID	H2-S-O4	7664-93-9	10%
WATER	H2O	7732-18-5	remainder

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 Poisons Information Centre or a doctor, or for at least 15 minutes.
Inhalation	If inhaled, remove from contaminated area. To protect rescuer, use a Full-face Type B (Inorganic and acid gas) respirator or an Air-line respirator. 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 the Poisons Information Centre or a doctor.
Ingestion	For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If swallowed, do not induce vomiting.
Advice to Doctor	Treat symptomatically

5. FIRE FIGHTING MEASURES

Flammability	Non flammable. May evolve toxic gases (sulphur oxides) when heated to decomposition. May evolve flammable hydrogen gas in contact with some metals.
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	2P

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 sodium bicarbonate or 50-50 mixture of sodium carbonate and calcium hydroxide. Collect for complete neutralisation and appropriate disposal.

7. STORAGE AND HANDLING

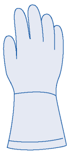
Storage	Store in secured, cool, dry, well ventilated area, removed from oxidising agents (eg. hypochlorites), alkalis, most metals, heat sources and foodstuffs. Ensure containers are adequately labelled and protected from physical damage. Check regularly for leaks or spills. Large storage areas should have appropriate fire prevention and ventilation systems.
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.

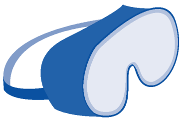
8. EXPOSURE CONTROLS/ PERSONAL PROTECTION

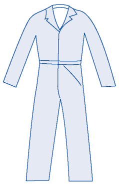
Exposure Stds

Ingredient	Reference	TWA		STEL	
		ppm	mg/m3	ppm	mg/m3
Sulphuric acid	ASCC (AUS)	--	1	--	3

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. Maintain vapour levels below the recommended exposure standard.
PPE	Wear splash-proof goggles, PVC or rubber gloves and coveralls. When using large quantities or where heavy contamination is likely, wear: a PVC apron and rubber boots. Where an inhalation risk exists, wear: an Air-line or a Type B (Inorganic gases and vapours) respirator. In a laboratory situation, wear: a laboratory coat.







9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	COLOURLESS TO SLIGHTLY YELLOW LIQUID	**Solubility (Water)**	SOLUBLE
Odour	ODOURLESS	**Specific Gravity**	1.05 to 1.07
pH	< 1	**% Volatiles**	NOT AVAILABLE
Vapour Pressure	< 0.0001 kPa @ 20°C	**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		

10. STABILITY AND REACTIVITY

Chemical Stability	Potential for exothermic hazard.
Conditions to Avoid	Avoid heat, sparks, open flames and other ignition sources.
Material to Avoid	Incompatible with oxidising agents (eg. hypochlorites), alkalis (eg. hydroxides) and some metals. Adding water to this product may result in violent spattering.
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	Corrosive. Use safe work practices to avoid eye or skin contact and vapour inhalation. Exposure may result in severe and permanent eye, skin and respiratory damage. If diluted the potential for corrosive effects will be reduced.
Eye	Corrosive - irritant. Contact may result in irritation, lacrimation, pain, redness, corneal burns and possible permanent damage.
Inhalation	Corrosive. Over exposure may result in irritation of the nose and throat, coughing and bronchitis. High level exposure may result in ulceration of the respiratory tract, lung tissue damage, chemical pneumonitis and pulmonary oedema.
Skin	Corrosive. Contact may result in irritation, redness, itching, pain, rash, dermatitis and burns. Effects may be delayed.
Ingestion	Corrosive - toxic. Ingestion may result in gastrointestinal irritation, nausea, vomiting, abdominal pain and diarrhoea. Ingestion of large quantities may result in gastrointestinal tract ulceration, unconsciousness and convulsions.
Toxicity Data	SULPHURIC ACID (7664-93-9) LC50 (Inhalation): 18 mg/m3 (guinea pig) LD50 (Ingestion): 2140 mg/kg (rat) TCLo (Inhalation): 3 mg/m3/24 weeks (human)

12. ECOLOGICAL INFORMATION

Environment	Sulphuric acid is miscible with water and its dilution will increase the velocity of downward movement in the soil where it may dissolve the soil material. Sulphuric acid is harmful to aquatic life in very low concentrations. May cause corrosion and deterioration of many common materials found in the environment (eg steel, limestone).

13. DISPOSAL CONSIDERATIONS

Waste Disposal Collect for complete neutralisation and appropriate disposal. Wearing the protective equipment detailed above, neutralise to pH 6-8 by SLOW addition to a saturated sodium bicarbonate solution or similar basic solution. Dilute with excess water and flush to drain. Waste disposal should only be undertaken in a well ventilated area.

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE

Shipping Name	SULFURIC ACID with more than 51% acid				
UN No.	1830	**DG Class**	8	**Subsidiary Risk(s)**	None Allocated
Packing Group	II	**Hazchem Code**	2P	**EPG**	8A2

15. REGULATORY INFORMATION

Poison Schedule Classified as a Schedule 6 (S6) Poison 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 ACIDS: When mixing acids with water (diluting), caution must be taken as heat will be generated which causes violent spattering. Always add a small volume of acid to a large volume of water, NEVER the reverse.

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.
EINECS - European INventory of Existing Commercial chemical Substances.
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.
NTP - National Toxicology Program.
OSHA - Occupational Safety and Health Administration.
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.
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.

COLOUR RATING SYSTEM: RMT has assigned all Chem Alert reports a colour rating of Green, Amber or Red for the sole purpose of providing users with a quick and easy means of determining the hazardous nature of a product. Safe handling recommendations are provided in all Chem Alert reports so as to clearly identify how users can control the hazards and thereby reduce the risk (or likelihood) of adverse effects. As a general guideline, a Green colour rating indicates a low hazard, an Amber colour rating indicates a moderate hazard and a Red colour rating indicates a high hazard.

While all due care has been taken by RMT in the preparation of the Colour Rating System, it is intended as a guide only and RMT does not provide any warranty in relation to the accuracy of the Colour Rating System. As far as is lawfully possible, RMT accepts no liability or responsibility whatsoever for the actions or omissions of any person in reliance on the Colour Rating System.

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.

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MSDS Date: 24 Mar 2009

End of Report

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT NAME: **SULPHURIC ACID 60%**

OTHER NAMES: **None Assigned**

UN Number:	**1830**
D.G. Class:	**CORROSIVE 8**
Subsidiary Risk:	**NONE**
HAZCHEM Code:	**2P**
Packaging Group:	**II**
Poisons Schedule:	**6**

HAZARDOUS ACCORDING TO THE CRITERIA OF WORKSAFE AUSTRALIA.

RECOMMENDED USE: **Strong Acidic pH Control Agent; Drain Cleaner.**

PRODUCT DESCRIPTION / PROPERTIES

Appearance:	**Water white slightly oily looking.**
Boiling Point / Melting Point:	**100C**
Vapour Pressure:	**1mm at 145C**
Percent Volatiles:	**None Assigned**
Specific Gravity / Bulk Density:	**1.50**
Flash Point:	**None Assigned**
Flammability Limits:	**None Assigned**
Autoignition Temperature:	**None Assigned**
pH (Neat):	**None Assigned**
Shelf Life:	**None Assigned**

INGREDIENTS:	**CAS No.**	**Range (w/w)**
SULPHURIC ACID	7664-93-9	60
WATER	7732-18-15	To 100

Other ingredients not considered hazardous by Worksafe Australia.

HEALTH HAZARD INFORMATION

HEALTH EFFECTS

Swallowed:	Severe corrosive agent. Will cause intense burns and internal tissue destruction, possible fatal consequences.
Eye:	Very severe corrosion, may cause severe and permanent eye damage and consequent loss of sight.
Skin:	Highly corrosive to skin. May leave burns and scarring of tissue.
Inhaled:	Mists and vapours are highly corrosive can cause severe tissue damage to mouth, nose and respiratory tract. Coughing, sneezing, shortage of breath.

ACTUE: PROLONGED CONTACT WILL CAUSE SERIOUS TISSUE BURNS, AND PERMANENT SCARRING

FIRST AID

Swallowed:	Wash out mouth with water. Do not induce vomiting. Give a glass of water to drink. Do not give anything if victim is unconscious. Seek medical advice.
Eye:	Flood eyes with clean water for at least 15 minutes. Retract eyelids often. Seek medical advice.
Skin:	Irrigate skin with clean water for 15 minutes. Launder affected clothing with normal laundry detergents.
Inhaled:	Remove to fresh air, administer oxygen if necessary. If not breathing apply artificial resuscitation.
Advice to Doctor:	Treat Symptomatically – show this MSDS to a Doctor.

Product Name:	**SULPHURIC ACID 60%**

PRECAUTIONS FOR USE

EXPOSURE LIMITS:	T.W.A. 1 mg/m^3; STEL 3 mg/m^3
VENTILATION:	Ventilation exhaust system to remove mists, and avoidance of mist generation.
PERSONAL PROTECTION:	Eye bath and shower must be nearby. Eye protection (safety goggles) essential. Full protective clothing, apron. Long sleeve shirts / overalls boots and gloves are also very strongly advised.
FLAMMABILITY:	Not flammable however, in the presence of water it can react with metals to release hydrogen gas which is flammable.

SAFE HANDLING INFORMATION

STORAGE AND TRANSPORT:	Keep dry. Keep away from food stuffs, alkalis, halogen compounds. Do not let moisture enter container or else great heat / boiling may occur.
SPILLS AND DISPOSAL:	Contain with sand or Diatomaceous earth. Keep product from entering water ways. Remove for disposal in accordance with Local Waste Management. Diluted solutions can be neutralised with lime or soda ash.
FIRE / EXPLOSION HAZARD:	Not flammable. Will react violently with water causing boiling and spraying of acid and steam. Will react with many metals to release hydrogen gas which is flammable.
EXTINGUISHING MEDIA:	Fires – carbon dioxide foam. Heat – cool down with flooding of large excess of water, neutralise spills with lime or soda ash.
OTHER INFORMATION:	Always use product as directed. Never return any unused material to original drum.

KEEP OUT OF REACH OF CHILDREN

The information contained in this MSDS is specific to the product when handled and used neat. Check with your technical representative if you have any queries.

CONTACT POINTS:	**Emergency Contact**	**1800 737 411**

ISSUE NUMBER:	**002**
ISSUE DATE:	**01 MAY 2008**

THIS ISSUE NUMBER REPLACES ALL PREVIOUS ISSUES.

Water Treatment Services
(AUST) PTY LTD ABN 73 088 459 027
Unit 6/42 Keane St, Currajong, Townsville Qld 4812
PO Box 129, Castletown, Hyde Park, Townsville Qld 4812
Tel 07 4728 8920
Fax 07 4728 8109
Email info@watertreat.com.au
CERTIFIED QUALITY MANAGEMENT SYSTEM

MATERIAL SAFETY DATA SHEET

SODIUM HYPOCHLORITE SOLUTION

SECTION 1 IDENTIFICATION OF THE PRODUCT AND SUPPLIER

COMPANY DETAILS

Name: Water Treatment Services (Aust) Pty Ltd

Address:
Unit 6/42 Keane Street
CURRAJONG QLD 4812
PO Box 129
Castletown Hyde Park
TOWNSVILLE QLD 4812

Phone Number: 07 4728 8920
(Mon-Fri 8am-5pm)
Phone Number: 0408 755 890
(After Hours)

Emergency Contact Number 0408 755 890

PRODUCT DETAILS

Product Name: SODIUM HYPOCHLORITE SOLUTION
Manufacturers Code: SodHypo
Use: Control of microbiological organisms in industrial cooling water systems.

SECTION 2 HAZARDS IDENTIFICATION

Classification: Classified as hazardous according to the criteria of Worksafe Australia
C - Corrosive
U.N. Number: 1791 – Hypochlorite Solution
Dangerous Goods Class: 8
Subsidary Risk None Allocated
Hazchem Code: 2X
Poisons Schedule: 5
Packaging Group: III
Risk Phrases:

R31	Contact with acids liberates toxic gas.
R34	Causes burns.
R36/37/38	Irritating to eyes, skin and respiratory system

Safety Phrases:

S20/21	When using do not eat, drink or smoke.
S23	Do not breathe vapour
S24/25	Avoid contact with skin and eyes.
S26	In case of contact with eyes, rinse immediately with plenty of water. Seek medical advice.
S28	After contact with skin, wash immediately with plenty of soap-suds.
S36/37/39	Wear suitable protective clothing, gloves and eye/face protection.
S45	In case of accident or if you feel unwell, seek medical advice immediately (show label where possible).
S50	Do not mix with acids.

SECTION 3 COMPOSITION/INFORMATION ON INGREDIENTS

CHEMICAL NAME	*CAS NUMBER*	*PROPORTION (%w/w)*
Sodium Hypochlorite	7681-52-9	< 11
Sodium Chloride	7647-14-5	< 10
Sodium Hydroxide	1310-73-2	< 2
Water	7732-18-5	Balance

SECTION 4 FIRST AID MEASURES

Never give anything by mouth to an unconscious person.

Swallowed:	DO NOT induce vomiting. Thoroughly rinse mouth with water. Give water to drink. If vomiting occurs give further water. Seek immediate medical attention.
Eye:	Flush thoroughly with water with eyelids open for at least 15 minutes. Seek prompt medical attention.
Skin:	Remove contaminated clothing. Wash skin thoroughly with running water. If swelling, redness, blistering or irritation occurs seek medical assistance. Launder clothing before re-use.
Inhaled:	Remove victim from exposure – avoid becoming a casualty. If breathing is laboured and patient blue, ensure airways are clear and have qualified person give oxygen through a facemask. If breathing has stopped apply artificial respiration. Seek prompt medical attention.
Advice to Doctor:	Ingestion releases hypochlorous acid, which is irritating to mucous membranes and skin but has low systemic toxicity. Systemic effects include fall of blood pressure, delirium and coma. Administer antacids. Treat as for alkaline materials. Inhalation may be followed by pulmonary Oedema.

As with any chemical - ingestion, inhalation and prolonged or repeated skin contact should be avoided by good occupational work practice.

SECTION 5 FIRE FIGHTING MEASURES

Non flammable. When finely divided combustible materials (fabrics, paper, wood and dust) are contaminated with the solution they become more combustible than when in the dry state. Heating can cause expansion or decomposition leading to violent rupture of containers. Keep containers cool with water spray. If safe to do so, remove containers from path of fire. Will emit toxic fumes, chlorine oxides if involved in a large fire. Fire fighters to wear self-contained breathing apparatus as with any chemical fire.
Hazchem Code: 2X

SECTION 6 ACCIDENTAL RELEASE MEASURES

Wear ***PPE (Personal Protective Equipment)*** :
Contain and absorb spills with sand, soil or inert material. Avoid contaminating waterways. Collect into properly labelled drums for disposal in accordance with the appropriate authorities in your State. Wash spillage site with copious quantities of water.

SECTION 7 HANDLING AND STORAGE

Not to be loaded with dangerous when wet substances (Class 4.3), oxidising agents (Class 5) or foodstuffs. Store in a cool, well-ventilated place out of direct sunlight. Store away from acids and combustible materials. Containers must be vented and checked regularly for leaks. Transport and store upright with vent at top. Classified as a Dangerous Good, Class 8.

SECTION 8 EXPOSURE CONTROL / PERSONAL PROTECTION

Exposure Standards:	Chlorine 1ppm. Sodium Hypochlorite decomposes to chlorine only after strong acidification. No value assigned for this specific material.
Biological limit values:	No values found for this product.
Engineering Controls:	Use in well-ventilated area. Provide local exhaust ventilation if used in a confined area.
Personal Protection:	***PPE (Personal Protective Equipment) is mandatory.*** Avoid all skin and eye contact and inhalation of vapour. Wear impervious gloves, safety glasses and apron. Safety shower should be provided in the immediate work area. Always wash hands before smoking, eating, drinking or using the toilet. Wash contaminated clothing and protective equipment before storing or re-using, as in the dry contaminated state they become more combustible.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Clear colourless to light yellow liquid
Odour:	Slight chlorine odour
pH:	12.5 – 13.5
Vapour Pressure:	Not Applicable
Vapour Density:	Data not available
Boiling Point:	Approx 100°C
Freezing/melting point:	Data not available
Solubility:	Miscible with water
Specific Gravity:	1.140 – 1.160 @ 20°C
Flash Point and Method of Detection:	Not Flammable
Flammability Limits:	Not Applicable
Ignition Temperature:	Not Applicable
Additional Information:	None

SECTION 10 STABILITY AND REACTIVITY

Chemical Stability:	Contamination of product and exposure to light and heat will accelerate decomposition.
Conditions to avoid:	Heat and oxidizing agents.
Incompatible materials:	Acids, amines, ammonium salts, aziridine, methanol, phenylacetonitrile.
Hazardous decomposition products:	Hydrogen chloride. Chlorine gas. Oxides of chlorine.
Hazardous reactions:	Contact with metals may evolve flammable hydrogen gas. Contact with acids will produce toxic chlorine gas.

SECTION 11 TOXICOLOGICAL INFORMATION

No adverse health effects expected if the product is handled in accordance with the Material Safety Data Sheet. Symptoms that may arise if the product is mishandled are:

ACUTE:

Swallowed:	May cause burns to mouth and digestive tract. May be fatal if swallowed.
Eye:	May cause burns and irreversible eye damage.
Skin:	May cause burns and allergic contact dermatitis. Harmful if absorbed though the skin.
Inhaled:	Inhalation of spray or mist may cause irritation of nose, throat and lungs.
CHRONIC:	No data available.

SECTION 12 ECOLOGICAL INFORMATION

Ecotoxicity:	Avoid contaminating waterways.
Persistence and degradability:	Product expected to degrade rapidly in the environment.
Mobility:	Product expected to degrade rapidly in the environment.
Additional information:	None

SECTION 13 DISPOSAL CONSIDERATIONS

Disposal methods:	Soak onto dry earth or other non-combustible material. Dispose of in accordance with local State and Federal regulations.
Disposal containers:	Use plastic containers.
Special Precautions:	None

SECTION 14 TRANSPORT INFORMATION

UN Number:	1791
UN Proper Shipping Name	Hypochlorite Solution
Dangerous Goods Class:	8
Subsidiary Risk:	None Allocated
Packing Group:	III
Special precautions:	None
Hazchem Code:	2X

SECTION 15 REGULATORY INFORMATION

Poisons Schedule:	5
Additional Information:	None

SECTION 16 OTHER INFORMATION

Company Disclaimer: *The information contained herein is based on data available to Water Treatment Services (Aust) Pty Ltd from technical sources and is believed to be both accurate and reliable. Since we cannot anticipate or control the different conditions under which this information and product may be used, the user should review the recommendations in the context of the intended application and confirm that they are appropriate.*

POISONS INFORMATION CENTRE – 131126

ABN: 81 008 668 371

MATERIAL SAFETY DATA SHEET

Sodium Hydroxide (32% Solution)

STATEMENT OF HAZARDOUS NATURE

Classified as hazardous according to criteria of WorkSafe Australia

COMPANY DETAILS

Company:	**CSBP Limited**
Address:	Kwinana Beach Road, Kwinana, WA 6167
Telephone Number:	(08) 9411 8777
Emergency Telephone Number:	1800 093 333 (Emergency 24 hours)

IDENTIFICATION

Product Name:	Sodium Hydroxide (32% Solution)
Other Names:	Sodium hydroxide solution, caustic soda, lye solution
Manufacturers Product Code:	1283
UN Number:	1824
Dangerous Goods Class:	8
Subsidiary Risk:	No Subsidiary Risk allocated.
HAZCHEM Code:	2 R
Packing Group:	II
Poisons Schedule Number:	6
Use:	Intermediate product of chlor-alkali processes, water treatment.

Physical Description / Properties	
Appearance:	Odourless and colourless, or grey, syrupy liquid.
Boiling Point:	120 °C
Melting Point:	Freezes at 2 °C
Vapour Pressure:	No data available
Specific Gravity:	1.35 at 20 °C
Flash Point:	No data available
Flammability Limits:	Sodium hydroxide (32% solution) is not flammable
Solubility in Water:	Miscible in all proportions.

Other Properties	
Corrosiveness:	Sodium hydroxide (32% solution) is not compatible with aluminium, copper, zinc, magnesium, tin, or their alloys (i. e., bronze, brass, galvanised metals, etc.). Flammable and explosive hydrogen gas may be generated upon contact with these metals.
Reactivity with Common Substances:	Reactive with mineral acids, organic halogens nitromethane and ammonium compounds. Dissolves readily in water giving off heat. Has a strong affinity for water.
pH of 10% solution:	Higher than 14
Solubility in organic solvents:	Slightly miscible in some organic solvents

Other Properties (Cont..)

Bulk Density:	1.35 tonne/m^3 at 20 °C
Freezing Temperature:	Freezes at 2 °C
Viscosity (dynamic)	No data available

Ingredients

Chemical Name	***CAS Number***	***Proportion (% wt / wt)***
Sodium hydroxide	1310-73-2	32.0
Sodium carbonate	497-19-8	less than 0.5
Water		Remainder

HEALTH HAZARD INFORMATION

Health Effects

Acute:	Sodium hydroxide (32% solution) will cause severe caustic burns in contact with human flesh. The severity of the burn depends on the concentration of the solution and the duration of exposure.
Swallowed:	Sodium hydroxide (32% solution) will cause severe caustic burns to the mouth, oesophagus and stomach, accompanied by severe burning sensation. Severe scarring of tissue and death may result. Symptoms include bleeding, vomiting, abdominal pain, diarrhoea and fall in blood pressure. Damage may appear days after exposure. Swallowing large amounts may cause death. LD_{50} (Oral, rat) = 312 mg/kg (Calculated from oral, rat LD_{50} of 100mg/kg for pure sodium hydroxide).
Eye:	Sodium hydroxide (32% solution), or residue from crystallised cold solution, will cause pain, severe eye burns and permanent eye damage pain following contact.
Skin:	Sodium hydroxide (32% solution) will cause severe chemical burns. Residue from crystallised cold solution, on prolonged contact, may cause some irritation, including redness and itching.
Inhaled:	Inhalation of mist, above sodium hydroxide (32% solution) may result in burns and irritation to the nose and upper respiratory tract, resulting in lesions of the nasal septum, pulmonary oedema, pneumonitis and emphysema. Symptoms may include coughing and sore throat. Inhalation of mists at elevated temperatures will increase these symptoms. Prolonged exposure may be harmful.
Chronic:	Prolonged, or repeated exposure to residue from crystallised cold solution, may cause drying of the skin with cracking and irritation that may lead to dermatitis and necrosis.

First Aid

Swallowed:	If person is conscious, rinse mouth thoroughly with water immediately and give water or milk to drink. DO NOT induce vomiting. Seek urgent medical attention.
Eye:	Immediately irrigate with copious quantities of water, while holding eyelids open, for at least 15 minutes. Seek urgent medical attention following eye contact.
Skin:	Wash affected areas with copious amounts of water. Remove all contaminated clothing whilst continuing to wash. Contaminated clothing should be laundered before re-use. Washing affected area with 1% aqueous boric acid, or vinegar if available, may be helpful. Seek urgent medical attention following skin contact.
Inhaled:	Remove affected person from exposure to a well-ventilated area. Keep warm and at rest. In emergency situations, if breathing is difficult give oxygen. If the affected person suffers cardiac arrest commence cardio-pulmonary resuscitation immediately. Seek urgent medical attention.
First Aid Facilities:	Whenever sodium hydroxide (32% solution) is in regular use ensure drinking water, safety shower/eyewash station and eye-wash bottle are available.

Advice to Doctor	Sodium hydroxide is an alkali, which on contact with flesh causes a liquefaction necrosis on proteins, and is potentially much more dangerous than acid burns. Alkali agents liquefy tissue by denaturation of proteins and saponification of fats. In contrast to acids, whose tissue penetration is limited by the formation of a coagulum, alkalis can continue to penetrate very deeply into tissue.
	Treatment for sodium hydroxide burns to eyes: • Retract eyelids to ensure thorough irrigation of the conjuctival cul-de-sacs; • Irrigate eyes with several litres of saline for at least 20 minutes; • Perform pH tests, if available, before and after each set of eye irrigations, and continue this monitoring until the pH returns to the normal range (pH 7 to 8); • DO NOT use neutralising agents or any other additives; • Evaluate completely general appearance of the globe, conjunctiva, anterior chamber and cornea, with attention to redness, pallor, or opacification, and presence of foreign bodies; • Stain with fluorescein to look for areas of increased uptake signifying corneal abrasion - a slit lamp examination may be useful. It allows for a more detailed examination of the cornea and anterior chamber, including the presence of a hyphema or hypopyon; • Verify pupillary and extraocular muscle function; • Document the visual acuity of patients with ocular exposure or complaints. Documentation should include right eye and left eye individually, then vision with both eyes; • Before administering, or prescribing, cycloplegic drops, steroid drops, or vascoconstrictive agents, one should consider consulting an ophthalmologist.
	Treatment for sodium hydroxide fumes, or mist inhalation: • Pulmonary oedema may arise. Symptoms may be delayed for several hours. Affected persons should not be left unattended for this period; • If the larynx is involved, local oedema may produce respiratory distress, stridor and a hoarse voice.
	Treatment for sodium hydroxide burns to skin: • Skin lesions require copious saline irrigation; • Treat alkali burns as thermal burns with non-adherent gauze and wrapping; • Deep second-degree burns may benefit from topical silver sulfadiazine.
	Treatment for sodium hydroxide ingestion: • Severe burns from alkali ingestion may lead to the life-threatening complications of oesophageal perforation and mediastinitis. These are associated with chest pain, dyspnoea, fever, subcutaneous emphysema of the chest or neck, and a pleural rub. Symptoms and signs associated with significant alkali-induced tissue injury include pain in the mouth and throat, drooling, pain on swallowing, vomiting, abdominal pain and haematemesis. Extensive tissue injury may be associated with fever, tachycardia, hypotension and tachypnoea; • Initial management is primarily supportive. Particular attention should be directed towards securing the airway, fluid resuscitation and provision of analgesia;

Advice to Doctor

Treatment for sodium hydroxide ingestion (Cont..)

- DO rinse any visible material from the mouth with water or saline;
- DO NOT induce vomiting, as re-exposure of the mucosa to the alkali is harmful;
- DO NOT attempt to neutralise the ingested alkali since exothermic reaction may extend the corrosive injury;
- Consider passing a naso-gastric tube;
- A chest X-ray, upright abdominal film is recommended – this may show widening of the mediastinum, pleural effusions, pneumomediastinum and / or pneumothorax. Perforation of the stomach or small intestine is associated with clinical features of chemical peritonitis, fever, abdominal tenderness, guarding and rebound, and ileus. Septic shock and multi-organ failure complicate perforation;
- DO NOT give oral fluids as these may interfere with endoscopic evaluation;
- DO NOT give oral activated charcoal as it will interfere with endoscopic evaluation;
- Inspection of the oropharynx may reveal areas of mucosal burn, which appear as white or grey patches with erythematous borders. The absence of visible burns to the lips, mouth or throat does not necessarily imply an absence of significant burns to the oesophagus;
- Tracheoesophageal fistulae may result from perforation of the anterior oesophageal wall. The fistula may extend to involve the aorta and, in this case, is fatal;
- Symptomatic patients may need the following investigations:
    - Arterial blood gas analysis;
    - Coagulation profile;
    - Complete blood count;
    - Contrast oesophagography or thoracic CT (to detect oesophageal perforation);
    - ECG;
    - Electrolytes;
    - Glucose;
    - Liver and renal function;
    - Radiological studies;
    - Chest x-ray, upright abdominal film;
    - Type and cross-match;
    - Upper gastrointestinal endoscopy should be performed as soon as practicable and within 24 hours of ingestion. This investigation is essential to assess the severity of mucosal damage and plan treatment. Upper gastrointestinal endoscopy should also be considered for asymptomatic patients who have intentionally ingested a strong alkali and children, where the history may be unreliable;
    - Early oesophagogastroscopy, by direct visualisation of the lesion with fibre optic endoscopes, is the most effective investigation for the classification of alkali burns and in planning management and follow-up.

Advice to Doctor

Treatment for sodium hydroxide ingestion (Cont..)

- Ongoing supportive care includes maintenance of adequate analgesia, fluid, electrolyte and pH balance, nutritional support, and monitoring for the development of complications.

Subsequent management and prognosis is largely dictated by findings at upper gastrointestinal tract endoscopy. These may be graded as follows:

- Grade I: Simple inflammation.
- Grade II: Few ulcerations and focal necrosis limited to part of the oesophagus.
- Grade III: Multiple ulcerations, extensive necrosis involving the entire oesophagus, massive haemorrhage.

Grade I and II lesions should heal completely with supportive care alone and can be adequately managed on a general medical ward.

Patients with Grade I lesions will usually tolerate oral fluids but those with Grade II lesions may require a period of total parenteral nutrition or a feeding jejunostomy.

Patients with Grade III endoscopic findings require intensive care management, total parenteral nutrition or a feeding jejunostomy until healing is documented, and are likely to develop oesophageal strictures.

Urgent laparotomy (without associated thoracotomy) with surgical resection of necrotic tissue and surgical repair is indicated in the presence of symptoms or signs of gastrointestinal perforation or where full thickness necrosis is found at endoscopy.

There is no clinical evidence that corticosteroids prevent the development of strictures following alkali ingestion.

Prophylactic broad-spectrum antibiotics are not indicated unless there is evidence of gastrointestinal tract perforation or full thickness necrosis.

Long Term Complications

Those patients with Grade III or circumferential Grade II burns are at risk of developing an oesophageal stricture. For this reason, these patients require follow-up evaluations that include endoscopic examination and/or contrast radiography until complete healing or stricture formation is documented. Eighty percent of strictures produce symptoms within two months. Oesophageal stricture formation requires long-term dilation or surgical repair.

Survivors of alkali ingestion are at an increased risk of developing carcinoma of the oesophagus. The average interval between the original injury and diagnosis of carcinoma is greater than 40 years.

PRECAUTIONS FOR USE

Exposure Standards:	TLV:2 g/m^3 8 hour, peak limitation.
Engineering Controls:	Use in open or well-ventilated areas.

Personal Protection

Respirator Type (AS 1716):	Where mist is a problem, use P2 type canister respirator.
Glove Type:	Avoid contact with this substance. Wear PVC gauntlet type gloves to prevent contact.
Eye Protection:	Wear chemical goggles and face shield to prevent eye and facial contact.
Clothing:	Wear PVC jacket and trousers, and alkali resistant footwear, to prevent contact.
Personal Hygiene:	Change and wash clothing and personal protection equipment if contaminated, or before storing and/or re-using. Wash hands and face thoroughly after handling and before work breaks, eating, drinking, smoking and using toilet facilities.

Flammability

Fire Hazards:	Sodium hydroxide (32% solution) is not flammable and will not support combustion. Ambient fire may liberate hazardous vapours. Flammable and explosive hydrogen gas will form when sodium hydroxide (32% solution) is in contact with copper, zinc, magnesium, tin, or their alloys (i. e., bronze, brass, galvanised metals, etc.), or aluminium. Thermal decomposition may result in sodium oxide being produced.

SAFE HANDLING INFORMATION

Storage and Transport

Location:	Store in accordance with Australian Standard AS 3780 *The storage and handling of corrosive substances*.
Storage Incompatibilities:	Store away from mineral acids, organic halogens, nitromethane and ammonium compounds. May form toxic ammonia in contact with ammonium compounds and urea. Incompatible with copper, zinc, magnesium, tin, or their alloys (i. e., bronze, brass, galvanised metals, etc.), aluminium, mineral acids, organic halogens, nitromethane and ammonium compounds.
Dangerous Goods Class:	8
Subsidiary Risk:	No Subsidiary Risk allocated.
Special Transport Requirements:	Transport in accordance with The *Australian Code for the Transport of Dangerous Goods by Road and Rail*. Transport in a clean, suitable tank that is compatible with strong caustic solutions.

Spills and Disposal

Minimising Spill / Leaks:	Shut off sodium hydroxide (32% solution) supply, if safe to do so. Shut off all possible sources of ignition.
Clean Up Spills / Leaks:	Clear area of all unprotected personnel. Contain using sand and earth, or absorbent material such as kitty litter. For small spill neutralise with sodium bicarbonate and recover. For large spills notify Fire and Rescue Services, then CSBP Emergency Response.

Spills and Disposal (Cont..)

Precautions for Clean Up Crew:	Clean up personnel must wear full protective clothing, including respiratory protection. Sodium hydroxide (32% solution) spills will cause surfaces to be slippery and slimy. Prevent run-off into drains and waterways.
Special Equipment for Clean up:	Bags of sodium bicarbonate or chemical absorbent and substantial amounts of water will be required for large spill. Sodium hydroxide (32% solution)-compatible portable pumps may be required for large spills. Portable safety shower and eyewash facility may also be needed for clean up personnel. A front-end loader may be required to scoop up sodium carbonate residue [the product of the neutralisation of sodium hydroxide (32% solution) with sodium bicarbonate].
Disposal Method:	Dispose of all contained and neutralised spill residue in accordance with Department of Environmental Protection requirements.

Fire / Explosion Hazard

Hazards of Use / Storage:	Sodium hydroxide (32% solution) is not combustible and is not considered a fire risk, but may generate flammable and explosive hydrogen gas if in contact with copper, zinc, tin magnesium, or aluminium. Hot sodium hydroxide (32% solution) can react violently with water. Avoid storage and contamination with ammonium compounds and urea as toxic ammonia gas may evolve.
List of Dangerous Decomposition or Combustion Products:	Intense heat will cause loss of water, and prolonged heat may lead to decomposition of sodium hydroxide (32% solution), giving off toxic and corrosive sodium oxide.
Fire-fighting Recommendations. Types of Extinguisher / Fire-fighting Agents:	Do not use extinguishers containing powdered MAP (mono ammonium phosphate) because of liberation of ammonia gas.
HAZCHEM Code:	2R

OTHER INFORMATION

When diluting sodium hydroxide (32% solution), always add it slowly to water - never add water to sodium hydroxide (32% solution).

CONTACT POINT

Organisation	Location	Telephone Number	Person
CSBP Limited	Kwinana, WA	(08) 9411 8730	Safety and Hygiene Advisor
Poisons Information Centre	Subiaco, WA	13 11 26	Duty Officer

IMPORTANT NOTES

1. This material safety data sheet summarises our best knowledge of the health and safety hazard information of the product and how to safely handle and use the product in the workplace. Each user should read this material safety data sheet and consider the information in the context of how the product will be handled and used in the workplace, including in conjunction with other products.
2. If clarification or further information is needed to ensure that an appropriate risk assessment can be made, the user should contact the Safety and Emergency Services Department, CSBP Limited on (08) 9411 8777.
3. Our responsibility for products sold, is subject to our terms and conditions, a copy of which is sent to our customers, and is also availableon request.
4. CSBP Limited reserves the right to make change to material safety data sheets without notice.

Disclaimer Statement

*****END OF MSDS*****

Material Safety Data Sheet

FERRIC CHLORIDE SOLUTION

Infosafe No.	AJ1L8	**Issue Date**	December 2006	**Status**	ISSUED by APSSC

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Product Name	FERRIC CHLORIDE SOLUTION
Product Code	A222
Company Name	APS, A Division of Nuplex Industries (Aust) Pty Ltd (ABN 25 000 045 572)
Address	8 Abbott Road SEVEN HILLS NSW 2147
Emergency Tel.	1800 022 037 (24H)
Telephone/Fax Number	Tel: (02) 9839 4000 Fax: (02) 9674 6225
Recommended Use	Not available.
Other Names	Not Available
Other Information	New Zealand: Asia Pacific Specialty Chemicals (NZ) Limited 119 Carbine Road Mt Wellington, Auckland 6 Emergency Tel: 0800 154 666 (24H) Telephone: (09) 276 4019 Fax: (09) 276 7231

2. HAZARDS IDENTIFICATION

Hazard Classification

Australia:
Classified as Hazardous, according to criteria of National Occupational Health & Safety Commission, Australia (NOHSC).
Classified as Dangerous Goods, according to the Australian Code for the Transport of Dangerous Goods by Road and Rail.
New Zealand:
Classified as Hazardous according to the Hazardous Substances (Classification) Regulations 2001, New Zealand.
Classified as Dangerous Goods for transport, according to the NZS 5433:1999 Transport of

Dangerous Goods on Land.
HSNO Classification:
Classified as 6.1D - A substance that is moderate acutely toxic
Classified as 6.3A - A substance that is irritating to the skin
Classified as 8.3A - A substance that is corrosive to ocular tissue
Classified as 9.3C - A substance that is harmful to terrestrial vertebrates

Risk Phrase(s)

R22 Harmful if swallowed.
R34 Causes burns.

Safety Phrase (s)

S28 After contact with skin, wash immediately with plenty of water.
S7/8 Keep container tightly closed and dry.
S24/25 Avoid contact with skin and eyes.
S36/37/39 Wear suitable protective clothing, gloves and eye/face protection.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredients	**Name**	**CAS**	**Proportion**
	Iron (III) chloride	7705-08-0	60-100 %
	Ingredients deemed not to be hazardous		Balance

4. FIRST AID MEASURES

Inhalation Remove the source of contamination or move the victim to fresh air. Ensure airways are clear and have qualified person give oxygen through a face mask if breathing is difficult. Seek medical attention.

Ingestion DO NOT INDUCE VOMITING. Wash out mouth with water. Seek immediate medical attention.

Skin Wash affected area thoroughly with copious amounts of running water. Remove contaminated clothing and wash before reuse or discard. Seek medical attention.

Eye If contact with the eye(s) occurs, wash with copious amounts of water holding eyelid(s) open. Take care not to rinse contaminated water into the non-affected eye. Seek immediate medical attention.

First Aid Facilities Eye wash station, safety shower and normal washroom facilities.

Advice to Doctor Treat symptomatically.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media Water spray, dry chemical, carbon dioxide or appropriate foam.

Hazards from Combustion Products Under fire conditions this product may emit toxic and/or irritating fumes.

Specific Hazards	Can liberate (flammable) hydrogen gas upon contact with most metals. If safe to do so, remove containers from the path of the fire.
Hazchem Code	2Z
Precautions in connection with Fire	Full protective clothing and self-contained breathing apparatus.

6. ACCIDENTAL RELEASE MEASURES

Emergency Procedures	Wear appropriate personal protective equipment and clothing to minimise exposure. Avoid any inhalation, skin or eye contact. Extinguish or remove all sources of ignition and stop leak if safe to do so. Increase ventilation. Evacuate all unnecessary personnel. If possible contain the spill. Place inert absorbent material onto spillage. Collect the material and place into a suitable labelled container. Do not dilute material but contain. Dispose of waste according to federal, Environmental Protection Authority and state regulations. If the spillage enters the waterways contact the Environmental Protection Authority, or your local Waste Management Authority.

7. HANDLING AND STORAGE

Precautions for Safe Handling	Use in a well ventilated area. DO NOT store or use in confined spaces. Build up of mists or vapours in the atmosphere must be prevented. Avoid breathing in spray or mists or vapours. Any exposure without protection must be prevented in order to lessen the possibility of disorders.
Conditions for Safe Storage	Store in a cool, dry well-ventilated area away from extremes of temperature and away from incompatible materials. Keep containers tightly closed when not in use and securely sealed and protected against physical damage. Inspect regularly for deficiencies such as damage or leaks.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

National Exposure Standards	No exposure standards have been established for this material by the Australian National Occupational Health & Safety Commission (NOHSC) or the Occupational Safety and Health Service (OSH) of the New Zealand Department of Labour.
Engineering Controls	Use with good general ventilation. If mists or vapours are produced local exhaust ventilation should be used.
Respiratory Protection	If engineering controls are not effective in controlling airborne exposure then respiratory protective equipment should be used suitable for protecting against airborne contaminants. Final choice of appropriate breathing protection is dependant upon actual airborne concentrations and the type of breathing protection required will vary according to individual circumstances. Expert advice may be required to make this decision. 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.
Eye Protection	Safety glasses with side shields, goggles or full-face shield as appropriate recommended. Final choice of appropriate eye/face protection will vary according to individual circumstances i.e. methods of handling or engineering controls and according to risk assessments undertaken. Eye protection should conform with Australian/New Zealand Standard AS/NZS 1337 - Eye Protectors for Industrial Applications.
Hand Protection	Wear gloves of impervious material. Final choice of appropriate gloves will vary according to individual circumstances i.e. methods of handling or according to risk assessments undertaken. Reference should be made to AS/NZS 2161.1: Occupational protective gloves - Selection, use and maintenance.

Body Protection	Suitable workwear should be worn to protect personal clothing, eg cotton overalls buttoned at neck and wrist. When large quantities are handled the use of plastic aprons and rubber boots is recommended.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Dark brown liquid.
Odour	Not available.
Melting Point	Not available.
Boiling Point	Not available.
Solubility in Water	Soluble.
Specific Gravity	Not available.
pH Value	Not available.
Vapour Pressure	Not available.
Vapour Density (Air=1)	Not available.
Flash Point	Not applicable.
Flammable Limits - Lower	Not available.
Flammable Limits - Upper	Not available.

10. STABILITY AND REACTIVITY

Chemical Stability	Stable under normal use conditions.
Conditions to Avoid	Extremes of temperature and direct sunlight.
Incompatible Materials	Metals, strong oxidising agents, allyl chloride, potassium, sodium, epichlorohydrin.
Hazardous Decomposition Products	Thermal decomposition may result in the release of toxic and/or irritating fumes including hydrogen chloride, chlorine.
Hazardous Polymerization	Will not occur.

11. TOXICOLOGICAL INFORMATION

Toxicology Information	Acute toxicity: (Ferric chloride). LD50 ORAL (rat): 316 mg/kg
Inhalation	Inhalation of mists or vapours will result in respiratory irritation and possible harmful corrosive effects including lesions of the nasal septum, pulmonary edema, pneumonitis and emphysema.
Ingestion	Harmfull if swallowed. Ingestion of this product may cause nausea, vomiting, abdominal pain and chemical burns to the mouth, throat and stomach.
Skin	Skin contact will cause redness, itching, irritation, severe pain and chemical burns with resultant tissue destruction.
Eye	Eye contact will cause stinging, blurring, tearing, severe pain and possible permanent corneal damage
Chronic Effects	Not available.

12. ECOLOGICAL INFORMATION

Ecotoxicity	Not available.
Persistence / Degradability	Not available.
Mobility	Not available.
Information on Ecological Effects	LC50 (fish): 6 mg/L 24-96hr, static bioassay (as iron). Water flea (daphnia): TLm: 15 ppm 96hr, fresh water.
Environment Protection	Do not allow product to enter drains, waterways or sewers.

13. DISPOSAL CONSIDERATIONS

Disposal Considerations	Dispose of waste according to federal, EPA and state regulations.

14. TRANSPORT INFORMATION

Transport Information

Australia:
This material is classified as a Class 8 (Corrosive) Dangerous Good according to the Australian Code for the Transport of Dangerous Goods by Road and Rail. Dangerous goods of Class 8 (Corrosive) are incompatible in a placard load with any of the following:
- Class 1, Explosive
- Class 4.3, Dangerous When Wet Substance
- Class 5.1, Oxidising Agent
- Class 5.2, Organic Peroxide
- Class 6, Toxic and Infectious Substances, if the Class 6 dangerous goods are cyanides and the Class 8 dangerous goods are acids
- Class 7, Radioactive Substance

and are incompatible with food and food packaging in any quantity.
New Zealand:
This material is classified as a Class 8 - Corrosive Substance according to NZS 5433:1999 Transport of Dangerous Goods on Land.
Must not be loaded in the same freight container or on the same vehicle with:
- Class 1, Explosives

- Class 5.1, Oxidising substances
- Class 5.2, Organic peroxides
- Class 7, Radioactive materials unless specifically exempted

And are incompatible with food and food packaging in any quantity.
Note 1; Cyanides (Class 6.1) must not be loaded in the same freight container or on the same vehicle with acids (Class 8).
Note 2; Strong acids must not be loaded in the same freight container or on the same vehicle with strong alkalis. Packing Group I and II acids and alkalis should be considered as strong.
Must not be loaded with in the same freight container; and on the same vehicle must be separated horizontally by at least 3 metres unless all but one are packed in separate freight containers with:

- Class 4.3, Dangerous when wet substances

Goods of packing group II or III may be loaded in the same freight container or on the same vehicle if transported in segregation devices with:

- Class 4.3, Dangerous when wet substances
- Class 5.1, Oxidising substances
- Class 5.2, Organic peroxides

And are incompatible with food and food packaging in any quantity.

U.N. Number	2582
Proper Shipping Name	FERRIC CHLORIDE SOLUTION
DG Class	8
Hazchem Code	2Z
Packaging Method	3.8.8
Packing Group	III
EPG Number	8A1
IERG Number	37

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15. REGULATORY INFORMATION

Regulatory Information	Australia: Classified as hazardous according to criteria of National Occupational Health & Safety Commission (NOHSC). Poison Schedule: Not scheduled.
Poisons Schedule	Not Scheduled
National and or International Regulatory Information	New Zealand: Classified as Hazardous according to the Hazardous Substances (Classification) Regulations 2001. Approval code: TRS06002
Hazard Category	Harmful,Corrosive

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16. OTHER INFORMATION

Date of

preparation or last revision of MSDS	MSDS Reviewed: December 2006 MSDS Created: October 2002
Contact Person/Point	Australia: Business Hours: Mr Paul Verren Telephone: (02) 9839 4024 Emergency Tel: 1800 022 037 New Zealand: Business Hours: Mr Lloyd Williams Telephone: (09) 276 4019 Emergency Tel: 0800 154 666 IMPORTANT ADVICE: This MSDS summarizes our best knowledge of the health and safety hazard information of the product and how to safely handle and use the product in the workplace. Each user should read this MSDS and consider the information in the context of how the product will be handled and used in the workplace including its use in conjunction with other products. If clarification or further information is needed to ensure that an appropriate risk assessment can be made, the user should contact Nuplex Industries (Aust) Pty Ltd. Our responsibility for products sold is subject to our standard terms and conditions, a copy of which is sent to our customers and is also available on request.

End of MSDS

Material Safety Data Sheet

PRODUCT NAME **AQUEOUS AMMONIA SOLUTIONS (10 - 35%)**

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Supplier Name	**INCITEC PIVOT LIMITED**
Address	70 Southbank Boulevard, Southbank, Victoria, AUSTRALIA, 3006
Telephone	(03) 8695 4400
Fax	(03) 8695 4419
Emergency	1800 033 111 (All Hours)
Web Site	http://www.incitecpivot.com.au
Synonym(s)	AQUA AMMONIA • AMMONIUM HYDROXIDE SOLUTION • AMMONIA LIQUOR • AMMONIA SCRUBBER LIQUOR • BIG N SCRUBBER LIQUOR • AQUEOUS AMMONIA • 20040 - PRODUCT CODE
Use(s)	CATALYST • CHEMICAL REAGENT • FERTILISER • NEUTRALISING AGENT

2. HAZARDS IDENTIFICATION

CLASSIFIED AS HAZARDOUS ACCORDING TO NOHSC CRITERIA

RISK PHRASES

R34 Causes burns.
R37 Irritating to respiratory system.
R41 Risk of serious damage to eyes.
R50 Very toxic to aquatic organisms.

SAFETY PHRASES

S23 Do not breathe gas/fumes/vapour/spray (where applicable).
S24/25 Avoid contact with skin and eyes.
S26 In case of contact with eyes, rinse immediately with plenty of water and contact a doctor or Poisons Information Centre.
S36/37/39 Wear suitable protective clothing, gloves and eye/face protection.
S45 In case of accident or if you feel unwell, contact a doctor or Poisons Information Centre immediately (show the label where possible).

CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE

UN No.	2672	**Hazchem Code**	2R	**Pkg Group**	III
DG Class	8	**Subsidiary Risk(s)**	None Allocated	**EPG**	8A1

3. COMPOSITION / INFORMATION ON INGREDIENTS

Ingredient	Formula	Conc.	CAS No.
AMMONIUM HYDROXIDE	NH_4-OH	10-35%	1336-21-6
WATER	H_2O	65-90%	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	Quickly remove from exposure. Remove contaminated clothing and check that there is no obstruction to the airway. If breathing is weak or has ceased and give artificial respiration. Further treatment should be symptomatic and supportive. Consult doctor and recommend admission to hospital for observation.
Skin	Remove contaminated clothing and gently flush affected areas with water. Launder clothing before reuse.
Ingestion	DO NOT induce vomiting. Immediately wash out mouth with water, and then give water to drink. Seek medical attention.

5. FIRE FIGHTING MEASURES

Flammability	Non flammable. May evolve toxic gases when heated to decomposition. Contact with some metals (eg: aluminium), may liberate potentially flammable - explosive hydrogen gas. May form explosive compounds with mercury, halogens and hypochlorites.
Fire and Explosion	Non flammable. 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	2R

6. ACCIDENTAL RELEASE MEASURES

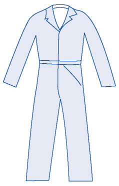
Spillage	If spilt (bulk), contact emergency personal if appropriate. Wear splash-proof goggles, PVC/rubber gloves, coveralls and boots. Where an inhalation risk exists, wear a Type K (Ammonia) respirator. Prevent spill entering drains or waterways. Absorb spill with sand or similar and place in sealable containers for disposal. Potentially toxic to aquatic life. Caution: slippery when wet.

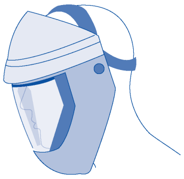
7. STORAGE AND HANDLING

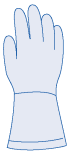
Storage	Store in cool, dry, well ventilated area, removed from oxidising agents (eg. hypochlorites), acids (eg sulphuric acid), heat sources and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use. Check regularly for leaks or spills. Large storage areas should have appropriate ventilation systems. Also store removed from mercury, halogens, hypochlorites and silver salts.
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.

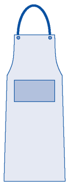
8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Ventilation	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.
Exposure Standards	AMMONIUM HYDROXIDE (1336-21-6) ES-STEL : 35 ppm (27 mg/m3) as Ammonia ES-TWA: 25 ppm (18 mg/m3) as Ammonia
PPE	Wear a faceshield, coveralls, rubber gloves, PVC boots and a PVC apron. Where an inhalation risk exists, wear a Type K (Ammonia) Respirator. If spraying, with prolonged use, or if in confined areas, wear an Air-line respirator.









9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	CLEAR COLOURLESS LIQUID	**Solubility (water)**	SOLUBLE
Odour	STRONG PUNGENT ODOUR	**Specific Gravity**	0.88 - 0.92
pH	11.6 (1% Aqueous solution)	**% Volatiles**	100 %
Vapour Pressure	356.8 - 543.0 mmHg @ 20 C	**Flammability**	NON FLAMMABLE
Vapour Density	0.6 (Air = 1)	**Flash Point**	NOT AVAILABLE
Melting Point	NOT AVAILABLE	**Upper Explosion Limit**	25 %
Boiling Point	37 C (25% Solution)	**Lower Explosion Limit**	16 %
Evaporation Rate	NOT AVAILABLE	**Autoignition Temperature**	NOT AVAILABLE

10. STABILITY AND REACTIVITY

Reactivity Incompatible with oxidising agents (eg. peroxides), acids (eg. sulphuric acid), active metals (eg. aluminium, potassium, magnesium), and heat and ignition sources. Also incompatible with mercury, halogens, hypochlorites, and silver salts.

Decomposition May evolve toxic gases when heated to decomposition.

11. TOXICOLOGICAL INFORMATION

Health Hazard Summary Highly corrosive - severe irritant. This product has the potential to cause acute and chronic health effects. Use safe work practices to avoid eye or skin contact and vapour-mist generation. Upon dilution the potential for corrosive effects-possible tissue damage is reduced. Ammonia gas evolved from solution is a strong eye and upper respiratory tract irritant, avoid exposure.

Eye Highly corrosive - severe irritant. Contact may result in pain, lacrimation, redness, conjunctivitis, corneal burns and ulceration with possible permanent damage.

Inhalation Corrosive. Over exposure may result in mucous membrane irritation of nose and throat, coughing and bronchitis. At high levels; ulceration of the respiratory tract, lung damage, chemical pneumonitis and pulmonary oedema.

Skin Highly corrosive. Contact may result in severe irritation, ulceration and burns with dermatitis. Prolonged contact may result in severe, slow healing burns.

Ingestion Highly corrosive. Ingestion may result in burns to the mouth and throat, nausea, vomiting and abdominal pain. Large doses may result in ulceration, unconsciousness, convulsions and death.

Toxicity Data AMMONIUM HYDROXIDE (1336-21-6)
LD50 (Ingestion): 350 mg/kg (rat)

12. ECOLOGICAL INFORMATION

Environment ATMOSPHERE: Ammonia is readily returned to the soil by washout from rain. SOIL: Ammonia is strongly adsorbed to the soil. WATER: Rapidly converted to nitrates resulting in an increase in the pH of water and an oxygen demand (BOD) several days after the introduction of ammonia. Highly toxic to fish - levels of 1 ppm in water may be fatal to some species. Avoid contaminating waterways. Fertilisers, particularly those containing nitrogen and/or phosphorus, can stimulate weed and algal growth in static surface waters. Nitrogen fertilisers may contain or form nitrate which can contaminate surface and ground-water. High nitrate concentrations may render the water unsuitable for human and livestock consumption.

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 BY THE CRITERIA OF THE ADG CODE

Shipping Name AMMONIA SOLUTION, relative density between 0.880 and 0.957 at 15 C in water, with more than 10 % but not more than 35 % ammonia

UN No.	2672	**DG Class**	8	**Subsidiary Risk(s)**	None Allocated
Pkg Group	III	**Hazchem Code**	2R	**EPG**	8A1

IATA

Shipping Name AMMONIA SOLUTION, relative density between 0.880 and 0.957 at 15 C in water, with more than 10 % but not more than 35 % ammonia

UN No.	2672	**DG Class**	8	**Subsidiary Risk(s)**	None Allocated
Pkg Group	III				

IMDG

Shipping Name AMMONIA SOLUTION, relative density between 0.880 and 0.957 at 15 C in water, with more than 10 % but not more than 35 % ammonia

UN No.	2672	**DG Class**	8	**Subsidiary Risk(s)**	None Allocated
Pkg Group	III				

15. REGULATORY INFORMATION

Poison Schedule Classified as a Schedule 6 (S6) Poison 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:
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

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Web: www.rmt.com.au

MSDS Date: 01 November 2006

End of Report

MATERIAL SAFETY DATA SHEET

AP-20

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1. PRODUCT IDENTIFICATION

TRADE NAME:	**AP-20**
Use:	A drilling fluid additive
Description:	Water Treatment Scale Preventer
Supplier Name:	Fluidstar (Pty) Ltd
Address:	Unit 3/No. 1 General McArthur Place Redbank Qld 4301
Telephone:	+ 61(0) 7 3288 4480, email: info@fluidstar.com.au
Emergency Contact:	+61 400 195 406

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2. HAZARDS IDENTIFICATION

NOT CLASSIFIED DANGEROUS GOODS ACCORDING TO THE CRITERIA OF THE ADG CODE FOR TRANSPORT.

HAZARD CLASS:	None
RISK PHRASE:	None
SAFETY PHRASES:	None

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3. COMPOSITION / INFORMATION ON INGREDIENTS

Ingredient	CAS #	Concentration
Water		Balance
Scale Preventer	Not available	0-10%
Alkali salts	1310-58-3	0-10%

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4. FIRST AID INFORMATION

FIRST AID

SWALLOWED:	If swallowed, DO NOT induce vomiting. Give a glass of water to drink and seek medical advice.
EYE:	If in eyes, hold eyes open, flood with water for at least 15 minutes and see a doctor urgently.
SKIN:	If skin contact occurs, remove contaminated clothing and wash skin thoroughly. Wash clothing before reuse.
INHALED:	Remove victim from exposure if safe to do so. Remove contaminated clothing and loosen remaining clothing. Allow patient to assume a comfortable position and keep warm. Seek medical assistance if symptoms persist.

5. FIRE FIGHTING MEASURES

FLAMMABILITY: This product is not combustible. Fire fighters to wear self-contained breathing apparatus in the event of a fire. Use water fog, or fine spray mist to extinguish.

6. ACCIDENTAL RELEASE MEASURES

SPILLS AND DISPOSAL: Spills may be slippery. Remove non-essential personnel from the area. Ensure that any other products of incompatible classes near the spill are removed. Dam and recover if possible. Prevent entry into drainage systems, sewers and waterways. Collect with inert absorbent material such as sand or earth. Dilute well with water before disposal. Consult Local Authority on disposal.

7. HANDLING AND STORAGE

HANDLING: Not classified Dangerous Goods for storage. When not being used, the product containers should be stored upright, and secured with the original closure. If transfer to another container becomes necessary, ensure that the container is clearly labelled, the container is of a type suitable for the product, and is clean and free of other materials. Do not eat, drink or smoke in contaminated areas. Before eating, drinking or smoking, remove contaminated clothing and wash hands.

DISPENSING: Always use clean and dry equipment to dispense the product. Containers should be cleaned before and after use. All dispensers should be washed out after use.

FLAMMABILITY: Non-combustible material.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE STANDARDS: There are no exposure standards available for this product. Worksafe Australia has no standard set.

PERSONAL PROTECTIVE EQUIPMENT: Use sensible work practices that reduce operator exposure to the product. Protective clothing and equipment should be worn: Respiratory protection should be used if there is a risk of exposure to high vapour concentrations. Respirators should comply with AS1716 or an equivalent approved by a state/territory authority.

ENGINEERING CONTROLS:	Ensure that adequate ventilation is provided. Maintain air concentrations below recommended exposure standards. Avoid generating and inhaling mists. Keep containers closed when not in use.

9. PHYSICAL AND CHEMICAL PROPERTIES

COLOUR:	Blue
FORM:	Liquid
ODOUR:	Mild
pH at 20°C	7.0 – 7.51
BOILING POINT:	Approx 100ºC
MELTING POINT:	Not applicable
SOLUBILITY IN WATER:	Soluble
SPECIFIC GRAVITY at 20°C:	1.15 g/cm^3
SELF-INFLAMMABILITY:	Product is not self-igniting

10. STABILITY AND REACTIVITY

CONDITIONS TO BE AVOIDED:	No decomposition if used according to specifications.
MATERIALS TO BE AVOIDED:	Reacts with acids ·
DANGEROUS PRODUCTS OF DECOMPOSITION:	None, if storage and handling is done according to specification.

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11. TOXICOLOGY INFORMATION

HEALTH EFFECTS
ACUTE:

Swallowed:	May cause irritation and minor discomfort.
Eye:	May cause irritation, reddening of the eyes.
Skin:	May cause irritation and lead to dermatitis.
Inhaled:	Inhalation of vapour may cause irritation of the respiratory tract and nasal passages.
Chronic*:*	No long term exposure effects are known*.*

12. ECOLOGICAL INFORMATION

ECOTOXICITY:	Concentrated product may harm environment. Dilute well with water before disposal as per Local Authority regulations.

13. DISPOSAL REGULATIONS

DISPOSAL METHODS: In accordance with Local, State and Federal regulations. Dilution is the preferred method of disposal.

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14. TRANSPORT INFORMATION

PRODUCT IS NOT REGULATED DURING TRANSPORTATION

UN NUMBER:	None allocated		
SHIPPING NAME:	None allocated	**DANGEROUS GOODS CLASS:**	None allocated
HAZCHEM CODE:	None allocated	**SUBSIDIARY RISK:**	None allocated
PACKAGING GROUP:	None allocated	**EPG NUMBER:**	None allocated

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15. REGULATORY INFORMATION

POISONS SCHEDULE: None allocated
AICS: All chemicals listed on the Australian Inventory of Chemical Substances.

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16. OTHER INFORMATION

Date of Preparation: Issue Date 20-Oct-05
Last Revision: Revised 17 June 2007

CONTACT POINTS

ORGANISATION	TELEPHONE
Poisons Information Centre –Australia Wide	131126
Fluidstar	+61 7 3288 8485 0400 195 406
Fire Brigade	000
Police	000

Disclaimer:

Every endeavor has been made to ensure that the information contained in this publication is reliable and offered in good faith. It is meant to describe the safety requirements of our products and should not be construed as guaranteeing specific properties. Customers are encouraged to conduct their own tests as end user suitability of the product for particular uses is beyond our control. The information is not intended as an inducement to bargain and no warranty expressed or implied is made as to its accuracy, reliability or completeness. FLUIDSTAR Pty Ltd accepts no liability for loss, injury or damage arising from reliance upon the information contained in this data sheet except in conjunction with the proper use of the product to which it refers. Due care should be taken that the use and disposal of this product is in compliance with appropriate Federal, State and Local Government regulations.

END OF MSDS

Material Safety Data Sheet

Prepared by Chem Alert

Product Name **AS1800**

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Supplier Name	QED OCCTECH SERVICES PTY LTD (ABN 41 009 200 211)
Address	88 Welshpool Road, WELSHPOOL WA, 6106, AUSTRALIA
Telephone	+61 8 9416 0500
Fax	+61 8 9361 8564
Email / Web	info@qedocctech.com
Synonyms	AS 1800, OCCTECH AS1800, OE AS1800.
Uses	SCALE REMOVER, SCALE INHIBITOR.

2. HAZARDS IDENTIFICATION

CLASSIFIED AS HAZARDOUS ACCORDING TO NOHSC CRITERIA
CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE

3. COMPOSITION / INFORMATION ON INGREDIENTS

Ingredient	Formula	Conc.	CAS No.
WATER	H_2O	<2%	7732-18-5
ADDITIVES		Not Available	Not Available
POLYCARBOXYLIC ACID		Not Available	Not Available

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. Seek medical attention if irritation develops.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor.

Advice To Doctor Treat symptomatically.

5. FIRE FIGHTING MEASURES

Flammability Non flammable. No fire or explosion hazard exists.

Fire and Explosion Non flammable. 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 if appropriate. Wear splash-proof goggles, PVC/rubber gloves, a Type B (Inorganic and acid gas) respirator (where an inhalation risk exists), 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.

Colour Rating AMBER

7. HANDLING AND STORAGE

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 (eg. if container is damaged).

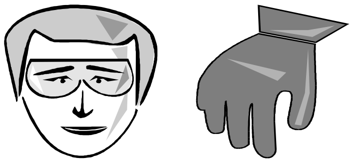
Storage Store in cool, dry, well ventilated area, out of direct sunlight and out of the reach of children, removed from oxidising agents, alkalis and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Ventilation Use with adequate natural ventilation. Open windows and doors where possible. In poorly ventilated areas, mechanical extraction ventilation is recommended.

Exposure Standards An exposure standard (ES-TWA, ES-STEL, WES-TWA, ES-PEAK, ES-TLV) has not been allocated to the ingredients contained in this product.

PPE Wear splash-proof goggles and PVC or rubber gloves. When using large quantities or where heavy contamination is likely, wear coveralls. Where an inhalation risk exists, wear a Type B (Inorganic and Acid gas) Respirator. In a laboratory situation, wear a laboratory coat.



9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance: CLEAR COLOURLESS LIQUID (20L, 200L & 1000L CONTAINERS)
Odour: SLIGHT ODOUR
pH: NOT AVAILABLE
Vapour Pressure: NOT AVAILABLE
Vapour Density: NOT AVAILABLE
Boiling Point: 100 - 102 C
Melting Point: -5 - 0 C
Evaporation Rate: NOT AVAILABLE
Solubility (water): SOLUBLE
Specific Gravity: 1.10 - 1.15
% Volatiles: NOT AVAILABLE
Flammability: NON FLAMMABLE
Flash Point: NOT RELEVANT
Upper Explosion Limit: NOT RELEVANT
Lower Explosion Limit: NOT RELEVANT
Autoignition Temperature: NOT AVAILABLE
Decomposition Temperature: > 200 C

10. STABILITY AND REACTIVITY

Reactivity Incompatible with oxidising agents (eg. hypochlorites, peroxides) and alkalis (eg. hydroxides).

Decomposition Products May evolve toxic gases if heated to decomposition.

11. TOXICOLOGICAL INFORMATION

Health Hazard Summary Slightly corrosive. This product has the potential to cause adverse health effects with eye contact or prolonged skin contact. Due to the low vapour pressure of this product an inhalation hazard is not anticipated with normal use. Use

11. TOXICOLOGICAL INFORMATION cont.

safe work practices to avoid direct eye or skin contact and vapour/ mist generation-inhalation.

Eye Slightly corrosive - irritant. Exposure may result in lacrimation, pain, redness and possible corneal burns with prolonged contact.

Inhalation Slightly corrosive - irritant. Over exposure at high levels may result in mucous membrane irritation of the nose and throat with coughing. Due to the low vapour pressure of this product an inhalation hazard is not anticipated with normal use.

Skin Slightly corrosive - irritant. Prolonged and repeated contact may result in irritation, skin rash, dermatitis, blisters and burns.

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

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 the protective equipment detailed above, neutralise to pH 6-8 by SLOW addition to a saturated sodium bicarbonate solution or similar basic solution. Dilute with excess water and flush to drain. Waste disposal should only be undertaken in a well ventilated area.

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

Transport Class 8 Corrosive. Do not transport with chemicals of class; 1 (Explosives), 4.3 (Dangerous When Wet), 5.1 (Oxidising agents), 5.2 (Organic peroxides), 6 (Toxics - where the Toxic is a cyanide and the Corrosive is an acid), 7 (Radioactives), 8 (where products are acid/alkali) and foodstuffs.

UN Number	1760
Shipping Name	CORROSIVE LIQUID, N.O.S.
DG Class	8
Subsidiary Risk(s)	None Allocated
Packing Group	III
Hazchem Code	2X

15. REGULATORY INFORMATION

AICS All chemicals listed on the Australian Inventory of Chemical Substances (AICS).

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).

16. OTHER INFORMATION

Additional Information ACIDS: When mixing acids with water (diluting), caution must be taken as heat will be generated which causes violent spattering. Always add a small volume of acid to a large volume of water, NEVER the reverse.

Colour Rating AMBER

16. OTHER INFORMATION cont.

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:
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.
COLOUR RATING SYSTEM: Chem Alert reports are assigned a colour rating of Green, Amber or Red for the purpose of providing users with a quick and easy means of determining the hazardous nature of a product. Safe handling recommendations are provided in all Chem Alert reports so as to clearly identify how users can control the hazards and thereby reduce the risk (or likelihood) of adverse effects. As a general guideline a Green colour rating indicates a low hazard, an Amber colour rating indicates a moderate hazard and a Red colour rating indicates a high hazard.

Report Reviewed 1st January 2006

Date Printed 11th April 2006

Report Status Chem Alert reports are compiled as an independent source of information by RMT's scientific department. The information is based on the latest chemical and toxicological research, and in compliance with relevant standards, guidance notes and legislation (where applicable). The Chem Alert report is not intended as a replacement to the manufacturer's original MSDS that is provided to Chem Alert subscribers for convenience. In many instances, Chem Alert reports are compiled on behalf of manufacturers, in which case they serve as the "Manufacturer's MSDS" and are clearly identified as such on the relevant reports.

Prepared By

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Fax: +61 8 9322 1794
Web: www.rmt.com.au

Colour Rating AMBER

Material Safety Data Sheet

1 . Identification of the material and supplier

Product name	**BP Ultimate Diesel**
SDS #	0000002790
Historic SDS#:	None.
Product use	Fuel for compression ignition diesel engines.
Supplier	BP Australia Pty Ltd (ABN 53 004 085 616) Melbourne Central, 360 Elizabeth Street, Melbourne, Victoria 3000, Australia Tel: +61 (03) 9268 4111 Fax: +61 (03) 9268 3321
EMERGENCY TELEPHONE NUMBER	1800 638 556
Product code	0000002790

2 . Hazards identification

Statement of hazardous/dangerous nature	HAZARDOUS SUBSTANCE. NON-DANGEROUS GOODS.
Risk phrases	R40- Limited evidence of a carcinogenic effect.
Safety phrases	S2- Keep out of the reach of children. S24- Avoid contact with skin. S36/37- Wear suitable protective clothing and gloves. S61- Avoid release to the environment. Refer to special instructions/safety data sheet. S62- If swallowed, do not induce vomiting: seek medical advice immediately and show this container or label.

3 . Composition/information on ingredients

Ingredient name	**CAS no.**	**%**
Fuels, diesel	68334-30-5	50 - 100

Contains small quantities of polycyclic aromatic hydrocarbons (PAHs).

4 . First-aid measures

Eye contact	In case of contact, immediately flush eyes with a copious amount of water for at least 15 minutes. Get medical attention if irritation occurs.
Skin contact	In case of contact, immediately flush skin with plenty of water. Remove contaminated clothing and shoes. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention if irritation develops.
Inhalation	If inhaled, remove to fresh air. Get medical attention if symptoms appear.
Ingestion	Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately.
Notes to physician	Product can be aspirated on swallowing or following regurgitation of stomach contents, and can cause severe and potentially fatal chemical pneumonitis, which will require urgent treatment. Because of the risk of aspiration, induction of vomiting and gastric lavage should be avoided. Gastric lavage should be undertaken only after endotracheal intubation. Monitor for cardiac dysrhythmias. Note: High Pressure Applications Injections through the skin resulting from contact with the product at high pressure constitute a major medical emergency. Injuries may not appear serious at first but within a few hours tissue becomes swollen, discoloured and extremely painful with extensive subcutaneous necrosis. Surgical exploration should be undertaken without delay. Thorough and extensive debridement of the wound and underlying tissue is necessary to minimise tissue loss and prevent or limit permanent damage. Note that high pressure may force the product considerable distances along tissue planes.

5 . Fire-fighting measures

Extinguishing Media	
Suitable	In case of fire, use water fog, foam, dry chemical or carbon dioxide extinguisher or spray.
Not Suitable	Do not use water jet.
Hazards from combustion products	These products are carbon oxides (CO, CO_2) (carbon monoxide, carbon dioxide) . Other hazardous substances.
Unusual fire/explosion Hazards	Combustible liquid and vapour. Vapour may cause flash fire. Vapours may accumulate in low or confined areas, travel a considerable distance to a source of ignition and flash back. Runoff to sewer may create fire or explosion hazard.
Special fire-fighting procedures	DO NOT FIGHT FIRE WHEN IT REACHES MATERIAL. Withdraw from fire and let it burn. Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. First move people out of line-of-sight of the scene and away from windows. Do not use water jet.
Protection of fire-fighters	Fire-fighters should wear self-contained positive pressure breathing apparatus (SCBA) and full turnout gear.

6 . Accidental release measures

Emergency Procedures	Immediately contact emergency personnel. Keep unnecessary personnel away. Vapours are heavier than air and may spread along floors. Use suitable protective equipment (See Section: "Exposure controls/personal protection"). Follow all fire fighting procedures (See Section: "Fire-fighting measures").
Methods and materials for containment and clean-up	If emergency personnel are unavailable, contain spilled material. For small spills add absorbent (soil may be used in the absence of other suitable materials) scoop up material and place in a sealed, liquid-proof container for disposal. For large spills dike spilled material or otherwise contain material to ensure runoff does not reach a waterway. Place spilled material in an appropriate container for disposal. Avoid contact of spilt material with soil and prevent runoff entering surface waterways. See Section 13 for Waste Disposal Information.
Personal protection in case of a large spill	Splash goggles. Full suit. Boots. Gloves. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

7 . Handling and storage

Handling	Avoid breathing vapours or spray mists. Use only with adequate ventilation. Keep away from heat, sparks and flame. To avoid fire or explosion, dissipate static electricity during transfer by earthing and bonding containers and equipment before transferring material. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Avoid contact of spilled material and runoff with soil and surface waterways. Wash thoroughly after handling. Never siphon by mouth. When using do not eat, drink or smoke.
Storage	Keep container tightly closed. Keep container in a cool, well-ventilated area. Store and use only in equipment/containers designed for use with this product. Empty packages may contain some remaining product. Hazard warning labels are a guide to the safe handling of empty packaging and should not be removed. Do not enter storage tanks without breathing apparatus unless the tank has been well ventilated and the tank atmosphere has been shown to contain hydrocarbon vapour concentrations of less than 1% of the lower flammability limit and an oxygen concentration of at least 20% volume. Always have sufficient people standing by outside the tank with appropriate breathing apparatus and equipment to effect a quick rescue.
Combustibility Classification	Combustible liquid Class C1 (AS 1940).
Additional information- Storage	Light hydrocarbon vapours can build up in the headspace of tanks. These can cause flammability/explosion hazards even at temperatures below the normal flash point (note: flash point must not be regarded as a reliable indicator of the potential flammability of vapour in tank headspaces). Tank headspaces should always be regarded as potentially flammable and care should be taken to avoid static electrical discharge and all ignition sources during filling, ullaging and sampling from storage tanks. Will present a flammability hazard if heated above flash point but bulk liquids at normal storage temperatures will present virtually no fire hazard. If fuel contacts hot surfaces, or leaks from high pressure fuel pipes, the vapour and/or mists generated will create a flammability or explosion hazard. Product contaminated rags, paper or material used to absorb spillages, represent a fire hazard, and should not be allowed to accumulate. Dispose of safely immediately after use. Empty containers represent a fire hazard as they may contain flammable product residues and vapour. Never weld, solder or braze empty containers. To avoid fire, eliminate ignition sources.

8 . Exposure controls/personal protection

Ingredient name	Occupational exposure limits
Fuels, diesel	**ACGIH TLV (United States, 1/2007). Skin** TWA: 100 mg/m^3, (Measured as total hydrocarbons) 8 hour(s). Form: Total hydrocarbons

Where there are no regulatory exposure limits, for information and guidance, the ACGIH values are included.
For further information on these please consult your supplier.

Biological Limit Values	No biological limit allocated.
Control Measures	Provide exhaust ventilation or other engineering controls to keep the relevant airborne concentrations below their respective occupational exposure limits. In accordance with good industrial hygiene and safety work practices, airborne exposures should be controlled to the lowest extent practicable.
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.
Personal protective equipment	
Respiratory system	Use only with adequate ventilation. Do not breathe vapour or mist.
Skin and body	Avoid prolonged or repeated contact with skin. Wear protective clothing if prolonged or repeated contact is likely.
Hands	Wear protective gloves if prolonged or repeated contact is likely. The correct choice of protective gloves depends upon the chemicals being handled, the conditions of work and use, and the condition of the gloves (even the best chemically resistant glove will break down after repeated chemical exposures). Most gloves provide only a short time of protection before they must be discarded and replaced. Because specific work environments and material handling practices vary, safety procedures should be developed for each intended application. Gloves should therefore be chosen in consultation with the supplier/manufacturer and with a full assessment of the working conditions.
Eyes	Safety glasses with side shields.

9 . Physical and chemical properties

Physical state	Liquid.
Colour	Brown.
Odour	Mild
Flash point	>61.5 °C (Closed cup) Pensky-Martens.
Explosion limits	Lower: 0.7 % Upper: 5 %
Boiling point / range	180 to 380°C
Melting point / range	Not available.
Density	810 to 850 kg/m^3 (0.81 to 0.85 g/cm^3) at 15°C
Vapour density	Not available.
Vapour pressure	0.1 kPa (0.755 mm Hg)
Solubility	Very slightly soluble in cold water.
pH	Not available.
Relative density/Specific Gravity	0.84
Viscosity	Kinematic: 2.1 to 5.5 mm^2/s (2.1 to 5.5 cSt) at 40°C

10 . Stability and reactivity

Stability	The product is stable. (Ambient Temperatures)
Conditions to Avoid	Avoid all possible sources of ignition (spark or flame).
Incompatibility with various substances/Hazardous Reactions	Avoid strong oxidisers.
Hazardous polymerization	Will not occur.
Hazardous Decomposition Products	These products are carbon oxides (CO, CO$_2$) (carbon monoxide, carbon dioxide) . Other hazardous substances.

11 . Toxicological information

Effects and symptoms

Eyes	Unlikely to cause more than transient stinging or redness if accidental eye contact occurs.
Skin	Unlikely to cause harm to the skin on brief or occasional contact but prolonged or repeated exposure may lead to dermatitis.
Inhalation	May cause irritation of respiratory tract, coughing, shortness of breath.
Ingestion	Unlikely to cause harm if accidentally swallowed in small doses, though larger quantities may cause nausea and diarrhoea.

Chronic toxicity

Carcinogenic effects	Carcinogenic Category 3

12 . Ecological information

Ecotoxicity	Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
Biodegradability	
Persistence/degradability	This product is inherently biodegradable.
Mobility	Spillages may penetrate the soil causing ground water contamination. This material may accumulate in sediments.
Bioaccumulative potential	This product is not expected to bioaccumulate through food chains in the environment.
Other ecological information	Spills may form a film on water surfaces causing physical damage to organisms. Oxygen transfer could also be impaired.

13 . Disposal considerations

Disposal Consideration / Waste information	Avoid contact of spilled material and runoff with soil and surface waterways. Consult an environmental professional to determine if local, regional or national regulations would classify spilled or contaminated materials as hazardous waste. Use only approved transporters, recyclers, treatment, storage or disposal facilities. Dispose of in accordance with all applicable local and national regulations.
Special Precautions for Landfill or Incineration	Empty packages may contain some remaining product. Hazard warning labels are a guide to the safe handling of empty packaging and should not be removed.

14 . Transport information

Not classified as dangerous for transport (ADG, IMDG, ICAO/IATA).

Special precautions for user	No known special precautions required. See Section: "Handling and storage" for additional information.

15 . Regulatory information

Standard for the Uniform Scheduling of Drugs and Poisons

5

Control of Scheduled Carcinogenic Substances

Ingredient name	**Schedule**
Fuels, diesel	Scheduled

Other Classification Information

Australia Regulations	Labelling requirements for SUSDP do not apply to a poison that is packed and sold solely for industrial, laboratory or manufacturing use. However, this product is labelled in accordance with NOSHC National Code of Practice for labelling of workplace substances.
Other regulations	
Inventories	**Europe inventory:** All components are listed or exempted. **United States inventory (TSCA 8b):** All components are listed or exempted. **Australia inventory (AICS):** All components are listed or exempted. **Canada inventory:** All components are listed or exempted. **China inventory (IECSC):** At least one component is not listed. **Japan inventory (ENCS):** Not determined. **Korea inventory (KECI):** All components are listed or exempted. **Philippines inventory (PICCS):** All components are listed or exempted.

16 . Other information

Key to abbreviations

AMP = Acceptable Maximum Peak
ACGIH = American Conference of Governmental Industrial Hygienists, an agency that promulgates exposure standards.
ADG = Australian Code for the Transport of Dangerous Goods by Road and Rail
ADG Code = Australian Code for the Transport of Dangerous Goods by Road and Rail
CAS Number = Chemical Abstracts Service Registry Number
HAZCHEM Code = Emergency action code of numbers and letters which gives information to emergency services. Its use is required by the ADG Code for Dangerous Goods in bulk.
ICAO = International Civil Aviation Organization.
IATA = International Air Transport Association, the organization promulgating rules governing shipment of goods by air.
IMDG = International Maritime Organization Rules, rules governing shipment of goods by water.
IP 346 = A chemical screening assay for dermal toxicity. The European Commission has recommended that Method IP 346 be used as the basis for labelling certain lubricant oil base stocks for carcinogenicity. The EU Commission has stipulated that the classification as a carcinogen need not apply if it can be shown that the substance contains less than 3% DMSO extract as measured by IP 346. (See Note L, European Commission Directive 67/548/EEC as amended and adapted.) DMSO is a solvent.
NOHSC = National Occupational Health & Safety Commission, Australia
TWA = Time weighted average
STEL = Short term exposure limit
UN Number = United Nations Number, a four digit number assigned by the United Nations Committee of Experts on the Transport of Dangerous Goods.

History

Date of issue 27/08/2007.

Date of previous issue No Previous Validation.

Prepared by Product Stewardship

Notice to reader

All reasonably practicable steps have been taken to ensure this data sheet and the health, safety and environmental information contained in it is accurate as of the date specified below. No warranty or representation, express or implied is made as to the accuracy or completeness of the data and information in this data sheet.

The data and advice given apply when the product is sold for the stated application or applications. You should not use the product other than for the stated application or applications without seeking advice from us.

It is the user’s obligation to evaluate and use this product safely and to comply with all applicable laws and regulations. The BP Group shall not be responsible for any damage or injury resulting from use, other than the stated product use of the material, from any failure to adhere to recommendations, or from any hazards inherent in the nature of the material. Purchasers of the product for supply to a third party for use at work, have a duty to take all necessary steps to ensure that any person handling or using the product is provided with the information in this sheet. Employers have a duty to tell employees and others who may be affected of any hazards described in this sheet and of any precautions that should be taken.

Material Safety Data Sheet

TRIETHYLENE GLYCOL

Infosafe No.	AJ1J5	**Issue Date**	August 2007	**Status**	ISSUED by APSSC

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Product Name	TRIETHYLENE GLYCOL
Product Code	80641
Company Name	APS, A Division of Nuplex Industries (Aust) Pty Ltd (ABN 25 000 045 572)
Address	8 Abbott Road SEVEN HILLS NSW 2147
Emergency Tel.	1800 022 037 (24H)
Telephone/Fax Number	Tel: (02) 9839 4000 Fax: (02) 9674 6225
Recommended Use	Solvent and plasticizer in vinyl, polyester and polyurethane resins; dehydration of natural gas; humectant in printing inks; extraction solvent ('Udex' process).
Other Names	None Listed
Other Information	New Zealand: Asia Pacific Specialty Chemicals (NZ) Limited 119 Carbine Road Mt Wellington, Auckland 6 Emergency Tel: 0800 154 666 (24H) Telephone: (09) 276 4019 Fax: (09) 276 7231

2. HAZARDS IDENTIFICATION

Hazard Classification

Australia:
Not classified as Hazardous according to criteria of 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.

New Zealand:
Not classified as Hazardous according to the New Zealand Hazardous Substances (Minimum Degrees of Hazard) Regulations 2001.

Not classified as Dangerous Goods for transport according to the New Zealand Standard NZS 5433:1999 Transport of Dangerous Goods on Land.

Risk Phrase(s)

3. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredients	**Name**	**CAS**	**Proportion**
	Trigol	112-27-6	100 %

4. FIRST AID MEASURES

Inhalation	Remove affected person from exposure. Allow to assume most comfortable position and keep warm. Keep at rest until fully recovered. If symptoms persist seek medical attention.
Ingestion	Do not induce vomiting. Rinse mouth and lips thoroughly with water. Seek medical attention.
Skin	If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. If irritation develops seek medical attention.
Eye	If in eyes, hold eyelids apart and flush the eyes continuously with running water. Continue flushing for several minutes until all contaminants are washed off completely. Seek medical attention.
First Aid Facilities	Eye wash station and normal washroom facilities.
Advice to Doctor	Treat symptomatically.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Foam, dry chemical powder, carbon dioxide, water fog or water spray.
Hazards from Combustion Products	Under fire conditions this product may emit toxic and/or irritating fumes, smoke and gases including carbon monoxide and carbon dioxide.
Specific Hazards	Combustible liquid. This product will burn if exposed to fire.
Precautions in connection with Fire	Fire fighters should wear Self-Contained Breathing Apparatus (SCBA) and full protective clothing to prevent exposure to vapours, fumes or products of combustion. Water spray may be used to cool down heat-exposed containers.

6. ACCIDENTAL RELEASE MEASURES

Emergency Procedures	Increase ventilation. Evacuate all unnecessary personnel. Wear protective clothing and equipment to prevent exposure. If possible contain the spill. Place inert absorbent such as vermiculite or sand onto material. Prevent run off into drains and waterways. Use clean non-sparking tools to collect the material and place into suitable, labelled containers for the

subsequent recycling or disposal. If spillage enters the waterways inform the EPA and the local water authorities, in accordance with applicable regulations. Dispose of waste according to relevant local, state and federal government regulations.

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7. HANDLING AND STORAGE

Precautions for Safe Handling Avoid contact with skin and eyes. Wear overalls, impervious gloves and safety glasses. Use only in well ventilated areas. Avoid breathing vapour or spray mist. Keep containers closed when not in use. Do not empty into drains. Ensure that a high level of personal hygiene is maintained when using this product, that is, always wash hands after handling, and before eating, drinking, smoking or using the toilet facilities.

Conditions for Safe Storage Store in a cool, dry, well ventilated area away from oxidising agents. Keep containers closed when not in use and securely sealed and protected against physical damage. Inspect regularly for deficiencies such as damage or leaks.

Storage Regulations Classified as a Class C2 (COMBUSTIBLE LIQUID) for the purposes of storage and handling, in accordance with the requirements of AS1940. This product should be stored and used in a well ventilated area away from naked flames, sparks and other sources of ignition.

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8. EXPOSURE CONTROLS/PERSONAL PROTECTION

National Exposure Standards No exposure standards have been established for this substance by the Australian National Occupational Health & Safety Commission (NOHSC) or the Occupational Safety and Health Service (OSH) of the New Zealand Department of Labour. However, over-exposure to some chemicals may result in enhancement of pre-existing adverse medical conditions and/or allergic reactions and should be kept to the least possible levels.

Engineering Controls If mists or vapours are generated a local exhaust ventilation system, drawing vapours and mists away from workers' breathing zone, should be used.

Respiratory Protection If engineering controls are not effective in controlling airborne exposure then an approved respirator with an organic vapour type 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 laminated film or other impervious, suitable gloves conforming to AS/NZS 2161: Occupational protective gloves.

Body Protection Suitable protective workwear, e.g. cotton overalls buttoned at neck and wrist. Industrial clothing should conform to the specifications detailed in AS/NZS 2919: Industrial clothing.

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9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Clear, colourles liquid with a mild odour.
Melting Point	-7°C
Boiling Point	285°C at 760 mmHg
Solubility in	

Water	Completely soluble
Specific Gravity	1.125 at 20°C
Vapour Pressure	<0.01 mmHg at 20°C
Vapour Density (Air=1)	5.17 (Air=1)
Evaporation Rate	Not available
Flash Point	168°C
Flammability	Combustible liquid.
Auto-Ignition Temperature	375°C
Flammable Limits - Lower	0.9%
Flammable Limits - Upper	9.2%

10. STABILITY AND REACTIVITY

Chemical Stability	Stable under normal conditions of storage and handling.
Incompatible Materials	Strong oxidizing agents and strong acids.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Hazardous Polymerization	Will not occur.

11. TOXICOLOGICAL INFORMATION

Toxicology Information	LD50 (Oral, Rat): 17,000 mg/kg LD50 (Dermal, Rabbit): 22,500 mg/kg
Inhalation	Vapours or spray mist may be irritating to the respiratory system.
Ingestion	Possible aspiration hazard. Ingestion of this product may irritate the gastric tract causing nausea and vomiting.
Skin	May cause redness, itching and irritation.
Eye	May be irritating to eyes. May cause redness and tearing of the eyes.
Chronic Effects	Not available

12. ECOLOGICAL INFORMATION

Ecotoxicity	Not available
Persistence / Degradability	Not available
Mobility	Not available
Bioaccumulative Potential	Not available
Environment Protection	Do not allow product to enter drains, waterways or sewers.

13. DISPOSAL CONSIDERATIONS

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

14. TRANSPORT INFORMATION

Transport Information	Australia: Not classified as Dangerous Goods, according to the Australian Code for the Transport of Dangerous Goods by Road and Rail. New Zealand: Not classified as Dangerous Goods for transport according to the NZS 5433:1999 Transport of Dangerous Goods on Land.
Storage and Transport	Not classified as dangerous goods.

15. REGULATORY INFORMATION

Regulatory Information	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
National and or International Regulatory Information	New Zealand: Not classified as Hazardous according to the New Zealand Hazardous Substances (Minimum Degrees of Hazard) Regulations 2001.

16. OTHER INFORMATION

Date of preparation or last revision of MSDS	MSDS Reviewed: August 2007 Supersedes: September 2002
Contact	Australia: Business Hours: Mr Paul Verren

Person/Point	Telephone: (02) 9839 4024 Emergency Tel: 1800 022 037 New Zealand: Business Hours: Mr Lloyd Williams Telephone: (09) 276 4019 Emergency Tel: 0800 154 666 IMPORTANT ADVICE: This MSDS summarizes our best knowledge of the health and safety hazard information of the product and how to safely handle and use the product in the workplace. Each user should read this MSDS and consider the information in the context of how the product will be handled and used in the workplace including its use in conjunction with other products. If clarification or further information is needed to ensure that an appropriate risk assessment can be made, the user should contact Nuplex Industries (Aust) Pty Ltd. Our responsibility for products sold is subject to our standard terms and conditions, a copy of which is sent to our customers and is also available on request.

End of MSDS

APPENDIX C:

Chemical Sizing Data provided by QGC

Head	64	m

Chemical Sizing 20MLD

Description	Value	Units
Ferric Chloride		
Purpose of Chemical	Coagulant	
Number of Application Points	1	#
Maximum Dose	5	mg/L
Average Dose	10	mg/L
Minimum Dose	20	mg/L
Chemical Consumption at Maximum Flow and Average Dose	156	kg/day
Chemical Delivery Method	Tank Truck	
Days of Storage	30	days
Number of Bulk Storage Tanks	1	
Tank Diameter	3	m
Tank Height	3.6	m
Number of Active Metering Pumps	1	#
Number of Standby Metering Pumps	1	#
Sodium Hypochlorite		
Purpose of Chemical	Biofouling & Disinfection	
Number of Application Points	2	#
Application Point #1		
Maximum Dose	5	mg/L
Average Dose	5	mg/L
Minimum Dose	10	mg/L
Application Point #2		
Maximum Dose	1	mg/L
Average Dose	4	mg/L
Minimum Dose	7	mg/L
Chemical Consumption at Maximum Flow and Average Dose	158	kg/day
Chemical Delivery Method	Tank Truck	
Days of Storage	30	days
Number of Bulk Storage Tanks	1	
Tank Diameter	3.3	m
Tank Height	4.3	m
Number of Active Metering Pumps	2	#
Number of Standby Metering Pumps	2	#

Aqueous Ammonia		
Purpose of Chemical	Biofouling	
Number of Application Points	1	#
Maximum Dose	2.4	mg/L
Average Dose	1.2	mg/L
Minimum Dose	1.2	mg/L
Chemical Consumption at Maximum Flow and Average Dose	19	kg/day
Chemical Delivery Method	Tote	
Days of Storage	30	days
Number of Bulk Storage Totes	2	
Tank Diameter	1.2	m
Tank Height	1.2	m
Number of Active Metering Pumps	1	#
Number of Standby Metering Pumps	1	#
Sulfuric Acid		
Purpose of Chemical	pH Adjustment	
Number of Application Points	1	#
Maximum Dose	137	mg/L
Average Dose	137	mg/L
Minimum Dose	137	mg/L
Chemical Consumption at Maximum Flow and Average Dose	2,000	kg/day
Chemical Delivery Method	Tank Truck	
Days of Storage	30	days
Number of Bulk Storage Tanks	1	
Tank Diameter this will not	3.3	m
Tank Height hold 2000 x 30 = 60 000 kg	4.9	m
Number of Active Metering Pumps	1	#
Number of Standby Metering Pumps	1	#
Scale Inhibitor		
Purpose of Chemical	Scaling Control	
Number of Application Points	1	#
Maximum Dose	1.5	mg/L
Average Dose	2.0	mg/L
Minimum Dose	3.5	mg/L
Chemical Consumption at Maximum Flow and Average Dose	30	kg/day
Chemical Delivery Method	Tote	
Days of Storage	30	days

Number of Bulk Storage Totes	1	
Tank Diameter	1.2	m
Tank Height	1.2	m
Number of Active Metering Pumps	1	#
Number of Standby Metering Pumps	1	#
Sodium Hydroxide		
Purpose of Chemical	pH Adjustment	
Number of Application Points	2	#
Application Point #1		
Maximum Dose	5	mg/L
Average Dose	10	mg/L
Minimum Dose	15	mg/L
Application Point #2		
Maximum Dose	5	mg/L
Average Dose	10	mg/L
Minimum Dose	15	mg/L
Chemical Consumption at Maximum Flow and Average Dose	17	kg/day
Chemical Delivery Method	Tote	
Days of Storage	30	days
Number of Bulk Storage Totes	1	
Tank Diameter	1.2	m
Tank Height	1.2	m
Number of Active Metering Pumps	2	#
Number of Standby Metering Pumps	2	#

Chemical Sizing 40MLD		
Description	**Value**	**Units**
Ferric Chloride		
Purpose of Chemical	Coagulant	
Number of Application Points	1	#
Maximum Dose	5	mg/L
Average Dose	10	mg/L
Minimum Dose	20	mg/L
Chemical Consumption at Maximum Flow and Average Dose	312	kg/day
Chemical Delivery Method	Tank Truck	
Days of Storage	30	days
Number of Bulk Storage Tanks	1	

Tank Diameter	2.7	m
Tank Height	4.6	m
Number of Active Metering Pumps	1	#
Number of Standby Metering Pumps	1	#
Sodium Hypochlorite		
Purpose of Chemical	Biofouling & Disinfection	
Number of Application Points	2	#
Application Point #1		
Maximum Dose	10	mg/L
Average Dose	5	mg/L
Minimum Dose	5	mg/L
Application Point #2		
Maximum Dose	7	mg/L
Average Dose	4	mg/L
Minimum Dose	1	mg/L
Chemical Consumption at Maximum Flow and Average Dose	315	kg/day
Chemical Delivery Method	Tank Truck	
Days of Storage	30	days
Number of Bulk Storage Tanks	2	
Tank Diameter	3.3	m
Tank Height	4.3	m
Number of Active Metering Pumps	2	#
Number of Standby Metering Pumps	2	#
Aqueous Ammonia		
Purpose of Chemical	Biofouling	
Number of Application Points	1	#
Maximum Dose	1.2	mg/L
Average Dose	1.2	mg/L
Minimum Dose	2.4	mg/L
Chemical Consumption at Maximum Flow and Average Dose	37	kg/day
Chemical Delivery Method	Tote	
Days of Storage	30	days
Number of Bulk Storage Tanks	1	
Tank Diameter	3.3	m
Tank Height	4.9	m
Number of Active Metering Pumps	1	#
Number of Standby Metering Pumps	1	#

Sulfuric Acid		
Purpose of Chemical	pH Adjustment	
Number of Application Points	1	#
Maximum Dose	137	mg/L
Average Dose	137	mg/L
Minimum Dose	137	mg/L
Chemical Consumption at Maximum Flow and Average Dose	3,400	kg/day
Chemical Delivery Method	Tank Truck	
Days of Storage	30	days
Number of Bulk Storage Tanks	2	
Tank Diameter	3.3	m
Tank Height	4.3	m
Number of Active Metering Pumps	1	#
Number of Standby Metering Pumps	1	#
Scale Inhibitor		
Purpose of Chemical	Scaling Control	
Number of Application Points	1	#
Maximum Dose	1.5	mg/L
Average Dose	2.0	mg/L
Minimum Dose	3.5	mg/L
Chemical Consumption at Maximum Flow and Average Dose	59	kg/day
Chemical Delivery Method	Tote	
Days of Storage	30	days
Number of Bulk Storage Totes	2	
Tank Diameter	1.2	m
Tank Height	1.2	m
Number of Active Metering Pumps	1	#
Number of Standby Metering Pumps	1	#
Sodium Hydroxide		
Purpose of Chemical	pH Adjustment	
Number of Application Points	2	#
Application Point #1		
Maximum Dose	5	mg/L
Average Dose	10	mg/L
Minimum Dose	15	mg/L
Application Point #2		
Maximum Dose	5	mg/L

Average Dose	10	mg/L
Minimum Dose	15	mg/L
Chemical Consumption at Maximum Flow and Average Dose	33	kg/day
Chemical Delivery Method	Tote	
Days of Storage	30	days
Number of Bulk Storage Totes	2	
Tank Diameter	1.2	m
Tank Height	1.2	m
Number of Active Metering Pumps	2	#
Number of Standby Metering Pumps	2	#

4.2. UF/RO Water Treatment Plant Concept Design

4.2.1. Design PFD

The process flow diagram for the 40MLD and 20 MLD WTP generic design options is provided in Figure 1.1