



**REPORT**

# Stimulation Risk Assessment - Santos Southwest Queensland Tenements

*Human Health and Ecological Risk Assessment - Halliburton*

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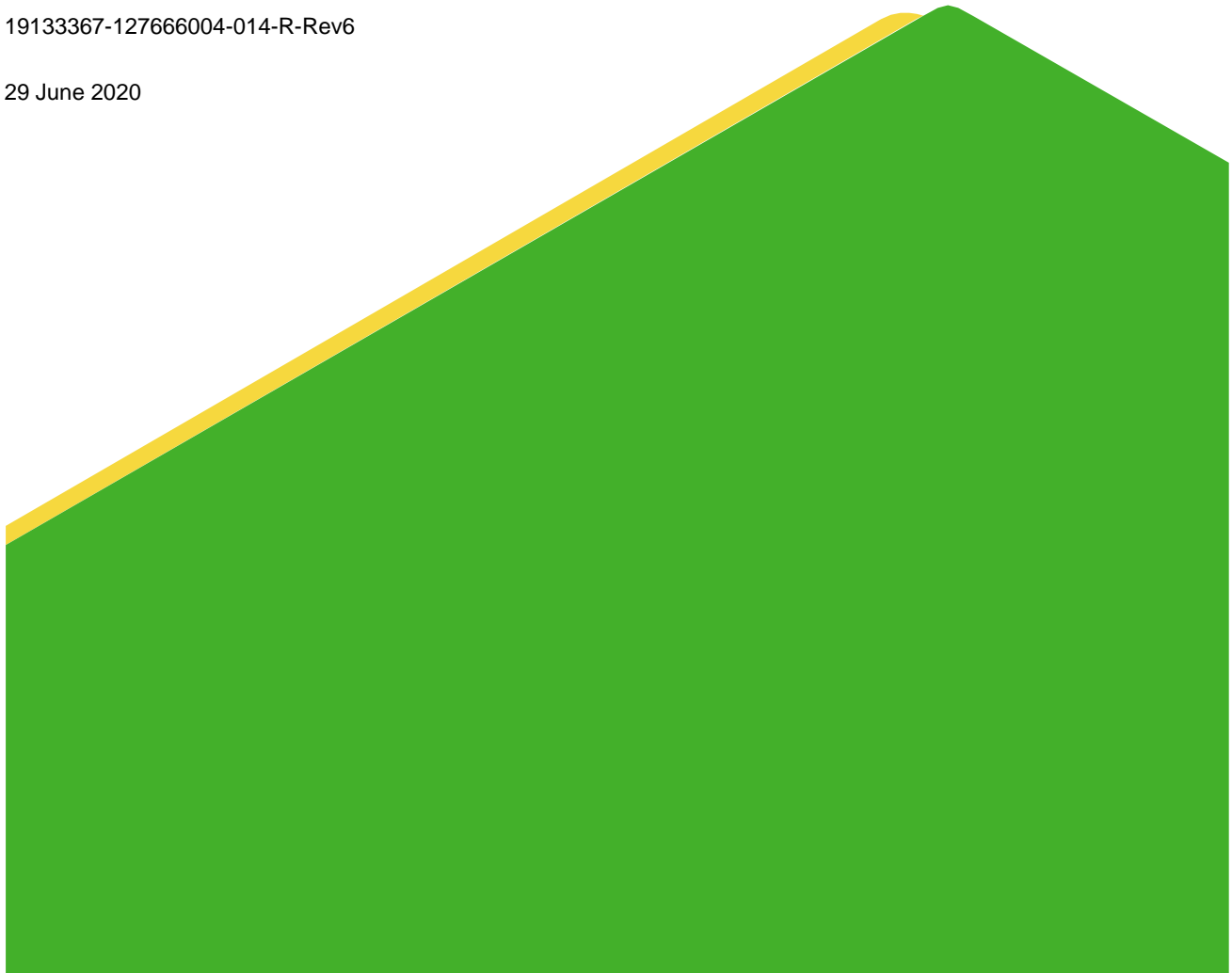
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# Executive Summary

## Introduction

Santos Ltd (Santos) engaged Golder Associates Pty Ltd (Golder) to prepare this desktop risk assessment of stimulation activities for conventional oil and gas production in their Southwest Queensland (SWQ) tenements. This Stimulation Risk Assessment (SRA) is undertaken to meet Department of Environment and Science (DES; formerly Department of Environment and Heritage Protection (DEHP)) Environmental Authority (EA) consent conditions.

An earlier version of this report was prepared in 2012. This current version has been updated with new information on revised fluid systems and EA consent conditions. As a consequence, the Product Descriptions (Section 3.0), and chemical assessments in Sections 4.0 (Aquatic Assessment), 5.0 (Terrestrial Assessment), and 6.0 (Human Health Assessment) in this report have been updated with new chemicals and new data on previously identified chemicals. Within these report sections, however, the approach to the chemical hazard assessments has largely remained the same. Section 7.0 (Risk Characterisation) has also been updated with the new chemical information.

This desktop SRA is presented in two report volumes, as follows:

- Volume One discusses the environmental and geological settings within which Santos' stimulation activities take place and the general techniques for the drilling, completion and stimulation of wells. The report also discusses why stimulation is essential in SWQ and outlines Santos' current forward programme for fracture-stimulation, although it should be noted that for a variety of reasons (including but not limited to future production performance and / or access-related issues such as the flooding of the Cooper Creek system), the forward program is frequently reviewed and is subject to change.
- Volume Two (this report) relates specifically to the stimulation fluids proposed to be used by *Halliburton* on Santos wells in the SWQ. Stimulation fluids specifically assessed in this report are:
  - 'DeltraFrac(H) Treatments'
  - 'DFS-BCG Treatments'
  - 'DFS-BCG(H) (formally HyborH) Treatments'
  - 'High Temperature Acid Spearheads'.

Halliburton stimulation fluid proprietary chemical information was disclosed directly to Golder by Santos on 24 October 2019. Full disclosure was provided for the chemical constituents in each of the fluids considered, including the mass of each constituent in a typical fluid mixture.

## Comparison of Conventional Oil and Gas Operations to Coal Seam Gas (CSG) Operations

There are key differences between CSG and conventional oil and gas production, both in the geographic and geological setting of the resource and the methodology for accessing the resource, that have a substantial bearing on the risk profile presented by stimulation activities. These include:

- Santos' conventional oil and gas operations in SWQ are located in an arid, sparsely populated area of central Australia. Whilst groundwater is an important water supply to support the rural land uses, the extent of water supply development is limited (commensurate with the small population base)
- In Santos' SWQ operations, the hydrocarbon reservoirs generally occur in anticlines capped with thick, laterally-extensive low permeability formations that isolate the reservoirs from overlying water-bearing formations; and
- The oil and gas reservoirs in the SWQ study area are very deep, of the order of 1500 to 3000 m below ground level, which provides hundreds to over a thousand metres vertical separation between the

formations in which stimulation activities are proposed and the shallow groundwater resources. There is also no requirement to remove formation water in order to facilitate gas flow, with the possible exception of well blow downs on a case by case frequency.

Hence, the combination of the remote project location, low population density (and limited water supply development), and the substantial vertical separation of oil and gas reservoirs from primary groundwater supply aquifers results in an inherently low risk profile with regard to stimulation activities.

### **Environmental Setting and Environmental Values**

Santos operates conventional gas and oil fields within scattered petroleum production tenements that, along with Santos' exploration licences cumulatively cover approximately 30,000 km<sup>2</sup> of Southwest Queensland. These tenements, exploration licenses and the land surrounding the Santos tenements comprise the Santos SWQ *study area*. The study area is described in detail within Volume One of the SWQ SRA report.

The terrain in the study area is generally characterised by low undulating topography (hills and ridges) between the various river and creek systems and associated floodplains. The area is sparsely developed, and generally comprises rural communities and homesteads that are largely engaged in farming and livestock. The oil and gas reservoirs which are the targets for stimulation lie within the Cooper Basin and the overlying Eromanga Basin.

Based on an understanding of the environmental setting, this risk assessment considered the following key environmental values:

#### **Groundwater Environmental Values:**

- Town water supply
- Stock and domestic water supply
- Sandstone aquifers of the GAB; and
- Groundwater Dependant Ecosystems (GDEs).

#### **Surface Water Environmental Values:**

- Protection of aquatic ecosystems
- Recreation and aesthetics: primary recreation with direct contact, and visual appreciation with no contact; and
- Cultural and spiritual values.

#### **Terrestrial Environmental Values:**

- Protection of flora and fauna, such as small mammals reptiles and birds.

Environmental values are further considered and evaluated in Volume One of the SWQ SRA report.

### **Stimulation Process Description Summary**

With regard to the process of stimulation, the requirements of the EA approval conditions are considered within Volume One of the SWQ SRA report, with the following specific information included:

- Practices and procedures to ensure that the stimulation activities are designed to be contained within the target gas producing formation.
- Indicative details of where, when and how often stimulation is to be undertaken on the tenures covered by this environmental authority.
- A description of Santos' well mechanical integrity testing program.
- Process control and assessment techniques to be applied for determining extent of stimulation activity(ies) (e.g. microseismic measurements, modelling etc.); and

- A process description of the stimulation activity to be applied, including equipment and a comparison to best international practice.

### **Evaluation of Exposure Pathways**

Potential exposure pathways were evaluated for on-site (i.e. within the well lease), and those relevant for off-site (i.e. anything beyond the well lease boundary). Potentially complete exposure pathways were evaluated for workers, trespassers, native fauna and flora and livestock. The environment immediately surrounding the well lease (i.e. off-site) throughout the study area may vary from lease to lease, but, was considered to potentially include homesteads (adult and child residents), water supply bores, creeks or wetlands/waterholes, livestock and native flora and fauna.

The on-site assessment indicated that the majority of potential exposure pathways were unlikely or incomplete, given the application of operational controls by Santos. These operational controls include:

- Occupational health & safety procedures implemented during stimulation operations to prevent workers from direct contact and inhalation exposure to chemicals during standard operations, spills and when handling flowback water or sediments.
- Implementation of spill containment procedures during operations to prevent migration of and exposure to chemicals.
- Vacuum removal of sediments and fluids contained within panel tanks, to prevent exposure to contaminants in windborne dust.
- Installation of signs to indicate the well lease (including the panel tank area) is a work zone to be accessed by authorised personnel only; and
- The use of lined above ground panel tanks (several metres high) to store flowback fluids, reducing access to the majority of potential ecological receptors including livestock and large mammals.

Within the well pad area, reasonable measures will be implemented to discourage entry of native fauna and livestock into the well lease area during stimulation operations. However, a potentially complete exposure pathway was identified for birds coming in direct contact with the flowback water in the panel tanks.

Potential off-site exposure pathways were evaluated for homesteads, livestock, native flora and fauna and aquatic ecosystems. Three possible chemical sources were identified: injected stimulation fluids, sediments from the panel tanks and flowback water. The exposure assessment concluded:

- Subsurface exposure to stimulation fluids is controlled by Santos' well design, well integrity testing procedures and operational monitoring, and this pathway (whereby stimulation fluids could escape into the formation and contaminate adjacent aquifers that are used for domestic or stock water supply) is considered unlikely or incomplete.
- Based on an understanding of the Eromanga and Cooper Basin geology and hydrogeology, and the nature and extent of groundwater supply development, exposure to residual stimulation chemicals through subsurface pathways is considered unlikely and incomplete, due to:
  - Significant vertical offset between the beneficial use aquifers and the shallowest hydrocarbon reservoirs (oil reservoirs of the Cadna-Owie Formation - 400 to 800 m). These formations are separated by low permeability formations and form a thick, competent and regionally extensive seal. The vertical offset to gas reservoirs is much greater (1,000 m to 1,800 m).
- Within formations that host both aquifers and hydrocarbon reservoirs (e.g. Hooray Sandstone), the water-bearing zones are separated from hydrocarbon reservoirs by intra-formational seals. However, there is not enough information available to discretise the internal stratigraphy of these formations. Where petroleum activities (including stimulation) occur within a formation that hosts both aquifers and hydrocarbon reservoirs, the lateral distance of the water supply bores accessing the aquifer to Santos' tenements was considered.

- The closest beneficial use bore to the Santos tenements targeting the Hooray Sandstone in the DES (formerly DEHP) database records is the Coothero Bore, which is located approximately 45 km from the closest tenement with stimulation activities proposed.
- At the surface, a spill or leak of flowback water from a panel tank was considered as a potential exposure scenario, however the implementation of operational controls, including use of liners in panel tanks, removal of fluid and sediment using vacuum techniques and engineering and operational controls (grading of well leases and stormwater controls) is considered sufficient to limit the potential for uncontrolled releases of flowback water to the environment. A further margin of safety is provided by Santos' evaluation of 'environmentally sensitive areas' when establishing well leases, which includes the establishment of buffers between petroleum (and stimulation) activities and features of potential environmental concern. Subsequently, the potential off-site exposure scenarios are considered unlikely and incomplete.

### **Hazard Assessment**

The toxicity of the chemicals used in the stimulation process by Halliburton have been assessed for persistence, bioaccumulation and aquatic toxicity (PBT), terrestrial toxicity and human health toxicity including the physical hazards of fire and explosion. The review of toxicity is qualitative in that it has provided a relative ranking of chemicals considered to represent a high, moderate or low hazard in respect to the ecological or human health end points with qualification of health issues arising from the ranking.

The evaluation of the hazards was based on the available data obtained from a range of literature sources and databases. As a consequence, data are limited to the quantity and quality of information available in those sources. A measure of the data completeness for the toxicological and hazard parameters used has been estimated using a percentage of the parameters for which data were available. An assessment of the quality of the available data is beyond the scope of this report. In the absence of verifying the data by going to the primary literature sources, the selection of data for use in the assessment has been confined to established, robust and reputable sources such as WHO (World Health Organisation) and US EPA (United States Environmental Protection Agency) where available. As new toxicological data are generated and becomes available in the published literature, the information presented in this hazard evaluation and the associated conclusions may be subject to change. This was realised in 2013 with the publication of new human health chemical hazard assessment approaches (NICNAS, 2013). As a result chemicals assessed after this date have been reviewed on the basis of the new national approach which incorporates a weighting for specific toxicological parameters. It should be noted that this methodology has not been employed for chemicals assessed prior to 2013, and so no change is reflected in previous assessments.

This hazard assessment did not consider the combined effects of the constituents when present in a mixture. Assessment of mixtures is considered beyond the scope of a screening level human health and ecological risk assessment.

### **Environmental Hazard**

Approaches for environmental risk assessment of individual chemicals are inherently conservative and designed to over-estimate risk as a precautionary approach and in recognition of the uncertainty surrounding effects of mixtures.

### **Aquatic Ecosystems**

Based on the hazard classification of the stimulation chemicals, seven chemicals were classified as a high hazard and considered to be COPC, as follows:

- Alcohols, C12-C15, Ethoxylated
- Surrogate for Amides, tall-oil fatty, N-N-bis(hydroxyethyl)
- Tall-oil, fatty, N,N-bis(hydroxyethyl)

- Chlorous acid, sodium salt
- Disodium octaborate tetrahydrate
- Sodium bisulfite
- Sodium iodide; and
- Surrogate for Ulexite.

The certainty of the hazard classification varies depending on the extent of data gaps and the reliance on modelled data. The percentage data gaps for the high hazard chemicals ranged from very low (Alcohols, C12-C15, Ethoxylated) to relatively high (Sodium iodide).

### **Terrestrial Ecosystems**

The organic chemicals classified as high hazard to terrestrial ecosystems were assessed according to their toxicological and physico-chemical properties. The following organic chemicals were assessed to have the potential to pose a higher environmental hazard to terrestrial ecosystems relative to the other chemicals assessed based on persistence (including volatility and soil half-life), and potential to biomagnify:

- Diethanol amine; and
- Hydrotreated light petroleum distillate.

Diethanol amine has low volatility but it does not persist in the soil and it does not biomagnify. Hydrotreated light petroleum distillate has a high potential to biomagnify but it does not persist in the environment based on its fast half-life and high volatility. Therefore, although these chemicals appear to pose a higher hazard than others, their risk profile to terrestrial receptors is relatively low.

The remaining chemicals were considered likely to degrade quickly or moderately quickly and/or have a high or moderate volatility. Hence, whilst direct toxicity to terrestrial receptors could occur from exposure to these chemicals (for example, following a spill or breach of containment, or from direct exposure via accidental entry into a panel tank) the effect will likely be reduced over time.

### **Human Health Hazard**

The hazard evaluation for human health undertaken in accordance with the 'low-medium-high' hazard ranking methodology indicated three of the twenty chemicals assessed to have a 'moderate to high' relative ranking:

- Methanol
- Sodium iodide
- Acetic acid.

The hazard evaluation for human health undertaken in accordance with the IMAP Framework hazard ranking methodology indicated twelve of the seventeen chemicals assessed under this methodology to be a Hazard Rank of 4 or 3.

- Ethylene Glycol
- Sodium bisulfite
- Ulexite
- Diethanolamine
- Sodium polyacrylate
- Butyl alcohol
- Tributyl tetradecyl phosphonium chloride

- Guar gum
- Hydrotreated light petroleum distillate
- Glutaraldehyde
- Monoethanolamine borate.

The hazard evaluation for human health suggests that the dominant concerns are related to occupational hazards such as carcinogenicity, silicosis, skin, eye and respiratory irritancy or corrosivity and sensitisation. In some cases, physical hazards of flammability and explosion prevail and are identified in this report. While extensive dilution of the stimulation chemicals is anticipated such that potential exposure concentrations would be much reduced for fluids injected into the well and in flowback fluid, there are a number of hazards that are suggested from this human health evaluation. These include the potential for:

- Residual elevation of organic moieties e.g. some salts have an organic part that will be present following dissociation that may increase in environmental waters.
- Changes in pH of environmental waters due to alkaline or acidic components.
- Elevations of certain metal concentrations in environmental waters.
- Some additives to exert endocrine disruption effects.
- Certain inorganic substances to generate atmospheric particulates that may impact nearby communities; and
- Volatile components to comprise nuisance or irritant effects should atmospheric concentrations be elevated in close proximity to communities.

These environmental hazards may be assessed further, and/or managed as required.

Golder notes that benzene, toluene, ethylbenzene and xylene (BTEX) and polycyclic aromatic hydrocarbon (PAH) compounds were not identified in the confidential disclosure of stimulation fluids chemicals provided to Golder by Halliburton on 13 July 2012 and to Golder by Santos in October 2019.

### **Qualitative Assessment of Fluids**

In 2012 Santos collected seven fluid samples during South Australian stimulation activities for chemical analysis. Two of these fluids ('DFS-BCG(H) (formally HyborH) Treatments' and 'High Temperature Acid Spearheads') are still in use or proposed for use by Halliburton in SWQ stimulation activities. The other two fluids assessed in this report ('DeltaFrac(H) Treatments' and 'DFS-BCG Treatments') were not assessed in the qualitative assessment of fluids.

These stimulation activities were undertaken by Halliburton in 2012 and are considered reasonably indicative of the proposed SWQ activities. The samples included:

- 'Stimulation fluid additives mixed with distilled water to assess the quality of the additives in isolation.
- Formation make up water prior to mixture with stimulation fluid additives to assess the quality of the formation water; and
- Flowback fluids as they were returned from the subsurface to assess the overall fluid quality (including the contribution of reservoir fluids to the overall flowback fluid quality).

Detectable concentrations of toluene, xylenes and hydrocarbon fractions were reported in two samples of distilled water mixed with stimulation fluid additives, prepared by Halliburton. The reported concentrations were below the DES BTEX standard.

Review of the data indicates that the flowback fluids contain substantially higher concentrations of hydrocarbons, which are considered to represent geogenically derived substances and these exceed the



respective water quality guideline concentrations (where available). The presence of geogenic hydrocarbons represents a key difference between conventional formations and those targeted through CSG production.

Examination of the make-up water drawn from formation water sources suggests the hydrocarbon concentrations are lower and range from concentrations below the limits of reporting to concentrations approaching or in some cases exceeding the respective water quality guidelines. This includes both potable water quality guidelines and ecological guidelines from both the Netherlands (RIVM, 2004) and Canada (CCME, 2008), which were referenced in the absence of water quality guidelines for hydrocarbon fractions in Australia. This represents a gap in the literature and needs to be addressed on an Industry wide basis. These exceedances only apply to the TPH fractional ranges and the aesthetics-based health values for ethyl benzene and total xylenes. It is noted that comparison of flowback water quality to potable water quality guidelines constitutes a conservative, screening level assessment as the exposure scenario upon which the guidelines were derived (i.e. chronic exposure from direct ingestion of water) is not strictly relevant to the management of flowback fluids.

The distilled water fluid formulations present a similar hydrocarbon concentration profile to the make-up water, with generally lower concentrations albeit with exceptions in some TPH fractional ranges and for p-isopropyltoluene. The latter are within an order of magnitude of the make-up water concentrations. In the case of the BTEX group the distilled water formulations have not identified BTEX concentrations exceeding BTEX water quality criteria specified in the Queensland Environmental Protection Regulation.

These results suggest that stimulation fluid formulations are not contributing substantial amounts of BTEX and TPH into the subsurface regions, and certainly at concentrations that are both below the regulated criteria (where available) and below the concentrations in the hydrocarbon reservoirs being fractured. Some qualification of this statement is required as a result of residual uncertainties. These uncertainties require further exploration and reflect:

- a) Limited sampling frequencies for the respective fluids examined.
- b) Confidence in the sampling integrity and any potential for introduction of extraneous contamination. There is potential in view of the immediate environmental surrounds of the stimulation conditions.
- c) The sampling process and its consistency with stimulation procedures at the time of sampling including spatial and temporal references, i.e. what was happening at the time of sampling and process locations, etc.

At the time of reporting, no information on fluid chemical volume per stimulation event for the two new fluids (*'DeltaFrac(H) Treatments'* and *'DFS-BCG Treatments'*) had been provided to Golder and has therefore not been included in this report.

### **Overall Risk Evaluation and Management Measures**

Considering the hazard, exposure assessment and qualitative assessment of fluids, although unlikely, flowback water at surface presents a possible risk. However, with Santos operational controls and management, the overall risk to human health and environment associated with the chemicals involved in stimulation are expected to be low. The management measures implemented through operational controls include:

- OH&S procedures implemented during stimulation operations to prevent workers from direct contact with chemicals during spills and when handling make up and flowback waters and sediments.
- Santos operational procedures regarding well integrity verification and fracture design to stay within the target formation.

- Assigning buffers during establishment of well leases between petroleum operations and potential “environmentally sensitive areas” identified through database review and site-specific ecological assessments.
- Implementation of spill containment procedures during operations to prevent migration of and exposure to chemicals.
- Vacuum removal of sediments and fluids contained within panel tanks, to prevent exposure to contaminants in fluids and windborne dust.
- Installation of signs to indicate that the well lease (including the panel tank area) is a work zone to be accessed by authorised personnel only.
- Lining (double lining) of panel tanks to prevent seepage of flowback water into the underlying aquifer; and
- Engineering and operational controls (grading of well leases and stormwater controls) to limit the potential for uncontrolled surface releases of flowback water to the environment.

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## 1.0 INTRODUCTION

### 1.1 Preamble

Santos Ltd (Santos) is a holder of numerous existing Environmental Authorities (EAs) for activities and operations throughout Southwest Queensland (SWQ), collectively referred to as “SWQ”. To meet EA consent conditions, a formal risk assessment of stimulation activities is required and subsequently, Golder Associates Pty Ltd (Golder) has been engaged by Santos to prepare this Stimulation Risk Assessment (SRA).

This version of the Stimulation Risk Assessment (SRA) updates a 2012 version (127666004-014-Rev3, dated August 2013 previously referred to as a Hydraulic Stimulation Risk Assessment (HSRA)). Updated contents include reference to the updated Environment Authority (EA) Blueprint Conditions (updated December 2019) and new information on revised fluid systems. As a consequence, the Product Descriptions (Section 3.0) and the chemicals assessments in Sections 4.0 (Aquatic Assessment), 5.0 (Terrestrial Assessment), and 6.0 (Human Health Assessment) of this report have been updated with new chemicals and new data on previously identified chemicals. Within these report sections, however, the approach to the chemical hazard assessments has largely remained the same. Section 7.0 (Risk Characterisation) has also been updated with the new chemical information.

This desktop SRA is presented in two volumes, as follows:

- Volume One discusses the environmental and geological settings within which Santos’ stimulation operations take place and the general techniques for the drilling, completion and stimulation of wells. The report also discusses why stimulation is essential in SWQ and outlines Santos’ current forward programme for fracture-stimulation, although it should be noted that for a variety of reasons (including but not limited to future production performance and / or access-related issues such as the flooding of the Cooper Creek system), the forward programme is frequently reviewed and is subject to change.
- Volume Two (this report) relates specifically to the stimulation fluids proposed to be used by *Stimulation Service Providers* on Santos wells in the SWQ conventional oil and gas fields. The report considers the ecological and human health toxicity of the chemical constituents in the stimulation fluids and includes an exposure pathway assessment and risk characterisation based on a review of complete exposure pathways and controls to mitigate exposure.

This reporting structure has been developed to accommodate the chemical assessment requirements of various stimulation fluids as they are introduced to the Australian market, for which the remainder of the EA conditions relating to the environmental setting and stimulation process description remain consistent over time. This reporting structure also affords greater ability to manage commercial-in-confidence issues associated with certain stimulation fluids.

This report specifically addresses the requirements of EA conditions related to the assessment of chemical constituents for the following *Halliburton* stimulation fluids:

- ‘*DeltraFrac(H) Treatments*’
- ‘*DFS-BCG Treatments*’
- ‘*DFS-BCG(H) (formally HyborH) Treatments*’
- ‘*High Temperature Acid Spearheads*’

Halliburton stimulation fluid proprietary chemical information was disclosed directly to Golder by Santos on 24 October 2019. Full disclosure was provided for the chemical constituents in each of the fluids considered, including the mass of each constituent in a typical fluid mixture.

This report should be read in conjunction with report entitled, *Stimulation Risk Assessment, Site Setting and Fracturing Process* [Volume One], (reference: 127666004-011-R-Rev0, dated 8 April 2020); which discusses

the environmental and geological settings within which Santos' stimulation operations take place in Southwest Queensland (SWQ) and the general techniques for the drilling, completion and stimulation of wells. The same report also evaluates exposure pathways and Santos management and control measures.

### 1.1.1 EA Consent Conditions

The Environmental Authority (EA) approval requirements for the Santos' SWQ operations necessitate the collection and provision of information on stimulation. Detailed regulatory requirements contained in these approvals and the sections of this risk assessment where the conditions are met are provided in Table 1. Conditions related to stimulation risk assessments can vary between Santos SWQ EAs and can also vary to include those with DES' Streamlined model conditions for petroleum activities guideline (ESR/2016/1989).

**Table 1: Summary of Consent Conditions Related to Stimulation Fluid Chemical Assessment**

Condition	Report Volume	Report Section
(a) a process description of the <u>stimulation</u> activity to be applied, including equipment	One	3.3
(b) provide details of where, when and how often <u>stimulation</u> is to be undertaken on the tenures covered by this environmental authority	One	3.4.1
(c) a geological model of the field to be stimulated including geological names, descriptions and depths of the target gas producing formation(s)	One	2.4 and 2.5
(d) naturally occurring geological faults	One	2.4.3.5 and 2.4.5
(e) seismic history of the region (e.g. earth tremors, earthquakes)	One	2.4.5
(f) proximity of overlying and underlying aquifers	One	2.5
(g) description of the depths that aquifers with environmental values occur, both above and below the target gas producing formation	One	2.6
(h) identification and proximity of <u>landholders' active groundwater bores</u> in the area where <u>stimulation</u> activities are to be carried out	One	2.5.7
(i) the environmental values of groundwater in the area	One	2.6
(j) an assessment of the appropriate limits of reporting for all water quality indicators relevant to <u>stimulation</u> monitoring in order to accurately assess the risks to environmental values of groundwater	Refer Stimulation Impact Monitoring Program	-
(k) description of overlying and underlying formations in respect of porosity, permeability, hydraulic conductivity, faulting and fracture propensity	One	2.4.4 and 2.5.5
(l) consideration of barriers or known direct connections between the target formation and the overlying and underlying aquifers	One	2.5.2.3, 3.3.4 and 3.3.7
(m) a description of the well mechanical integrity testing program	One	3.2.2
(n) process control and assessment techniques to be applied for determining extent of <u>stimulation</u> activities (e.g. microseismic measurements, modelling etc.)	One	3.3.4 and 3.3.7
(o) practices and procedures to ensure that the <u>stimulation</u> activities are designed to be contained within the target gas producing formation	One	3.3.4 and 3.3.7

Condition	Report Volume	Report Section
(p) groundwater <u>transmissivity</u> , flow rate, hydraulic conductivity and direction(s) of flow	One	2.5.3, 2.5.4 and 2.5.5
(q) a description of the chemicals used in <u>stimulation</u> activities (including estimated total mass, estimated composition, chemical abstract service numbers and properties), their mixtures and the resultant compounds that are formed after stimulation	Two	3.0
(r) a mass balance estimating the concentrations and absolute masses of chemicals that will be reacted, returned to the surface or left in the target gas producing formation subsequent to <u>stimulation</u>	Two	3.2
(s) an environmental hazard assessment of the chemicals used including their mixtures and the resultant chemicals that are formed after <u>stimulation</u> including: <ul style="list-style-type: none"> <li>(i). toxicological and ecotoxicological information of chemicals used</li> <li>(ii). information on the persistence and bioaccumulation potential of the chemical compounds used</li> <li>(iii). identification of the chemicals of potential concern in <u>stimulation</u> fluids derived from the risk assessment</li> </ul>	Two	4.0, 5.0, 6.0 and 7.3.2
(t) an environmental hazard assessment of the chemicals used including mixtures and the resultant chemicals that are formed after <u>stimulation</u>	Two	4.0, 5.0, 6.0 and 7.3.2
(u) identification and an environmental hazard assessment of using radioactive tracer beads in <u>stimulation</u> activities where such beads have been used or are proposed to be used	One	3.3.7.10
(v) an environmental hazard assessment of leaving chemical compounds in <u>stimulation fluids</u> in the target formation for extended periods subsequent to <u>stimulation</u>	Two	2.1.2.1
(w) human health exposure pathways to operators and the regional population	Two	6.0
(x) risk characterisation of environmental impacts based on the environmental hazard assessment	Two	7.0
(y) potential impacts to landholder bores as a result of <u>stimulation</u> activities	Two	2.2.3.1
(z) an assessment of cumulative underground impacts, spatially and temporally of the <u>stimulation</u> activities to be carried out on the tenures covered by this environmental authority	Two	7.5
(aa) potential environmental or health impacts which may result from <u>stimulation</u> activities including but not limited to water quality, air quality (including suppression of dust and other airborne contaminants), noise and vibration	One and Two	1.3 (Report Version One) 4.0, 5.0, 6.0 and 7.3.2 (Report Version 2)

\*Consent conditions from Schedule K (Well Construction, Maintenance and Stimulation), subsection K6, 21 December 2019

## 1.2 Risk Assessment Process

This report discusses the constituents used by Halliburton<sup>1</sup> with regard to toxicity to human health and the environment. The techniques used to assess the human health and environmental hazards of the constituents are described in the following sections. Where there was insufficient chemical and/or toxicological information to assess the hazards of individual constituents, an assessment was not performed.

The scope of the qualitative risk assessment comprises of:

- **Issue Identification** (Volume One) - A description of the current environmental setting (including a description of potential receiving environments and the various factors which act upon them, including climatic influences), detailed geological and hydrogeological information, gas well integrity and a description of the stimulation process including an identification of the constituents of the stimulation fluid.
- **Exposure Assessment** (This Volume) – The exposure assessment comprises of an evaluation of surface and subsurface exposure pathways assessment.
- **Hazard Assessment** (This Volume) – An evaluation of the environmental hazard of relevant chemical additives in the stimulation fluid based on aquatic toxicity, environmental persistence and bioaccumulation. The environmental hazard assessment provides a relative ranking of the chemical additives and those chemicals considered to represent a high hazard are identified as chemicals of potential concern (COPC) for further assessment. An evaluation of terrestrial and human health toxicity will also be presented; and
- **Risk Characterisation** (This Volume) – A qualitative evaluation of environmental and human health risk associated with the stimulation activities based on the identification of complete exposure pathways and hazard identification.

Human health risk assessment is limited to assessment of effects on one population: *humans*. Ecological risk assessment is concerned with assessment of effects on the ecosystem (populations and communities) and therefore is not limited to one receptor. The guidance framework for ecological risk assessment in Australia is the “Guideline on Ecological Risk Assessment” (NEPM, Schedule B(5), 2013) which refers to draft guidance prepared by EPA Victoria (Gibson *et al.*, 1997). These guidance documents focus on risks to terrestrial environments although the overall approach for assessment or risk is the same. The risk assessment was undertaken in general accordance with these guidelines and national guidelines for risk assessment recommended by enHealth (enHealth-Environmental Health Risk Assessment, “Guidelines for Assessing Human Health Risks from Environmental Hazards”, June 2012).

This hazard assessment did not consider the combined effects of the constituents when present in a mixture. Assessment of mixtures is considered beyond the scope of a screening level human health and ecological risk assessment.

If, in the future, conditions, stimulation methodologies and/or regulatory requirements change, and/or additional exposure pathways to additional receiving environments are identified, further evaluation of the associated risks *may* be warranted.

## 1.3 Limitations

Your attention is drawn to the document - “Limitations”, which is included in APPENDIX A of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

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<sup>1</sup> Water was not assessed because it is an intrinsic constituent of all living organisms and is not inherently toxic.

## 2.0 EXPOSURE ASSESSMENT

This aspect of risk assessment provides perspective on the potential for COPC to become available and be taken up by human and other ecological species. Exposure assessment seeks to qualify or quantify such uptake by considering the human population groups and other organisms or group of organisms (receptors) which may be exposed to the COPCs identified for the study and outlines the mechanisms (exposure pathways) by which these receptors may be exposed.

The assessment of exposure involves the evaluation of the data available for the study and the arising issues; the details associated with the surrounding environment that influence fate and transport processes; the nature of planned operations that use the COPC; the physico-chemical characteristics of the COPC and the respective potential exposure pathways consistent with the planned operations. This allows the nature of the potential exposure to be identified taking into consideration the fate and transport potential of the COPC.

For an exposure pathway to be considered to be complete there must be all of the following:

- Source of COPC - how the chemical entered the environment and which environmental media are affected.
- A transport media - how the chemical moves or migrates through the environment from one location to another, or from one environmental medium to another.
- An exposure point - how organisms can come into contact with the chemicals (e.g. direct contact or via the food web); and
- An exposure route - how the chemical could enter the organism (e.g. inhalation, ingestion or dermal contact).

If any one of these steps (source, transport media, exposure point or route) is not present, the exposure pathway is incomplete and further assessment of risks is not required. Conclusions regarding the completeness of exposure pathways may change over time in response to new information or developments, and as such should be periodically reviewed for verification.

### 2.1 Identification of Exposure Pathways and Populations

A detailed description of the study area environment is provided in Volume One. In general, the area is sparsely developed, and comprises rural communities and homesteads that are largely engaged in farming and livestock production. The identification of exposure pathways and populations or ecological receptors has been split into those considered relevant for on-site (i.e. within the well lease), and those relevant for off-site (i.e. anything beyond the well lease boundary). A general description of the well lease is provided in Volume One. Individual configurations of well leases may change; however, the general layout is considered adequate for the identification of exposure pathways and receptors.

The environment surrounding the well lease (i.e. off-site) may vary. In order to provide a conservative assessment, it has been assumed there is a homestead with a water supply bore located down gradient of the well lease. It is further assumed that the distance to the homestead is over two kilometres which thus then limits the potential consideration of:

- Vapour intrusion concerns into dwellings.
- The environmental distribution of chemicals as vapours producing odours or particulates that may deposit onto roof tops and indirectly into potable water supplies; and
- The potential for entrainment of chemicals used in and around the well leases into the indoor environment of homesteads and into areas where local (homegrown) food crops may be produced.

It has also been assumed that an ephemeral creek, livestock and native flora and fauna, are present in the surrounding environment. This hypothetical assumption was considered for the purposes of the exposure pathway assessment and may not actually occur in the vicinity of a stimulated well.

### 2.1.1 On-site Exposure Pathways

A well lease is a defined area that contains all of the equipment and infrastructure required to stimulate a well. A typical well lease is described in Volume One. Of particular note for the exposure assessment are the panel tank and the blender unit.

As such a well lease is an occupational environment and accordingly it is unnecessary to consider any on-site residential scenarios. Workers are typically housed in existing camps or camps specifically designed for stimulation (frac camps).

The environmental receptors on a well lease are limited. Livestock and large native animals such as kangaroos are deterred from entering the pad by human activity. However, Santos have indicated that cattle and kangaroos have been noted on well leases infrequently. Smaller fauna such as rodents, lizards, snakes and birds are known to enter well leases.

As described in Volume One stimulation fluid is blended on site to the specific requirements of the fracture design. The additives required for the fracture are brought onto site and stored in storage containers, blender unit or sand trailer. Blending of the fluid is a contained and completely automated process. A typical stimulation operation is of limited duration (two to three days). As such the chemicals are on site for a short period of time prior to and during the stimulation event. The likelihood of occupational or environmental exposure to these additives prior to injection during normal operation is considered low, as long as robust operational management measures are present and implemented appropriately. Potential occupational exposure to stimulation chemicals associated with a spill prior to injection is considered to be dealt with under appropriate occupational health and safety procedures and has not been considered further in this report.

The primary pathways for environmental and occupational exposures outside of spills are considered to be dermal, ingestion and inhalation and ingestion of particulates. Inhalation of volatile chemicals is considered to be of lesser concern as there are limited indoor or confined environments with all activities conducted outside, however, large atmospheric emissions in close proximity to the source would require evaluation from both an acute and chronic exposure perspective.

The main areas on site that are considered for occupational and environmental exposure is the lined panel tank used for flowback fluid storage and this is discussed in more detail below.

#### 2.1.1.1 Panel Tank

The panel tank is constructed during the stimulation phase, to provide containment for fluids associated with well fluids management (flowback fluids etc.) post drilling. Santos has indicated that panel tanks are approximately 2 m in height and are double lined. The length and width of the panel tank varies with the volume of fluid required to be contained. The panel tank is used during stimulation as the initial reservoir for flowback fluids. The fluid is held in the tank to allow the sediment to settle and until water and sediments can be removed via vacuum truck for offsite disposal as soon as practicable.

Human exposure to the water in the panel tank during normal operation would be limited but may occur if the tank or liner becomes damaged and requires repair. Normal OH&S procedures are expected to limit workers exposure to flowback water under these scenarios. Human and/or ecological exposure may occur in the event of a flood where the freeboard is breached.

Exposure to the sediment in the panel tank may occur if the tank is drained and the sediments dry out and contribute to wind borne dust. However, the majority of sediments are removed from the tank via vacuum

truck for off-site disposal as soon as practicable. Dust generation from a small volume of residual sediments is not likely to be of concern to human or ecological receptors and has not been considered further. Should the scale of operations result in multiple areas of residual sediments in closer proximity to townships then such an exposure pathway would warrant re-evaluation.

Cooper Basin activities are remote, and trespassers are unlikely to access the site even if the pad is not fully secure and accidental or deliberate exposure to chemicals in the flowback water in the panel tank is considered unlikely to occur.

Ecological exposures to stimulation chemicals within flowback water in the panel tank may occur for birds or flying mammals (such as bats) or from contact with sediments following drainage.

### **2.1.1.2 Measures to Limit Exposure**

Typically implemented measures to limit exposure include:

- Exposure to trespassers is limited through the use of signs which are clearly displayed indicating the well lease is a work zone and is to be entered by authorised personnel only.
- Height of the panel tanks (approximately 2 m) and the use of signage to indicate that the panel tanks are for access by authorised personnel only.
- Exposure of livestock and other terrestrial mammals to stimulation chemicals and/or flowback water is limited due to the presence of workers during stimulation activities (which is a deterrent to animals in the lease area), the height of the panel tanks and/or fencing (if required) on site during stimulation activities.
- Exposure to sediments in the lined panel tanks is limited by effective and efficient (as soon as practicably possibly) removal and off-site disposal.

A summary of the on-site qualitative exposure assessment is provided in Table 2.



**Table 2: On-site Exposure Assessment Summary**

Source	Exposure Scenario	Receptors	Exposure Pathways	Likelihood of Exposure Scenario	Comments
Lined panel tank sediments	Entry to panel tank or excavation/stockpiling of tank sediments	Workers, trespassers	Ingestion, dermal, inhalation of volatiles	Unlikely	OH&S procedures and PPE limit workers exposure to sediment. Associated risks are covered in inductions that all personnel and contractors must attend.
	Entry to panel tank	Birds, and potentially flying mammals such as bats	Ingestion, dermal, uptake	Possible	The presence of humans during stimulation activities is expected to deter majority of wildlife during operations. There is a possibility that birds and small mammals that can fly into the tanks may seek out the flowback water for drinking water or as a rest area.
	Panel tank sediment dries and sediments become windblown dusts	Workers, trespassers	Inhalation of dusts, indirect exposures through re-entrainment mechanisms	Possible	Sediments / residues are removed from site using vacuum truck and appropriately treated and disposed as soon as practicable.
	Panel tank sediment dries and sediments become windblown dusts	Native terrestrial fauna (mammals, reptiles, birds), terrestrial flora	Ingestion, inhalation of dusts, deposition of dust on foliage, uptake via roots	Possible	Sediments / residues are removed from site and appropriately treated and disposed as soon as practicable. Additionally, the height of the tanks should reduce potential dispersion of dusts to the environment. The volume of any residual sediment, mobilise as dust, from the panel tank is expected to be insufficient to adversely affect terrestrial flora.
Flowback water in panel tank	Working with panel tank inlet, liner, or extraction.	Workers	Ingestion, dermal, inhalation of volatiles, inhalation/ingestion of aerosols	Possible	OH&S procedures and PPE limit workers exposure to flowback water. Associated risks are covered in inductions that all personnel and contractors must attend.
	Entry (accidental or deliberate) to panel tank.	Trespassers	Ingestion, dermal inhalation of volatiles, inhalation/ingestion of aerosols	Possible	Trespassers entry is limited via remote location, height of panel tanks and signage. Trespassers can not be entirely precluded from areas.
	Entry to panel tank.	Birds, and potentially flying mammals such as bats	Ingestion	Possible	The presence of humans and stimulation activities is expected to deter majority of wildlife during operations. There is a possibility that birds and small mammals that can fly into the tanks may seek out the flowback water for drinking water or as a rest area.

Source	Exposure Scenario	Receptors	Exposure Pathways	Likelihood of Exposure Scenario	Comments
	Entry (accidental or deliberate) to panel tank.	Livestock	Ingestion	Unlikely	Panel tanks are approximately 2 m in height precluding potential exposure to livestock
Stimulation Chemicals	Spill, leak of well delivery system failure during surface handling. Supply or disposal vehicle accident on site	Workers	Ingestion, dermal inhalation of volatiles, inhalation/ingestion of aerosols indirect exposures through re-entrainment mechanisms	Unlikely	OH&S, PPE and spill containment, procedures adequately address this exposure. Associated risks are covered in inductions that all personnel and contractors must attend.
	Spill, leak of well delivery system failure during surface handling. Supply or disposal vehicle accident on site	Terrestrial fauna (mammals, reptiles, birds), terrestrial flora	Ingestion, dermal	Unlikely	The presence of humans and stimulation activities is expected to deter wildlife. The greatest hazard is to terrestrial flora in the immediate vicinity of a spill. Provided flora populations are not unique to the area of the well lease, re-colonisation is expected post-completion of stimulation activities.
Flowback Water	Spill, leak, delivery system failure or overflow	Workers, trespassers	Ingestion, dermal, inhalation (volatiles and aerosol)	Possible	OH&S procedures and PPE limit workers exposure to flowback water. Associated risks are covered in inductions that all personnel and contractors must attend.
	Spill, leak, delivery system failure or overflow	Terrestrial fauna (mammals, reptiles, birds), terrestrial flora	Ingestion, dermal, uptake via roots	Possible	The presence of humans and stimulation activities is expected to deter wildlife. The greatest hazard is to terrestrial flora in the immediate vicinity of a spill. Provided flora populations are not unique to the area of the well lease, re-colonisation is expected post-spill clean-up.

## 2.1.2 Off-site Exposure Pathways

The off-site environment is considered to be anything outside the boundary of the well lease. As discussed in Volume One the study area is sparsely developed with the predominant land use being for livestock. Volume One indicates the location of wells to be stimulated and indicates there are no major towns or homesteads within close proximity of a stimulation well.

As discussed in Volume One, published research indicates, on the basis of water level and water quality analysis (including major and minor ion chemistry and stable isotope analysis), that the surface water features in the study area (typically consisting of semi-permanent waterholes that form between episodic flood event) do not receive shallow groundwater recharge (Hamilton et al., 2005; Bunn et al., 2006; Costelloe et al., 2007, Cendon et al., 2010). The reported characteristic quality of groundwater in the shallow unconsolidated aquifers in the study area is saline, and the water quality and isotopic signature is distinct from that of the fresher water in the water holes of the Channel Country. In addition, reported water levels in the shallow aquifer are inferred to be below the base of the surface water features in the study area, such that water holes, and flowing river channels during flood events, are considered to be losing water features (i.e. exhibit leakage of water into the ground but do not receive groundwater baseflow). Hence, the potential exposure pathway comprising leakage of stimulation fluid down to shallow groundwater, off-site migration with groundwater flow and discharge to an aquatic environment associated with a surface water feature is considered to be an incomplete exposure pathway in the study area and has therefore been excluded from further consideration.

In the majority of instances, the well lease sites where stimulation will be conducted will be remote from water supply bores and will maintain an appropriate buffer distance from environmentally sensitive areas.

Table 3 provides a summary of the possible sources, exposure scenarios, human populations, ecological receptors and exposure pathways considered relevant for off-site. The main possible sources identified are the stimulation fluid, sediments in a panel tank and flowback water. These are discussed in more detail below.

### 2.1.2.1 Exposure to Stimulation Fluid

Potential human and ecological exposures to stimulation fluid is unlikely but theoretically could occur due to casing failures or through fractures into overlying aquifers. However, Santos currently uses an extensive system of procedures to minimise the likelihood of the fracture (and then the fluid) leaving the target area and the loss of well integrity; these are described in Volume One. The systems include extensive testing programs and operational and systems monitoring to ensure stimulation activities are confined to the target units. If a loss of integrity is identified in a well immediate measures are employed to decommission or rectify the situation.

On this basis it is considered unlikely that exposure to stimulation fluids could occur due to the fluid escaping the target formation and contaminating adjacent aquifers that are used for domestic or stock water supply.

This conclusion is supported by a study completed by Osborn et al (2011) which evaluated aquifers overlying the Marcellus and Utica shale formations of north-eastern Pennsylvania and upstate New York. The study evaluated a number of issues associated with stimulation including:

*'Concerns for impacts to groundwater resources, from (i) fluid (water and gas) flow and discharge to shallow aquifers due to the high pressure of the injected stimulation fluids in the gas wells'*

The study evaluated groundwater from 68 private water wells which ranged in depth from 36 to 190 m. The area of the study is undergoing an expansion of gas well drilling and stimulation and is in an area with extensive fracture systems with several major faults and lineaments. The study found:

*'no evidence for contamination of the shallow wells near active drilling sites from deep brines and/or stimulation fluids'*

A second source of possible human and ecological exposure to stimulation fluids is residual fluid in the target formation. It is conservatively assumed that up to 40% of fluid may remain in the target formation immediately following stimulation. Based on the depth and separation of the target formations in the Cooper and Eromanga Basin, it is considered unlikely that exposure would occur if chemicals in the residual fluid migrate down gradient in the target formation. Residual stimulation fluids captured during the production stage of the well operations would act to reduce the residual volume in the reservoir over time and would be managed in accordance with the produced formation water management systems. In addition, stimulation fluid chemicals are likely to rapidly reduce through dissociation of organic chemicals and the relatively short biotransformation half-lives of the majority of the organic chemicals.

As indicated in Volume One, the results of the bore inventory in the study area indicated that the closest water supply bores installed in proximity of a hydrocarbon-bearing formation (Hooray Sandstone) to Santos production wells potentially targeting the same formation is approximately 45 km. Residual stimulation fluid constituents in groundwater would be expected to attenuate well within this distance. This conclusion is based on review of the information in the DES registered bore database, and the available results of an ongoing Water Bore Baseline Assessment program to verify the information in the database. This conclusion is subject to review, if warranted, on the basis of future bore inventory results and fracture locations.

### **2.1.2.2 Exposure to Sediments in the Panel Tank**

Potential off-site human and ecological exposure to the sediment could occur if the panel tank is drained and the sediments were left to dry out and contribute to wind-borne dust. However, the majority of sediment is removed via vacuum truck and disposed of off-site. The volume of residual sediments in the panel tank is therefore considered to be small and unlikely to be of concern to either humans or ecological receptors. Additionally, the height of the panel tanks (approximately 2 m) is likely to minimise the potential for windblown dust to enter the environment.

### **2.1.2.3 Exposure to Flow Back Water**

Potential off-site human and ecological exposure to chemicals in the flowback water is unlikely but could possibly occur under a range of conditions; however, the implementation of controls makes this unlikely. Exposure scenarios are considered unlikely to include the potential for releases or infiltration of flowback water into shallow aquifers that are used for domestic or stock water supply or which discharge to surface water, and direct releases to surface water.

For this exposure pathway to be complete there must be all of the following:

- A failure of the panel tank and the panel tank double lining.
- A high permeability unit beneath the well lease that is able to transmit the flowback water to an underlying aquifer; and
- A shallow aquifer present in the subsurface beneath the well lease, that is either used as water supply or discharges into a creek.

If any of the above conditions are missing, no exposure will occur. The surface lithology of the Cooper Creek drainage was described as comprising a thick layer of low permeability "mud" overlying sand beds that host the shallow, saline aquifer (e.g. Nanson et al., 2008). The fine-grained surface deposits would substantially reduce the potential for infiltration of leaking flowback water to reach the shallow aquifer, and the shallow "water table" aquifers have been reported to be saline to the extent that they are unsuitable for most beneficial uses (e.g. Cendon et al., 2010). The shallowest groundwater supply in the study area is typically sourced from either the Glendower Formation or the Winton Formation, which underlie the Quaternary unconsolidated

sediments. Surface water bodies have been reported to be disconnected from the shallow groundwater system.

The concentrations of stimulation chemicals in the flowback water are expected to be lower than those injected due to the capture of first flush, although flowback water is likely to contain concentrations of 'geogenic' chemicals from the hydrocarbon reservoir. However, the toxicity of those chemicals is expected to rapidly decrease due to dissolution, the relatively rapid biodegradation and volatilisation of many of the chemicals. The likelihood of exposure to stimulation chemicals under this scenario in concentrations likely to be of concern is considered to be low.

#### **2.1.2.3.1 Spills and Overflows from Panel Tanks**

Potential off-site human and ecological exposure to flowback water is considered unlikely but could possibly occur in the event of a spill or overflow from the panel tank. However, the panel tanks are approximately 2 m in height and are adjusted (width and length ways) to be able to hold the maximum expected amount of flow back water and stormwater for a location. On this basis, a release could only occur during a prolonged period (weeks) of heavy rainfall. The probability of a spill or overflow event occurring is further reduced by minimising the duration that flowback fluids are stored in panel tanks. In addition, the toxicity of the chemicals in the flowback fluid are likely to rapidly reduce based on the dissociation of the inorganic chemicals, and the relatively short biotransformation half-lives of the majority of organic chemicals. In the event of a release, human and ecological receptors could possibly be exposed however sampling of soil, groundwater and surface water (if relevant) in the affected area would be required to determine if unacceptable exposures had occurred.

#### **2.1.2.4 Management Measures to Reduce Off-site Exposure**

Management measures that are implemented to reduce the potential for off-site exposure or to assess the potential for exposure include:

- Double lining of panel tanks to prevent seepage of flowback water into an underlying aquifer. This is already undertaken as a minimum standard.
- Establishment of buffers during establishment of well leases between petroleum operations and potential "environmentally sensitive areas" identified through database review and site-specific ecological assessment where warranted.
- Vacuum removal and disposal of the sediments during fluid drainage of the panel tank as soon as practicably possible.
- Soil, groundwater and surface water sampling of affected area following any spill/ overflow of a panel tank.

Table 3 provides a summary of the possible sources, exposure scenarios, populations and receptors and exposure pathways considered relevant for off-site exposure concerns.

**Table 3: Off-Site Exposure Assessment Summary**

Source	Exposure Scenario	Receptors	Exposure Pathways	Likelihood of Exposure Scenario	Comment
Stimulation Fluids	Fracture fluid escapes into aquifer via a well casing failure, or a fault/ fracture/ unconformity in formation/strata, and fluids enter aquifer used down gradient for stock and domestic water supply	Residents: adults and children  Livestock	Ingestion, dermal, inhalation  Ingestion	Unlikely	The exposure scenario is unlikely given the pathway linking source to receptor is predominantly absent. The shallowest occurrence of groundwater is generally at a depth that precludes hydraulic connection with surface water features resulting in a lack of GDEs within the study area. The well lease sites are remote with limited human inhabitants in the proximity of the operations – groundwater supply development is accordingly very limited, with large vertical or lateral separation of water supply wells from hydrocarbon reservoirs. Extraction of groundwater for domestic and livestock use is limited in the study area, as evidenced by the small number of registered bores (and even smaller number whose existence was confirmed during recent bore inventory and baseline assessment). The closest groundwater to surface water discharge points occur at significant distances down-hydraulic gradient of the well lease sites (i.e. of the order of 100 km or more). Exposure concentrations of stimulation chemicals at the receptor are likely to be insignificant. Management measures include Santos operational procedures i.e. well integrity testing and design of fracture to stay with the target formation. No recorded instances in peer-reviewed literature of stimulation chemicals in down gradient water supplies (Osborn et al 2011).
	Fracture fluid escapes into aquifer via a well casing failure, or a fault/fracture/unconformity in formation/strata, and fluids enter aquifer that discharges to surface water	Aquatic ecosystems	Direct exposure	Unlikely	
	Residual stimulation fluid in the formation migrates down gradient and enters a spring or water supply bore	Residents, aquatic ecosystems, livestock	Ingestion, dermal, inhalation	Unlikely	
Panel Tank Sediments	Panel tank sediment dry and become windblown dusts, contaminating surrounding soil	Native terrestrial flora and fauna, stock, Residents adults and children	Direct exposure/ inhalation/ ingestion of dusts	Unlikely	The majority of sediments / residues are removed from site using vacuum truck and appropriately treated and disposed as soon as practicable. Residual sediments are considered to be minimal.
Flowback Water	Seepage of chemicals to a shallow aquifer used downgradient for domestic water supply	Residents: adults and children	Ingestion, dermal, inhalation	Unlikely	Panel tanks are double lined as a minimum standard. The shallowest aquifer in the Quaternary sediments is reported to be very saline and is covered by a thick layer of low permeability mud which substantially limits

Source	Exposure Scenario	Receptors	Exposure Pathways	Likelihood of Exposure Scenario	Comment
	Seepage of chemicals to a shallow aquifer used downgradient for stock water supply	Livestock	Ingestion	Unlikely	infiltration. Extraction of groundwater for domestic and livestock use is limited in the study area, with a small number of bores whose existence was confirmed during a bore inventory. Identified bores are typically remote from the well lease operations, or access groundwater resources that would be very unlikely to be affected by surface seepage of flowback fluid; hence exposure pathway is considered to be incomplete.
	Seepage of chemicals to a shallow aquifer that discharges to surface water	Aquatic ecosystems	Direct exposure	Unlikely	
	Spill or leak from panel tank or tank overflow	Terrestrial fauna (mammals, reptiles, birds), terrestrial flora	Ingestion, dermal, uptake	Possible	Possible overflows during prolonged periods of high rainfall (>300 mm of rainfall required). The panel tank size is based on maximum expected flow back and environmental waters to try to prevent overflow. The greatest hazard is to terrestrial flora in the immediate vicinity of an overflow. Provided flora populations are not unique to the area, re-colonisation is expected post-overflow event. Likelihood of occurrence can be reduced through minimising storage duration, and transition to storage tanks for flowback water transport. The toxicity of fluid is likely to decrease rapidly due to short biotransformation half-lives of most chemicals.

## 2.2 Identification of Complete Exposure Pathways

### 2.2.1 On-site Exposure Pathways

The potential on-site exposure pathways are discussed in Section 2.1.1. The most likely potential exposures were evaluated for workers, trespassers, small fauna, flora and soil microorganisms.

Based on information provided by Santos, there does not appear to be complete exposure pathways identified for on-site workers under normal circumstances, provided the following conditions are met:

- Adequate OH&S procedures are adhered to that prevent direct contact and inhalation exposure with chemicals during spills and when handling flowback water or sediments; and
- Sediments in the panel tanks are disposed of appropriately and as soon as practicable.

Exposure of trespassers is considered to be an unlikely occurrence due to the nature of the sites and their remote locations. Exposure to flowback water is a complete exposure pathway (ingestion, dermal and inhalation) if trespassing occurs on unsecured sites. Exposure will be limited through ensuring all panel tanks are at least 2m in height with signage clearly displayed to indicate that the well lease is a work zone and access is restricted to authorised personnel.

Exposure pathways to the flowback water and dried sediments in the panel tanks for large native fauna (i.e. kangaroos) and livestock can be considered incomplete on the basis that the panel tanks are at least 2 m high and the majority of sediments are removed for off-site disposal.

Exposure pathways (direct contact) for small flora and fauna (i.e. soil microorganisms, plants, small mammals, snakes, lizards and birds) is considered complete for exposure to the flowback water in the panel tanks if a spill or leak was to occur or if birds or small mammals entered the tanks. Practical measures implemented by Santos will minimise potential exposures.

### 2.2.2 Off-site Exposure Pathways

The on-site exposure pathways are discussed in Section 2.1.2. The most likely potential exposures were evaluated for residents, livestock, native flora and fauna and aquatic ecosystems. Three possible sources were identified: stimulation fluids, sediments from the panel tank or flowback water.

Exposures were considered unlikely for all scenarios based on the engineering (liners) and operational controls that are being implemented by Santos, and the geographical remoteness of the stimulation activities. In the unlikely event that an uncontrolled release was to occur potential exposures could include direct contact and inhalation exposures for residents, livestock, native flora and fauna and aquatic ecosystems. The probability of a release from a panel tank occurring can be reduced through minimising the duration of flowback fluid storage. In addition, the toxicity of the chemicals in the flowback fluid are likely to rapidly reduce through dissociation of organic chemicals and the relatively short biotransformation half-lives of the majority of the organic chemicals.

The potential exposure to stimulation fluids due to entry into an overlying water supply aquifer via a well casing breach or a natural preferential pathway (fault/fracture) is considered unlikely. Santos has established operational procedures to foster well integrity and that fractures are contained within the target formation. The exposure pathways associated with residual fluid in the target formation is discussed in Section 2.1.2.1.

The potential exposure to residual sediments in the panel tank becoming windblown dusts (direct contact/inhalation and ingestion of dust) and contaminating surrounding soil is considered unlikely. Sediments are removed via a vacuum truck during fluid removal and the residual volume of tank sediments is likely to be insufficient to result in concentrations in soil that would be of concern in the surrounding terrestrial



environment. Additionally, the height of the panel tanks (approximately 2m) would act to reduce sediments becoming windblown dusts.

The potential for seepage of flowback fluids from the panel tank into an underlying aquifer and migration to a domestic water supply or discharge into a creek are considered unlikely. Santos are using double lined panel tanks to prevent the loss of fluids onto the surface and subsequently into the subsurface. If releases were to occur, the typical surface lithology in the study area comprises a thick layer of fine-grained material overlying the sand beds that host a saline aquifer (e.g. Nanson et al., 1998). The fine-grained material will substantially reduce the infiltration potential of released fluids, and the shallowest aquifer is generally too saline for most beneficial uses (e.g. Cendon et al., 2010). The shallowest groundwater resource developed for water supply in the study area is the Tertiary Glendower Formation, which underlies the unconsolidated Quaternary sediments.

### 2.2.3 Residual Stimulation Fluids in Target Formations

The depths to oil target formations in the study area exceed 1,300 mbgl, and typical depths of stimulation operations targeting gas formations occur at depths greater than 2,000 m bgl. The exposure pathways associated with injected stimulation fluids are considered to include water supply bores screened either within the oil target formation itself, or in an aquifer formation immediately adjacent to the target formation.

#### 2.2.3.1 Groundwater Extraction in the Eromanga Basin

Due to the depth (1,300 m bgl) and variable water quality of the oil target formations in the Eromanga Basin, and of the presence of shallower resources of suitable quality and yield, groundwater from the target formations is not typically used by the few pastoralists and residential users within the study area.

The following observations are made based on the proximity of water supply wells to oil and gas well locations in Volume One:

- The average offset between the base of the deepest (Hutton Sandstone) aquifer and the top of the Permian gas reservoirs is of the order of 200 to 300 m, with most of the intervening section consisting of impermeable mudstones and shales. However, landholder bores generally access the shallowest viable aquifer which, in the vicinity of the site, can be the shallow Glendower or Winton Formations. The vertical offset between these aquifers and the top of the gas-bearing Permian interval is of the order of 1,300 m to 1,800 m for the Glendower and 1,000 m to 1,500 m for the Winton.
- The active landholder bores in the oil fields of the *study area* range from approximately 3 to 10 km from the nearest proposed oil fracture stimulation target well. The upper-most formation proposed for stimulation is the Wyandra Sandstone (Upper Cadna-Owie). The nearest bore, Mt Margaret No 14, targets the relatively shallow Winton formation for stock purposes. The vertical distance at this location between the Winton Formation and the Wyandra Sandstone is at least 750 m.
- The active landholder bores within, or near, the gas fields of the *study area* range from approximately 45 to 90 km away from the nearest proposed stimulation location. The upper-most targets proposed for stimulation are formations within the Nappamerri Group. The vertical distance between the Hooray Sandstone and the Nappamerri group at this location is greater than 600 m; and
- The Coothero Bore was observed during the WBBA, and according to DEHP, targets the Hooray Sandstone for stock water. The Coothero Bore is located approximately 45 km from the nearest proposed location for gas production, and more than 80 km from the nearest location proposed for oil production from the Hooray Sandstone.

Hence, based on the available information, it appears unlikely that a complete exposure pathway exists in the study area for stimulation fluids to reach a water supply well.

### **2.2.3.2 Groundwater Extraction in the Cooper Basin**

Due to the significant depth of the Cooper Basin aquifers, these have not been accessed for water supply and are only intercepted while targeting gas production. This is supported by WERD and DES (formerly DEHP) Groundwater Databases and a recent Water Bore Baseline Assessment.

While no known water supply wells are completed within the Cooper Basin, although significantly separated, water supply development in the Eromanga Basin is considered as the next vertically closest aquifer in the study area (as discussed above). However, the important water supply aquifers of the Eromanga Basin are separated from the Cooper Basin reservoir formations by a major structural unconformity and basal aquitard units of the Eromanga Basin, and therefore, hydraulic connection is limited.

Based on the absence of water supply development in the Cooper Basin formations, and the limited hydraulic connectivity and significant vertical distance between the Cooper Basin and Eromanga Basin formations, the potential for a complete exposure pathway for either an environmental or water supply receptor is considered to be very low.

### 3.0 PRODUCT DESCRIPTION

Halliburton provided chemical information for stimulation fluids (a.k.a, fluid systems), as follows:

- *DeltaFrac(H) Treatments'*
- *'DFS-BCG Treatments'*
- *'DFS-BCG(H) (formally HyborH) Treatments'*
- *'High Temperature Acid Spearheads'.*

Golder understands these fluids are used in SWQ stimulation operations, for stimulation oil and gas formations.

#### 3.1 Chemical Constituents

A list of the individual stimulation fluid chemicals considered in this risk assessment and their respective Chemical Abstracts Service Registry numbers (CAS RN) are listed in Table 4. This list is similar to, but will inevitably vary from, other published sources of stimulation fluid compositions, as the specific stimulation fluid mixtures are proprietary products of the stimulation contractors and their product suppliers.

None of the stimulation fluid chemical constituents presented by Halliburton in the 13 July 2012 disclosure and in the information provided by Santos (November 2019) contained benzene, toluene, ethylbenzene, xylenes (BTEX) or polycyclic aromatic hydrocarbons (PAHs). It is noted, however, that TPH, PAHs and BTEX occur naturally in conventional oil and gas condensate and it is possible that these chemicals may naturally be present in the reservoir groundwater used in the stimulation process. In terms of the reaction by products of these chemicals none of the reaction by products are known to exhibit higher toxicity than the parent compounds. However, it is recognised that geochemical reactions in the formation are complex and there are knowledge gaps in this specific area.

**Table 4: Stimulation Chemicals Sorted into Organic and Inorganic**

Chemical Type	Chemical Name	CAS RN
Organic	Acetic acid	64-19-7
	Alcohols, C12-16, ethoxylated	68551-12-2
	Amine oxides, cocoalkyldimethyl	61788-90-7
	Benzaldehyde	100-52-7
	Cinnamaldehyde	104-55-2
	Citric acid	77-92-9
	Diethylene glycol	111-46-6
	Methanol	67-56-1
	Triethanol amine	102-71-6
	Diethanol amine	111-42-2
	Ethanol	64-17-5
	Hydrotreated light petroleum distillate	64742-47-8
	Sodium polyacrylate	9003-04-7
	Alcohols, C12-C15, ethoxylated	68131-39-5
	Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4
	Fatty acids, tall-oil, ethoxylated	61791-00-2
	Butyl alcohol	71-36-3
	Tributyl tetradecyl phosphonium chloride	81741-28-8
	Glutaraldehyde	111-30-8
	Monoethanolamine borate	26038-87-9
	Guar gum	9000-30-0
	Ethylene glycol	107-21-1
	Hydroxylpropyl guar	39421-75-5
Inorganic	Aluminium oxide	1344-28-1
	Chlorous Acid, sodium Salt	7758-19-2
	Disodium octaborate tetrahydrate	12008-41-2
	Hydrochloric acid	7647-01-0
	Iron oxide	1309-37-1
	Sodium bisulfite	7631-90-5
	Sodium carbonate	497-19-8
Sodium chloride	7647-14-5	

Chemical Type	Chemical Name	CAS RN
	Sodium hydroxide	1310-73-2
	Sodium iodide	7681-82-5
	Titanium dioxide	13463-67-7
	Ulexite	1319-33-1
	Aluminium silicate	1302-76-7
	Crystalline silica, cristobalite	14464-46-1
	Crystalline Silica, quartz	14808-60-7
	Silica Gel	112926-00-8

### 3.2 Mass Balance Calculations

A quantitative mass balance assessment of stimulation fluid components was undertaken. Four ‘fluid systems’ were assessed. For each mixture, Halliburton provided to Santos details regarding the products in the mixture, and a complete inventory (including mass fraction) of the individual chemicals in the fluid mixtures. The composition of the stimulation fluids and calculated total mass and injected concentrations of the individual chemicals are summarised in further detail in Table D1, APPENDIX C. The fluid compositions in Table C1 were divided into chemical additives, proppants, water in additives, and makeup water.

Mass and mass fraction calculations were undertaken by Santos based on information provided by the stimulation service provider in their “Stimulation Fluid Disclosure”. Table 5 presents the estimated mass (constituent weight) of additives, proppant and water included in the stimulation fluid systems *per stimulation event* for both the oil and gas wells. The stimulation service provider noted that typically only one stimulation event is conducted on oil production wells, whereas up to six stimulation events may be conducted on conventional gas production wells.

**Table 5: Estimated Component Mass per Stimulation Event in Typical Stimulation Fluid Systems**

Fluid System	DeltaFrac(H)	DFS-BCG	DFS-BCG(H)	High Temp. Acid Spearhead
<b>Typical Fluid Volume <sup>1</sup></b>				
<b>Mass of Stimulation Fluid Components (kg)</b>				
Additives	566	1,904	2,064	307
Proppant	49,895	49,895	49,895	0
Water in additives	442	1298	1319	540
Makeup water	56,932	189,976	189,975	647
<b>Proportion of Stimulation Fluid Components by Mass (%)</b>				
Additives	0.5%	0.8%	0.8%	20.5%
Proppant	46.3%	20.5%	20.5%	-
Water in additives	0.4%	0.5%	0.5%	36.2%
Makeup water	52.8%	78.2%	78.1%	43.3%

Notes: <sup>1</sup>Fluid volume per stimulation event, information not provided at time of preparation of this report

The additives in typical stimulation fluid mixtures comprise approximately 0.5 to 0.8 wt.% of the injected mixture for the primary fluid systems (DeltraFrac(H), DFS-BCG and DFS-BCG(H)) and the friction reduced water typically used for flushing during the stimulation process. The relative percentage of additives is higher in the acid spearhead mixture as this is a concentrated acid, however, is used in smaller total volumes when required.

If either DeltraFrac(H), DFS-BCG or DFS-BCG(H) are used to perform up to six stimulation stages within a single gas production well, then the total mass of additives injected for the well (excluding proppant) would range from approximately 1,840 kg to 12,000 kg.

Following completion of the stimulation process, a considerable volume of the injected stimulation fluids are recovered upon flowback of the injected fluid. Studies performed by the USEPA (2004) indicated that approximately 60% of the stimulation fluids are recovered in the first three weeks, and total recovery was estimated to be from 68% to 82%. If it is conservatively assumed that 40% of the stimulation fluid volume remains in the formation (this being the “worst case”) this would correspond to 120 to 830 kg per stimulation event, or 740 kg to 5,000 kg per production well where up to six stimulation stages are performed (excluding proppant).

## 4.0 AQUATIC HAZARD ASSESSMENT

An environmental hazard assessment was undertaken to classify the stimulation chemicals based on persistence (P), bioaccumulation (B) and toxic (T) potential (hereafter referred to as PBT). Using PBT, stimulation chemicals were classified into one of three hazard groups: low, moderate or high. Chemicals classified as high hazard were considered to be chemicals of potential concern (COPC). Identification of a chemical as a COPC did not indicate an unacceptable hazard, nor did it include an evaluation of whether there was a link between source, pathway, and receptor. A high hazard classification indicated the need to evaluate exposure to these chemicals in greater detail. A discussion of possible exposure pathways (to people and the environment) is presented later in Section 2.0 and a qualitative (in the absence of exposure concentrations) characterization of risk is presented in Section 7.0.

The environmental hazard assessment approach developed for this study used national and international guidance for assessment of PBT in the risk assessment, classification, and regulation of chemicals. The guidance used is predominantly focussed on hazard to aquatic receptors. The available guidance for assessment of hazard to terrestrial receptors is somewhat limited. Consequently, in the assessment of environmental hazard, aquatic and terrestrial toxicity were considered separately. This section presents the environmental hazard and includes assessment of toxicity to aquatic receptors. Section 5.0 presents the assessment of toxicity to terrestrial ecological receptors. Section 6.0 presents the human health toxicity assessment.

### 4.1 Chemical Information Sheets

In order to assess environmental hazard, readily available chemical and physical properties and aquatic ecotoxicological data were collated for the chemicals assessed. This information was compiled into a chemical information sheet for each chemical. The chemical information sheets are presented in APPENDIX E. The data used in the environmental hazard assessment of each chemical, are discussed in the following paragraphs.

#### 4.1.1 Chemical and Physical Properties

Physical and chemical properties that affect the fate and behaviour of chemicals in the environment were used in the assessment of environmental P and B were obtained from the following sources in order of priority:

- 1) European Chemicals Agency (ECHA).
- 2) U.S. National Library of Medicine, National Center for Biotechnology Information, PubChem (PubChem).
- 3) Modelled data from USEPA (2009) EPISUITE™ (Estimation Programs Interface Suite™ for Microsoft® Windows) modelling software (only when data were not available from the SDS or the HSDB); and
- 4) For data poor chemicals, an internet search for reputable agencies or researchers who may have published data.
- 5) The Material Safety Datasheet (SDS) provided to Golder by the contractor (provided in APPENDIX B for reference).

USEPA (2009) EPISUITE™ software was developed by Syracuse Research Corporation (SRC) for the USEPA Office of Pollution Prevention and Toxics. EPISUITE™ provides a package of modelling software programs that can estimate physical/chemical, environmental fate and ecotoxicity data for organic chemicals. Inorganic chemicals should not be evaluated using EPISUITE™ because the estimation methods used are developed based on organic chemicals.

In using EPISUITE™, the following limitations for modelling organic chemicals are noted:

- 1) Chemicals that rapidly hydrolyse are unsuitable to be modelled namely, acid halides<sup>2</sup>, isocyanates<sup>3</sup>, sulphonyl chlorides<sup>4</sup>, siloxanes<sup>5</sup>, and alpha-chloro ethers. No chemicals identified in the list of stimulation chemicals considered for this study meeting this description were subject to modelling.
- 2) Data generated for organic salts may not be reliable, namely cationic salts of Group I, Group II, transition metals, Actinides, and Lanthanides. These should not be profiled because there are not adequate data in the estimation models' databases to predict properties with confidence. Organic salts however of Sodium (Na), Potassium (K), and Ammonium (NH<sub>4</sub><sup>+</sup>) may be evaluated reliably. No chemicals identified in the list of the stimulation chemicals considered for this study meeting this description were subject to modelling.
- 3) Organo-metallic compounds should not be evaluated. No chemicals identified in the list of the stimulation chemicals considered for this study meeting this description were subject to modelling.
- 4) Highly reactive compounds should not be modelled. No chemicals identified in the list of the stimulation chemicals considered for this study meeting this description were subject to modelling; and
- 5) High molecular weight compounds with a molecular weight greater than 1000 should not be modelled. No chemicals identified in the list of the stimulation chemicals considered for this study meeting this description were subject to modelling.

The EPISUITE™ estimation programs are simple to use, requiring only one input (e.g., CAS RN or SMILES notation<sup>6</sup>) from the user and a nomination of the program to be used based on the data required by the user. EPISUITE™ includes a database of chemical and physical properties, algorithms, and Quantitative Structure Activity Relationships (QSAR) models with which to estimate parameters. The following programs were used to generate physical and chemical data for this study:

- KOWWIN™ - octanol/water partition coefficient ( $K_{ow}$ ).
- HENRYWIN™ - Henry's Law Constant.
- BIOWIN™ - Biodegradation rate.
- LEV3EPI™ - Fugacity model to estimate partitioning to soil air, water and sediment.
- KOCWIN™ - Soil organic carbon partition coefficient ( $K_{oc}$ ); and
- BCFBAF™ - Bioconcentration factor.

<sup>2</sup> Acid halides are organic compounds containing the group -COX where X is a halogen atom (e.g., fluorine, chlorine, bromine, iodine). The inherent reactivity of acid halides precludes their free existence in nature; all are made by synthetic processes.

<sup>3</sup> Isocyanates are salts or esters of isocyanic acid, they are nitrogen based and may be described as neutral derivatives of primary amines. Isocyanates are represented by the general formula RNCO where R typically represents an alkyl (a monovalent radical, such as ethyl or propyl, having the general formula C<sub>n</sub>H<sub>2n+1</sub>) or aryl (an organic group derived from an aromatic hydrocarbon by removal of one hydrogen), but sometimes is linked to elements such as sulphur (S), silicon (Si), phosphorous (P), nitrogen (N), or the halogens (e.g., fluorine, chlorine, bromine, iodine).

<sup>4</sup> Sulfonyl chlorides have the general formula R-SO<sub>2</sub>-Cl which hydrolyse readily and are reactive with alcohols and amines.

<sup>5</sup> Siloxanes may be organic or inorganic and are made up of silicon, oxygen, plus (usually) carbon and hydrogen. They have the structural unit R<sub>2</sub>SiO, where R is an alkyl group, usually methyl.

<sup>6</sup> SMILES (Simplified Molecular Input Line Entry System) string is a linear notation for chemical structures.



## 4.1.2 Aquatic Toxicity Information

Acute and chronic aquatic ecotoxicological data were obtained from the following sources in order of priority:

- 1) USEPA (2009 and 2019) ECOTOXicology Database Version 4.0.
- 2) European Chemicals Agency (ECHA).
- 3) U.S. National Library of Medicine, National Center for Biotechnology Information, PubChem (Pubchem).
- 4) Safety Data Sheets (SDS) provided to Golder under this contract.
- 5) Australasian Journal of Ecotoxicology; and
- 6) Hazardous Substances Data Bank (HSDB, a toxicology database on the U.S. National Library of Medicine's Toxicology Data Network.

Where ecotoxicological data were not available for the chemicals of interest or a suitable surrogate, data were modelled using ECOSAR™ software version 1.11 dated July 2012. ECOSAR™ (which stands for Ecological Structure Activity Relationships) estimates the toxicity of chemicals to fish, aquatic invertebrates and microalgae in water. Toxic effect predictions are made using a set of QSARs models. QSARs predict the aquatic toxicity of untested chemicals based on their structural similarity to chemicals for which aquatic toxicity data are available. The toxicity data used to build the QSARs come from a database of publicly available and confidential data submitted to the US EPA New Chemicals Program. The QSARs used in ECOSAR™ correlate a compound's physicochemical properties and its aquatic toxicity within specific chemical classes and applies rules for selecting the appropriate chemical class for the compound. ECOSAR™ generates acute (short-term) toxicity and, when available, chronic (long-term or delayed) toxicity.

In using ECOSAR™, the following limitations are noted:

- 1) ECOSAR™, is designed to be used by individuals with some knowledge of environmental toxicology and organic chemistry, it is not designed to be used by individuals without experience in these fields.
- 2) Inorganic chemicals (e.g., sodium chloride, and non-polar inorganics such as titanium dioxide) should not be evaluated using ECOSAR™. No chemicals meeting this description identified in the list of stimulation chemicals considered for this study were subject to modelling.
- 3) Organo-metallic chemicals<sup>7</sup> should not be evaluated using ECOSAR™. No chemicals meeting this description identified in the list of stimulation chemicals considered for this study were subject to modelling.
- 4) For chemicals that rapidly hydrolyse or highly reactive chemicals it is suggested that evaluations using ECOSAR™ should take into consideration the degradation products in addition to the parent compounds. As a general rule, where:
  - Half-life < 1 hour, an assessment of degradation products may be recommended.
  - Half-life = 1 hour – 14-days, an assessment of parent and degradation products may be recommended.
  - Half-life > 14-days, an assessment of the parent product may be recommended.
- 5) Complex salts<sup>8</sup> with a complex organic cation and anion are difficult to model using ECOSAR™. In cases such as these the anion, cation and dissociation products should be taken into consideration. Based on the individual compounds it should be modelled as a single compound (neutralized with both cation and anion attached) or as separate individual compounds (dissociated with no charge). No

<sup>7</sup> Organo-metals are chemicals that contain carbon bonded to a metal species such as methyl mercury compounds.

<sup>8</sup> Complex salts such as potassium ferricyanide ( $K_3Fe(CN)_6$ ) which consists of a complex ion that does not dissociate in solution, differ from simple inorganic salts such as sodium chloride (NaCl) that readily dissociates in solution.

chemicals meeting this description identified in the list of stimulation chemicals considered for this study were subject to modelling, either as a compounds or as individual components.

- 6) Compounds with a molecular weight greater than 1,000 should not be evaluated using ECOSAR™. However, many polymers are made up of dimers, trimers and oligomers with a molecular weight of less than 1,000 and therefore the individual components could be assessed using the ECOSAR™ model separately. No chemicals meeting this description identified in the list of stimulation chemicals considered for this study were subject to modelling, either as compounds or as individual components.
- 7) The ECOSAR™ model does not have the ability to take into consideration molecular conformation, and therefore cannot distinguish between stereoisomers, optical isomers, tautomers, or specific conformations. This is important as three-dimensional molecular properties or molecular conformation can be important as this relates to absorption, binding, and resulting toxicity potential of a chemical; and
- 8) Chemicals with unknown or variable composition (UVCs, such as oligomers, natural fats, or a product mixture) may have different results using ECOSAR™ depending on the composition assessed with the model. For chemicals such as these the representative structures would need to be identified and noted or all possible compositions would need to be assessed. No chemicals meeting this description identified in the list of stimulation chemicals considered for this study were subject to modelling.

## 4.2 Hazard Versus Risk

The approach presented in the following paragraphs is an assessment of environmental hazard, rather than environmental risk. Risk assessment of chemicals in the environment is based on a comparison between the levels to which an organism in a particular environmental compartment (e.g. water) is exposed, and a maximum level which an organism can tolerate based on a defined exposure scenario (in an environmental compartment) without significant adverse effect. The environmental hazard assessment presented herein, is not a risk assessment *per se* because it does not consider likely exposure concentrations for most of the stimulation chemicals. A qualitative assessment of the risk will be conducted based on an identification of relevant exposure pathways associated with the stimulation fluid COPC.

Approaches to ranking or screening chemicals for the purposes of assessing relative “hazard” or “risk” can include likelihood and consequence matrices. In these matrices, a chemical may be scored high for consequence (which may be a function of PBT) but low for likelihood (which may be a function of whether the chemical is considered likely to be present in the environment at hazardous concentrations). Overall, such a chemical may then score a relatively lower hazard or risk than would be identified from its consequence (or PBT) score alone. The environmental hazard assessment approach here works on the premise of potential for PBT; that is, the data that may apply to “consequence”. “Likelihood” of exposure was not assessed.

## 4.3 Hazard Assessment Approach

The environmental hazard assessment approach developed for this study is consistent with national and international guidance for assessment of potential for PBT in the risk assessment, classification, and regulation of chemicals. Physical and chemical properties that affect the fate and behaviour of chemicals in the environment (including degradation rates, partition coefficients, and aquatic ecotoxicological data) were used in assessment of environmental PBT potential.

The Australian National Framework for Chemicals Environmental Management (NChEM) guidance manuals were consulted in preparation of the environmental hazard assessment approach, namely:

- EPHC (2009a). Environmental Risk Assessment Guidance Manual for Industrial Chemicals; and
- EPHC (2009b). Environmental Risk Assessment Guidance Manual for Agricultural and Veterinary Chemicals.

These guidance manuals present the data requirements and methodology for assessment for environmental hazard and risk assessment of industrial and agriculture and veterinary chemicals, consistent with international best practice. NChEM guidance was prepared by the National Environment Protection and Heritage Council (EPHC) for the Department of the Environment, Water, Heritage and the Arts (DEWHA). DEWHA undertakes environmental risk assessments of industrial chemicals for the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) and of agricultural and veterinary chemicals for the Australian Pesticides and Veterinary Medicines Authority (APVMA).

In addition, the following literature was consulted for PBT assessment guidance:

- ANZECC and ARMCANZ (2000). Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, National Water Quality Management Strategy, Australian and New Zealand Guidelines for Fresh and Marine Water Quality, October 2000.
- ANZG (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia.
- CCME (2008) Canadian Council of Ministers of the Environment, The National Classification System for Contaminated Sites (NCSCS) Guidance Document.
- Christensen et al. (2003) Assessment Tools under the New European Union Chemicals Policy.
- Environment Canada (2003) Existing Substances Branch Guidance Manual for the Categorization of Organic and Inorganic Substances on Canada's Domestic Substances List, Determining Persistence, Bioaccumulation Potential, and Inherent Toxicity to Non-human Organisms.
- European Commission (2003) Technical Guidance Document on Risk Assessment in support of Commission Directive 93/67/EEC on Risk Assessment for New Notified Substances, Part II Chapter 3 Environmental Risk Assessment.
- ECETOC (2005) Risk Assessment of PBT Chemicals.
- Franke et al. (1994) The Assessment of Bioaccumulation.
- Langley (1993) Refining Exposure Assessment. In: The Health Risk Assessment and Management of Contaminated Sites. Proceeding of the Second National Workshop on the Health Risk Assessment and Management of Contaminated Sites.
- Swann et al. (1983) A rapid method for the estimation of the environmental parameters octanol/water partition coefficient, soil sorption constant, water to air ratio, and water solubility. Residue Reviews; and
- UNECE (2011) Globally Harmonised System (GHS) of Classification and Labelling of Chemicals. Revision 4. Part 4 Environmental Hazards and Annex 9 Guidance on hazards to the aquatic environment.

The above guidance is predominantly focussed on hazard to aquatic receptors. Guidance for assessment of hazard to terrestrial receptors is limited. The following sources were consulted in developing an approach for assessment of hazard to terrestrial receptors (this is discussed later in Section 5.0):

- European Commission (2003) Technical Guidance Document on Risk Assessment in support of Commission Directive 93/67/EEC on Risk Assessment for New Notified Substances, Part II Chapter 3 Environmental Risk Assessment; and
- National Environment Protection Council (NEPC) (2013). National Environment Protection (Assessment of Site Contamination) Amendment Measure.

## 4.4 Environmental Hazard Classes

The environmental hazard assessment approach presented herein uses several lines of evidence (LOE) that were assessed in a weight of evidence (WOE) framework. Physical, chemical and toxicological parameters selected for assessment of potential for PBT were assigned values that equate to the following hazards:

- High Hazard
- Moderate Hazard; and
- Low Hazard.

Golder has refined this approach on a variety of projects including for assessment of stimulation chemicals. Hazard may be assessed using numeric or non-numeric approaches. Golder's experience using numeric indices is that greater sensitivity (than is possible) in the assessment of hazard is implied when generating statistical averages (e.g., to one or more decimal place). For example, using a numeric score of 1, 2, and 3 for low, moderate, and high hazard respectively for a variety of parameters, average scores of 1.7 or 2.2 could be obtained. These scores imply differences in hazard where none may be determined from the data assessed and the approach. Assessment of hazard via a non-numeric, descriptive approach avoids this and hence a non-numeric approach was used herein.

Hazard was assigned to individual parameters representative of P, B, or T. The LOE were used to assign an overall hazard classification (based on the WOE) for each chemical. There were no minimum data requirements (i.e. in some instances a hazard was evaluated on few data for each of P, B, or T). In order to quantify this uncertainty, a measure of data gaps was calculated for each chemical. In the assessment of T, the highest hazard assigned to either acute or chronic data was adopted as the final hazard classification for T. The approach for assessment of T differed from P and B because some chemicals have few aquatic ecotoxicological data. This resulted in weighting of the assessment towards T and is considered conservative and appropriate for a screening level risk assessment.

Not all the physical and chemical parameters collated for the stimulation chemicals presented in the chemical information sheets (refer to APPENDIX E) were used in the environmental hazard assessment.

The hazard benchmarks set for this study are considered a relative assessment. The benchmarks were assigned with the intent of incorporating the precautionary principle (i.e., designed to be inherently conservative and therefore biased towards capturing, rather than rejecting chemicals that are likely to pose PBT hazard).

The individual hazards assigned to the respective benchmarks for each parameter are presented in Section 4.6.

## 4.5 Assessment of Organic Versus Inorganic Substances

The approach for the aquatic hazard assessment of inorganic and organic substances differs. The approach for the assessment of inorganic substances<sup>9</sup> was devised based predominantly on guidance published by Environment Canada (2003). Following the Environment Canada (2003) approach, toxicity is considered in conjunction with persistence. The assessment of bioaccumulation potential of inorganic chemicals is more difficult to interpret in hazard assessment and was not included in the approach presented herein.

Non-metal-containing inorganic substances may be assessed following guidance for organic substances.

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<sup>9</sup> Inorganic substances may be described as metal-containing inorganic salts, organic-metal salts, and ionizable inorganics

Justification for the hazard assigned to the individual parameters and the adopted ranges are discussed in the following section.

## 4.6 Environmental Hazard Assessment Parameters

The physical, chemical and aquatic ecotoxicological data collated and assessed in the aquatic environmental hazard assessment are presented in the chemical information sheets (refer to APPENDIX E) and summarised in Table 6 below.

**Table 6: Physical, Chemical and Toxicological Parameters Used in Environmental Hazard Assessment**

PBT	Applicable to Organic / Inorganic Chemicals	Parameter	Units
<b>Persistence</b>	Inorganic / Organic	Solubility	mg/L
	Organic	Henry's Law constant	atm m <sup>3</sup> /mol
	Organic	log K <sub>oc</sub>	L/kg
	Organic	EPISUITE™ Ready biodegradability	Qualitative
	Organic	EPISUITE™ Ultimate Biodegradation (Biowin 3)	Qualitative
	Organic	EPISUITE™ Primary Biodegradation (Biowin 4)	Qualitative
	Organic	EPISUITE™ Anaerobic Biodegradation (Biowin 7)	Qualitative
<b>Bioaccumulation</b>	Organic	BCF	unitless
	Organic	log K <sub>ow</sub>	unitless
<b>Toxicity</b>	Inorganic / Organic	Aquatic ecotoxicological data for: Plants Invertebrates Fish  Acute L(E)C50 Chronic NOEC Chronic LOEC/MATC//EC50	mg/L

The following sections describe in more detail the parameters used, the benchmarks set, and the hazard assigned.

### 4.6.1 Data Gaps

Where data were unavailable for a chemical, and/or data could not be modelled using EPISUITE™ the parameter was excluded from the environmental hazard assessment. An overall hazard was assigned for each of grouping for P, B and T based on the WOE (i.e., there were no minimum data requirements). In some instances, a hazard was evaluated on few data for each of P, B, or T. Because of this it was necessary to quantify the extent of data gaps. This is expressed as a percentage in the PBT summary in Table C2 (APPENDIX C).

### 4.6.2 Surrogates

Where data for listed chemicals were unavailable, data for a suitable surrogate chemical were adopted. Surrogate chemicals were selected on the basis of structural similarity (or structure activity relationships, SAR), functional groups present, relevant precursors or breakdown products, data availability, and professional judgement. The approach taken assumes that the chemical and physical parameters of the

surrogate are predominantly the same as the chemical in question. Use of surrogates is supported by relevant guidance (Environment Canada, 2003; NEPC, 2013; and UNECE, 2011) and is considered to be scientifically defensible.

Where chemicals were assessed using a surrogate, this is documented in this report for transparency. Where chemicals could not be assessed using a surrogate, they were not assessed due to insufficient data.

### 4.6.3 Persistence

The approach for assessment of persistence for inorganic and organic chemicals differs.

Inorganic chemicals were not directly assessed for persistence, although high solubility (particularly compared with toxicity) was considered a potential hazard as this could lead to rapid uptake into organisms. Chemicals that are soluble through dissociation into simple anions and cations have been discussed separately.

Organic chemicals were assessed based on solubility, Henry's Law Constant,  $K_{oc}$ , and degradation rates.

#### 4.6.3.1 Solubility

Aqueous solubility is measured in units of mg/L (or g/m<sup>3</sup>) at temperatures of 20°C – 25°C. Aqueous solubility is temperature dependent. The solubility of a chemical will influence the rate of migration (or mobility) of that chemical in the environment. An increase in solubility leads to a decrease in adsorption to soil and greater mobility (Langley, 1993). Poor solubility may result in low bioavailability and lower biodegradation rates. A poorly soluble chemical may be considered to have a tendency to persist and therefore have more time to exert a toxic effect. Conversely, high solubility could also imply greater mobility, greater bioavailability and greater hazard. Solubility, rather than effective solubility<sup>10</sup>, was adopted in this hazard assessment for simplicity. Effective solubility is a more accurate measure of chemical availability and mobility. However, effective solubility cannot be reliably predicted or modelled and is dependent on the chemical mixture and environmental factors (e.g. pH, temperature, oxidising or reducing conditions, etc). Solubility is a conservative and simple measure of mobility and availability of a chemical in groundwater and hence was used in this hazard assessment.

Organic substances with low water solubility typically have high predicted bioaccumulation factors and / or high log  $K_{ow}$  and hence may be considered highly bioaccumulative unless there is evidence to suggest otherwise (Environment Canada, 2003).

Inorganic substances generally need to be dissolved in water to exert deleterious effects (to aquatic receptors) and consequently solubility should be considered in conjunction with aquatic toxicity, as recommended by Environment Canada (2003). Environment Canada (2003) recommends that when the solubility of the substance is greater than the acute toxicity, the substance is likely to pose a hazard. Herein, the lowest acute ecotoxicological endpoint obtained for the chemical of interest was used for data considered in assessment of toxic potential). Where solubility data were not found for the inorganic chemicals considered, solubility was assumed to be greater than acute toxicity. This is conservative and results in a high hazard classification.

Low solubility was signed a high hazard (based on likelihood of persistence and high bioaccumulation tendency) for organic chemicals. Conversely, low solubility was assigned a low hazard for inorganic chemicals. The hazard category benchmarks adopted in this study are summarised in Table 7 and Table 8 for organic and inorganic substances, respectively. These were derived based on professional judgement (noting that the UNECE (2009) consider a substance with a solubility of less than 1 mg/L to be poorly soluble).

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<sup>10</sup> Effective solubility is the solubility of a compound that will dissolve from a chemical mixture (e.g., gasoline). The effective solubility of a compound from a chemical mixture is less than its aqueous solubility.

**Table 7: Solubility Benchmarks for Organic Substances**

Hazard Category	Hazard Symbol	Solubility (mg/L)
High Hazard	●	<10
Moderate Hazard	◐	10 – 100
Low Hazard	○	>100

**Table 8: Solubility Benchmarks for Inorganic Substances**

Hazard Category	Hazard Symbol	Solubility (mg/L)
High Hazard	●	>10
Moderate Hazard	◐	1 – 10
Low Hazard	○	<1

The benchmarks for the assessment of solubility in conjunction with aquatic toxicity for inorganic chemicals are presented in Table 9. The benchmarks were set following Environment Canada (2003). Because only two categories exist, a moderate hazard is not possible.

**Table 9: Benchmarks for Solubility Considered in Conjunction with Acute Toxicity (Inorganic Substances)**

Hazard Category	Hazard Symbol	Solubility & Toxicity (mg/L)
High Hazard	●	Solubility > Acute toxicity
Low Hazard	○	Solubility < Acute toxicity

#### 4.6.3.2 Henry's Law Constant

Henry's Law is a partition coefficient which is a measure of the tendency of a substance to partition into air from water at constant temperature and pressure. It can be used as a measure of environmental fate and transport of a substance. Henry's Law Constant is calculated using vapour pressure, molecular weight and water solubility for a chemical and is commonly expressed either as 'dimensionless' (i.e., no units) or in 'dimensions' (i.e., units of atmospheres (atm) m<sup>3</sup>/mol or Pa m<sup>3</sup> mol<sup>-1</sup>). Henry's Law Constant data were used in the environmental hazard assessment even though one of the parameters on which it is based (namely solubility) is assessed and scored separately.

Organic chemicals with a low Henry's Law Constant (i.e., low volatility and high solubility) are likely to be more persistent in the environment. Organic chemicals with a high Henry's Law Constant (i.e., high volatility, low water solubility) are likely to be less persistent in the environment. Organic chemicals with a low Henry's Law Constant were considered to present a greater environmental hazard in this assessment.

Henry's Law Constant benchmarks were assigned based on ranges provided in CCME (2008), Langley (1993) and professional judgement. The benchmarks are summarised in Table 10.

Inorganic chemicals were not assessed using Henry's Law Constant.

**Table 10: Benchmarks for Henry's Law Constant**

Hazard Category	Hazard Symbol	Henry's Law Constant (atm m <sup>3</sup> /mol)
High Hazard	●	<6.1x10 <sup>-09</sup>
Moderate Hazard	◐	6.1x10 <sup>-09</sup> - 6.1x10 <sup>-05</sup>
Low Hazard	○	>6.1x10 <sup>-05</sup>

### 4.6.3.3 Soil Adsorption Partition Coefficient ( $K_{oc}$ )

The soil organic carbon-water partitioning coefficient is the ratio of the mass of a chemical that is adsorbed in the soil per unit mass of organic carbon in the soil. It is a measure of the tendency for organic substances to be adsorbed by soil or sediment.  $K_{oc}$  values are useful in predicting the mobility of organic contaminants in soil and sediment. Higher  $K_{oc}$  values correlate to less mobile organic chemicals while lower  $K_{oc}$  values correlate to more mobile organic chemicals. Organic chemicals with lower mobility (greater persistence) are considered in this assessment to be a greater environmental hazard. The benchmarks for  $K_{oc}$  used are presented in Table 11. These benchmarks were derived after consideration of information provided in CCME (2008); Langley (1993) and Swann et al. (1983) and professional judgement.

**Table 11: Log  $K_{oc}$  Benchmarks**

Hazard Classification	Hazard Symbol	Log $K_{oc}$ Range (L/kg)
High	●	<3.7
Moderate	◐	2.7-3.7
Low	○	>2.7

### 4.6.3.4 Biodegradation

Degradation takes into account physical, biological, and chemical changes in a chemical over time (Langley, 1993). Biodegradation is “the process by which organic substances are decomposed by micro-organisms (mainly aerobic bacteria) into simpler substances such as carbon dioxide, water and ammonia” (UN, 1997 cited in OECD, 2010). The rate of biodegradation is generally described as percentage degradation over a period of days (28 days is often the benchmark), but sometimes longer or shorter exposure periods are reported. The longer the time taken for a substance to degrade, the more environmentally persistent that chemical is considered to be. Lower percentages of biodegradation over 28 days were considered to be indicative of higher environmental hazard.

The benchmarks assigned were based on guidance in Environment Canada (2003), UNECE (2011), the European Commission (2003) and professional judgement.

The following biodegradation data were sought:

- Aerobic Ready Biodegradability.
- Ultimate Biodegradation.
- Primary Biodegradation; and
- Anaerobic Biodegradation.

The use of more than one biodegradation measure was to capture appropriate measures of biodegradation for the likely environmental exposures to stimulation chemicals. Summary details of the tests are described below.

- i) **Aerobic Ready Biodegradation.** The aerobic ready biodegradability test is considered a stringent test likely to generate slower degradation rates than may actually occur in the natural environment or in a sewage treatment plant. It employs a high concentration of the test chemical and biodegradation rates are measured via non-specific parameters such as dissolved organic carbon, biological oxygen demand, and carbon dioxide production. Ready biodegradability testing is commonly used as the first screen to test for biodegradation potential and employs the use of microorganisms that are not pre-adapted to degradation of the chemical substance. A negative result in a test for ready biodegradability does not necessarily mean that the chemical will not be degraded under relevant environmental conditions;



- ii) **Anaerobic Biodegradation.** Anaerobic biodegradation testing is a screening test to measure the potential for biodegradation under anoxic conditions. The test substance (the only source of added organic carbon in the test) is exposed to diluted anaerobically digested sludge. Biodegradability of the test substance is measured via increased headspace pressure resulting from the evolution of carbon dioxide, methane and total inorganic carbon. The test is performed at 35°C to simulate the temperature in heated digesters or anaerobic sludge treatment. This temperature favours anaerobic biodegradation of chemicals with low or moderate toxicity to anaerobic bacteria. On the other hand, because this test uses a high concentration of test substance, negative results may be observed for some chemicals that would otherwise be biodegradable at lower concentrations. Anaerobic biodegradation half-lives were sought on the basis that the groundwater environment is likely to be anaerobic;
- iii) **Ultimate Biodegradation.** Ultimate biodegradation<sup>11</sup> testing aims to measure the time taken for a test substance to biodegrade completely into simple molecules e.g. carbon dioxide, biomass, water and other inorganic substances like ammonia; and
- iv) **Primary Biodegradation.** Primary biodegradation<sup>12</sup> testing measures the disappearance of the compound as a result of its biotransformation to another product.

A summary of the nominated aerobic ready biodegradation and anaerobic biodegradation benchmarks and the associated hazards assigned are presented in Table 12. These data were generated by EPISUITE™ BOWIN™ and represent one of two potential outputs and hence a moderate hazard is not possible.

**Table 12: Ready Aerobic and Anaerobic Biodegradation Benchmarks**

Hazard Classification	Hazard Symbol	Aerobic Ready Biodegradability (EPISUITE™)	Anaerobic Biodegradation (EPISUITE™ BOWIN 7)
High	●	No	≤0.5 Does not biodegrade fast
Low	○	Yes	≥0.5 Biodegrades fast

A summary of the nominated Ultimate Survey Biodegradation and Primary Biodegradation benchmarks and associated hazards are presented in Table 13. These data were generated using EPISUITE™ and BOWIN™.

**Table 13: Ultimate and Primary Biodegradation Benchmarks**

Hazard Classification	Hazard Symbol	Ultimate Survey Biodegradability (EPISUITE™ BOWIN 3)	Primary Biodegradation (EPISUITE™ BOWIN 4)
High	●	<2 (2 equates to months, 1 equates to longer than months)	<2 (2 equates to months, 1 equates to longer than months)
Moderate	◐	2 – 3 (2 equates to months, 3 equates to weeks)	2-3 (2 equates to months, 3 equates to weeks)
Low	○	>3 (3 equates to weeks, 4 equates to days, 5 equates to hours)	>3 (3 equates to weeks, 4 equates to days, 5 equates to hours)

#### 4.6.4 Bioaccumulation

Bioaccumulation potential was assessed for organic chemicals only and using two parameters: BCF and log K<sub>ow</sub>, as discussed below.

<sup>11</sup> Ultimate biodegradation is a measure of inherent biodegradability. Inherent biodegradability is similar to ready biodegradability testing with the exception that a low concentration of the test substance is used with a greater proportion of microorganisms that may be pre-adapted to the test substance. The conditions of an inherent biodegradation test are optimised to achieve rapid biodegradation. Inherent aerobic biodegradation data may over estimate the potential for biodegradation in the natural environment.

<sup>12</sup> Primary biodegradation is a measure of inherent biodegradability.

Bioaccumulation was not assessed for inorganic chemicals because the bioaccumulation of inorganic chemicals is difficult to predict and was considered beyond a screening level risk assessment.

#### 4.6.4.1 Octanol / Water Partition Coefficient ( $K_{ow}$ )

The octanol-water partition coefficient ( $K_{ow}$ ) is the ratio of the solubility of a chemical in octanol divided by its solubility in water. It is a measure of the preference for an organic substance to dissolve in an organic solvent or water and is used as a measure of lipophilicity and movement of a substance across a cell membrane. It is usually expressed as Log  $K_{ow}$ . It can be used to estimate environmental fate and transport of a chemical.

There is general consensus in the literature that a Log  $K_{ow}$  of less than 3.5 represents low or moderate potential to bioaccumulate, and a Log  $K_{ow}$  of greater than 3.5 represents an increased potential to bioaccumulate. UNECE (2009) consider that substances with Log  $K_{ow}$  less than 4 have no potential to bioaccumulate. UNECE (2009) and CCME (2008) consider that substances with Log  $K_{ow}$  greater than 4 have the potential to bioaccumulate. The European Commission (2003) consider that substances with Log  $K_{ow}$  greater than 4.5 have the potential to bioaccumulate. The benchmarks used in this study are summarised in Table 14 and were largely based on the classes provided by European Commission (2003), UNECE (2009), CCME (2008) and professional judgment.

Log  $K_{ow}$  is assessed for organic chemicals only.

**Table 14: Log  $K_{ow}$  Benchmarks**

Hazard Classification	Hazard Symbol	Log Kow (unitless)
High	●	>5
Moderate	◐	3-5
Low	○	<3

#### 4.6.4.2 Bioconcentration Factor (BCF)

The bioconcentration factor (BCF) is a measure of the tendency for a substance in water to accumulate in organisms, in particular fish. This parameter is an important determinant for uptake into organisms, potential for biomagnification and secondary poisoning (food chain transfer to higher trophic levels). The higher the BCF, the greater the potential for bioconcentration and secondary poisoning. The benchmarks assigned are summarised in Table 15. These benchmarks were assigned after consideration of information provided in ANZECC and ARMCANZ (2000), Franke et al. (1994), European Commission (2003), UNECE (2009) and professional judgment. The benchmarks presented by Franke et al. (1994) were more conservative than those presented by ANZECC and ARMCANZ (2000), the European Commission (2003) and UNECE (2009). As ANZECC and ARMCANZ (2000), European Commission (2003) and UNECE (2011) guidance were prepared with significant peer review by international scientific experts in their development, these guidance frameworks were given precedence over Franke et al. (1994). BCF was assessed for organic chemicals only.

**Table 15: BCF Benchmarks**

Hazard Classification	Hazard Symbol	BCF (unitless)
High	●	>5000
Moderate	◐	1000 - 5000
Low	○	<1000

## 4.6.5 Toxicity

There were frequently insufficient data to enable an assessment of both acute and chronic toxicity hence the highest hazard assigned to either the acute or chronic data was adopted as the classification of hazard for toxic (T) potential for the stimulation chemicals. This resulted in weighting of the assessment towards T. This was considered conservative and appropriate for a screening level hazard assessment.

### 4.6.5.1 Aquatic Ecotoxicology

To assess the toxic (T) potential of the chemicals, readily available acute (i.e., predominantly L(E)C<sub>50</sub><sup>13</sup>) and chronic (i.e., NOEC<sup>14</sup>, LOEC<sup>15</sup>, MATC<sup>16</sup> and non-lethal EC<sub>50</sub>) data for aquatic organisms were collated.

Chronic aquatic ecotoxicology data are preferred over acute because exposure occurs over a longer time-period, usually during a significant period of the organism's life-cycle or during a sensitive life-stage. However, acute ecotoxicological data dominate in the literature compared to chronic data. Acute toxicity is relevant if the anticipated environmental exposure concentrations are in the acute toxicity concentration range. The receptor groupings considered (plants, invertebrates and fish) and endpoints considered (acute, chronic) were given equal weighting.

As freshwater aquatic organisms were considered the most likely aquatic receptor exposed to stimulation chemicals albeit the likelihood for exposure is low (refer Section 7.0), freshwater ecotoxicological data were used in the assessment of toxic potential. There are generally few aquatic ecotoxicological data available for amphibians and reptiles, and no guidance was found in the international literature on the assessment of hazard for these receptor groups. Hence these receptors groups were excluded from the assessment of T.

The data obtained from USEPA ECOTOX database were screened as follows:

- Endpoints selected included mortality (acute), growth (chronic) and reproduction (chronic) for plants, invertebrates and fish;
- Chronic mortality exposures were not considered.
- Studies longer than 7 d were considered to be chronic (with the exception of microalgae).
- Studies shorter than 24hrs were not considered; and
- L(E)C<sub>x</sub> endpoints other than L(E)C<sub>50</sub> were not considered (namely EC<sub>0</sub>, EC<sub>100</sub>, EC<sub>10</sub>, EC<sub>20</sub>, etc).

Although included in the environmental hazard assessment, NOECs are not statistical or empirical point estimates of ecological effect. NOECs are hypothesis-based and reflect the test design (i.e., concentrations of exposure) rather than the dose-response curve. However, NOECs are well documented in the literature and are commonly used in ecological risk assessment and in derivation of risk-based ecological guidelines (preferred endpoints are EC<sub>10</sub>s (Warne et al. 2018)). Additional chronic endpoints namely LOEC, MATC and EC<sub>50</sub> were included in the hazard assessment to reduce the uncertainty associated with NOEC data.

Chronic data modelled using ECOSAR™ represent the geometric mean of NOEC and LOEC endpoints. Because the hazard assessment differentiated between NOEC and LOEC in assessment, these ECOSAR data were not used.

The chronic aquatic ecotoxicology ranges (for plants, invertebrates and fish) were assigned after consideration of information provided in European Commission (2003); UNECE (2009) and professional judgement. As a conservative approach to assessment of T, the lowest chronic effect concentration for each

<sup>13</sup> Lethal (or effect) concentration that kills (or effects) 50% of the test population.

<sup>14</sup> No observed effect concentration.

<sup>15</sup> Lowest observed effect concentration.

<sup>16</sup> Maximum acceptable tolerable concentration.

of NOEC, LOEC/MATC/EC<sub>50</sub>, and the lowest acute effect concentration for L(E)C<sub>50</sub> were used. The benchmarks adopted for chronic aquatic toxicological data are summarised in Table 16 and Table 17. The chronic studies represent non-lethal endpoints of growth and reproduction.

**Table 16: Chronic Aquatic Toxicity NOEC Benchmarks**

Hazard Classification	Hazard Symbol	Chronic Aquatic NOEC (mg/L)
High	●	<0.01
Moderate	◐	0.01 – 0.1
Low	○	>0.1

**Table 17: Chronic Aquatic Toxicity LOEC/MATC/EC<sub>50</sub> Benchmarks**

Hazard Classification	Hazard Symbol	Chronic Aquatic NOEC (mg/L)
High	●	<0.1
Moderate	◐	0.1 – 1
Low	○	>1

The acute aquatic ecotoxicity benchmarks (for plants, invertebrates and fish) were assigned after consideration of information provided in European Commission (2003); UNECE (2005) and professional judgement. The acute aquatic toxicity benchmarks are summarised in Table 18. The acute toxicity studies represent lethal, growth and reproduction endpoints.

**Table 18: Acute Aquatic Toxicity L(E)C<sub>50</sub> Benchmarks**

Hazard Classification	Hazard Symbol	Acute Aquatic L(E)C <sub>50</sub> (mg/L)
High	●	<1
Moderate	◐	1 – 100
Low	○	>100

#### 4.6.6 Environmental Hazard Classification

The environmental hazard classification assigned was based on the WOE for multiple LOE. The classifications were based on the available data, even if there were data gaps. Consequently, a measure of data gaps was assigned to quantify this uncertainty.

It should be noted that T classifications for a number of chemicals were based on modelled, rather than measured data. The modelled ecotoxicological data were from ECOSAR™ (discussed in Section 4.1.2). There is uncertainty associated with modelled data. The one (1) chemical for which modelled toxicological data was used is shown below in Table 19.

**Table 19: List of Chemicals Assessed Using Modelled ECOSAR™ Data**

Chemical	CAS RN
Amine oxides, cocoalkyldimethyl	61788-90-7

Surrogate chemicals were used for chemicals where the physico-chemical and/or toxicological data were insufficient. The four (4) chemicals assessed using surrogates are presented in Table 20.

**Table 20: List of Surrogate Chemicals**

Chemical	CAS RN	Surrogate Descriptor
Amides, C18-unsaturated, N,N-bis(hydroxyethyl)	93-83-4	Surrogate for Amides, tall-oil, fatty, N,N-bis(hydroxyethyl) (CAS RN 68155-20-4)
Tetra-n-butyl phosphonium chloride	2304-30-5	Surrogate for Tributyl tetradecyl phosphonium chloride (CAS RN 81741-28-8)
Reaction products of monoethanolamine and boric acid	94095-04-2	Surrogate for Monoethanolamine borate (CAS RN 26038-87-9)
Disodium octaborate tetrahydrate	12008-41-2	Surrogate for Ulexite (CAS RN 1319-33-1)

There was an additional chemical for which physico-chemical and/or toxicological data were insufficient and for which a suitable surrogate could not be found. This chemical is presented in Table 21 below and was not included in the environmental hazard classification assessment.

**Table 21: Chemicals Not Assessed**

Chemical	CAS RN
Hydroxypropyl guar	39421-75-5

A further group of four (4) inorganic chemicals presented in Table 22 below were not assessed as these were considered to be chemically equivalent to sand and therefore assessed as such.

**Table 22: Chemicals Equivalent to Sand**

Chemical	CAS RN
Crystalline silica, quartz	14808-60-7
Silica gel	112926-00-8
Aluminium silicate	1302-76-7
Crystalline silica, cristobalite	14464-46-1

Of the thirty-nine (39) stimulation chemicals assessed<sup>17</sup>, thirty-four (34) were classified for hazard (excluding the sand compounds). Of these thirty-four chemicals, seventeen (17) were classified low hazard, ten (10) were classified moderate hazard, and seven (7) were classified high hazard. The remaining five (5) chemicals were not subject to PBT assessment as discussed earlier and presented in Table 21 and Table 22.

Five (5) chemicals, hydrochloric acid, sodium carbonate, sodium chloride, sodium hydroxide and sodium iodide were not scored for persistence as these chemicals readily dissociate in the environment. An additional chemical, guar gum was not scored for persistence as it expected to be readily biodegradable based on its composition (a polysaccharide composed of galactomannan).

The stimulation chemical environmental hazard classifications of the thirty-four (34) chemicals are summarised in Table 23, with the detailed PBT values for each chemical provided in Table C2, APPENDIX C.

<sup>17</sup> Excluding hydroxypropyl guar. Guar gum was assessed

**Table 23: Stimulation Chemicals Environmental Hazard Classifications**

Rank	Name For Report	CAS RN	Data Gaps %
High	Alcohols, C12-C15, Ethoxylated	68131-39-5	6%
	Surrogate for Amides, tall-oil, fatty, N,N-bis(hydroxyethyl)	93-83-4	11%
	Chlorous acid, sodium salt	7758-19-2	27%
	Disodium octaborate tetrahydrate	12008-41-2	18%
	Sodium bisulfite	7631-90-5	36%
	Sodium iodide	7681-82-5	82%
	Surrogate for Ulexite	12008-41-2	18%
Moderate	Alcohols, C12-16, ethoxylated	68551-12-2	67%
	Amine oxides, cocoalkydimethyl	61788-90-7	33%
	Cinnamaldehyde	104-55-2	33%
	Hydrotreated light petroleum distillate	64742-47-8	17%
	Fatty acids, tall-oil, ethoxylated	61791-00-2	33%
	Glutaraldehyde	111-30-8	11%
	Guar gum	9000-30-0	89%
	Sodium carbonate	497-19-8	64%
	Sodium hydroxide	1310-73-2	82%
	Titanium dioxide	13463-67-7	55%
Low	Acetic acid	64-19-7	33%
	Benzaldehyde	100-52-7	17%
	Citric acid	77-92-9	44%
	Diethylene glycol	111-46-6	39%
	Methanol	67-56-1	17%
	Triethanol amine	102-71-6	22%
	Diethanol amine	111-42-2	17%
	Ethanol	64-17-5	22%
	Sodium polyacrylate	9003-04-7	61%
	Butyl alcohol	71-36-3	28%
	Surrogate for Tributyl tetradecyl phosphonium chloride	2304-30-5	33%
	Surrogate for Monoethanolamine borate	94095-04-2	67%
	Ethylene glycol	107-21-1	22%
	Hydrochloric acid	7647-01-0	82%

Rank	Name For Report	CAS RN	Data Gaps %
	Sodium chloride	7647-14-5	27%
	Aluminium oxide	1344-28-1	82%
	Iron oxide	1309-37-1	73%

#### 4.6.7 Identification of Chemicals of Potential Concern (COPC) to Aquatic Ecosystems

Based on the hazard classification of the stimulation chemicals (as presented in Table 23), the seven chemicals classified as a potential high hazard were considered to be COPC.

The certainty of the hazard classification varies depending on the extent of data gaps and the reliance on modelled data. The percent of data gaps were calculated and are presented in Table 23. The percentage data gaps for the high hazard chemicals ranged from 6% (Alcohols, C12-C15, Ethoxylated) to 82% (Sodium iodide).

#### 4.6.8 Evaluation of Mixture Toxicity

The environmental hazard assessment did not directly consider the combined effects of the stimulation chemicals when present in a mixture. However, the approach of assessing individual chemicals for environmental risk assessment is inherently conservative and designed to over-estimate risk as a precautionary approach and so allow for the potential for some mixture toxicity beyond that exhibited by individual chemicals.

There is a limited, endorsed mixture toxicity assessment guidance in Australia and elsewhere. The Australian National Water Quality Management Strategy (ANZECC & ARMCANZ, 2000 and ANZG, 2018) guidance recommends the use of direct toxicity assessment (DTA) for assessment of mixture impacts on the environment. Direct toxicity assessment (DTA) entails collection of an environmental sample containing the chemical mixture and undertaking ecotoxicological testing (exposing test organisms to the environmental sample and measuring effect). DTA considers the nature of the receiving ecosystem (freshwater or marine), and the potential influence of environmental factors that can modify the effect of the stressor (such as water hardness on metal toxicity). DTA typically involves laboratory-raised cultures of test organisms that broadly represent various trophic levels in a receiving waterbody (e.g., fish, aquatic invertebrates, plants, algae).

The use of a more conservative assessment (screening level assessment) as adopted in this SRA is considered more appropriate than DTA for Santos' SWQ operations, because Santos is not authorised to discharge hydraulic fracturing fluids to a specific environment, and there is a wide diversity of potential receptors and receiving environments within the Santos SWQ Project Area that cannot easily be accommodated by DTA. The individual chemical assessment approach in this SRA is considered appropriate to meet the requirements of mixture toxicity assessment for the EA to ensure the protection of all ecological receptors.

### 4.7 Exclusions and Limitations

The environmental hazard assessment is a qualitative assessment of environmental hazard. The following limitations with regard to the hazard assessment and source data are noted:

- The approaches consulted for assessment of PBT in devising the environmental hazard assessment approach were predominantly focussed on the assessment of organic chemicals. There was limited guidance for PBT assessment of inorganic chemicals.
- The hazard assessment approach relied in part on professional judgment and the evaluator's subjectivity in designating the parameter ranges for each parameter assessed.

- The assessment did not consider, *inter alia*.
  - Breakdown or reactive products of the chemicals that may pose more or less of an environmental hazard than the parent compound.
  - The quality, adequacy or accuracy of the available information sourced, noting that only sources considered to be reputable were used.
  - Endocrine disruption effects that are not assessed by standard ecotoxicological tests.
- The environmental hazard assessment approach did not adequately assess chemicals which were:
  - Hydrophilic i.e., highly soluble with low  $K_{ow}$ . Where aquatic ecotoxicological data were limited for these types of chemicals, toxicity may be underestimated because there is potential for these chemicals to be highly toxic.
  - Poorly biodegradable, of low acute toxicity, but were bioaccumulative (based on the BCF or  $K_{ow}$ ). These chemicals may exert chronic effects via accumulation in tissues over time.
- The data collated in the chemical information sheets (presented in APPENDIX E) were treated the same regardless of whether the data were measured experimental values or modelled / calculated values.
- It is noted in relation to the aquatic ecotoxicological data:
  - The species *Daphnia magna* are a sensitive species, frequently displaying sensitivity to chemicals orders of magnitude greater than other invertebrate species.
  - The test endpoint description in the (secondary) sources consulted was relied upon although it should be noted that true chronic and acute NOEC, LOEC, MATC and L(E)C50 depend on a variety of factors such as test duration, species tested, stage in the life-cycle, etc. which can only be verified by review of the primary literature.
  - Sources of Australian aquatic ecotoxicological data were consulted but the information was very limited. Furthermore, many species reported in the Australian literature were not necessarily indigenous species; and
  - There were no minimum data requirements (i.e. some chemicals were assessed based on few data for each of P, B, or T). In order to quantify this uncertainty, a measure of data gaps expressed as a percentage is identified in Table 23.



## 5.0 TERRESTRIAL TOXICITY ASSESSMENT

The previous Section (4.0) presented the assessment of environmental hazard based on P, B and T, where the toxic (T) potential was limited to aquatic receptors. As the following terrestrial receptors (soil microorganisms, plants and animals (vertebrates and invertebrates)) are considered possible or likely receptors<sup>18</sup> that may come into contact with stimulation fluid chemicals, an assessment of hazard to terrestrial receptors was developed in accordance with guidance presented in the following frameworks:

- European Commission (2003) Technical Guidance Document on Risk Assessment in support of Commission Directive 93/67/EEC on Risk Assessment for New Notified Substances, Part II Chapter 3 Environmental Risk Assessment; and
- National Environment Protection Council (NEPC) (2013). National Environment Protection (Assessment of Site Contamination) Amendment Measure.

### 5.1 Methodology

The methodology for selection, collation and assessment of terrestrial toxicological data for the purposes of assessing potential hazard to terrestrial receptors from the stimulation fluid chemicals is described in the following paragraphs.

Note that the approach for assessment of hazard to terrestrial receptors differs from the assessment of hazard to aquatic receptors presented in Section 4.3. Collation of physico-chemical and toxicological data for PBT hazard assessment (as was done with the aquatic toxicological data) was not undertaken. The available physical, chemical, and toxicological data were not considered sufficiently robust for a PBT assessment. Consequently, the chemicals of concern to terrestrial receptors were identified based on the terrestrial toxicological data. Physico-chemical data were then used to assess the likelihood for environmental exposure (discussed in Section 5.1.2 below). This approach results in a semi-quantitative or qualitative assessment of hazard to terrestrial receptors.

#### 5.1.1 Terrestrial Toxicological Data Sources

Where terrestrial toxicological data are available, this may be limited to results from short-term tests using earthworms and plants, rather than (preferred) long-term test results (European Commission, 2003). Studies that assess effects on soil function are rarely available in the literature, and the potential for food chain transfer (e.g., secondary poisoning via bioaccumulation) is not assessed via ecotoxicological studies. This can pose challenges for development of soil screening criteria protective of terrestrial receptors. To address these data deficiencies, the approach developed was to use QSARs to predict toxicity (using aquatic data), and laboratory mammal toxicological data as lines of evidence to identify COPC for terrestrial receptors. This approach has been adopted in this report based on guidance in the European Commission (2003) and NEPC (2013). However, guidance on assessment of effects on soil function was not found during the preparation of this report.

The European Commission (2003) suggest that the equilibrium partitioning method can be applied to aquatic data to identify a probably no effect concentration (PNEC) for soil organisms. The equilibrium partitioning method uses aquatic toxicological data combined with chemical partitioning properties (between soil and water) and soil density to predict the toxicity to soil organisms. This method cannot replace toxicity data for soil organisms and should only be considered as a screen for identifying substances requiring further testing (EC, 2003). The Amended NEPM (NEPC 2013) similarly recommends the use of the equilibrium partitioning method only where QSARs are unavailable.

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<sup>18</sup> Note that the exposure pathway assessment of this report (Section 7.0) lists the sources, pathways of exposure, and receptors that may come into contact with the stimulation fluid chemicals.

The approach adopted was to draw from the large dataset of laboratory mammal (rat, mouse, rabbit) toxicological data and use these animals as surrogates for the potential mammalian terrestrial receptors (e.g., livestock and native mammalian fauna) that may come in contact with stimulation fluid chemicals on or near to a well lease. It is acknowledged that these data are limited in application as they generally comprise acute (LC50) data for receptors that are not of direct interest for exposures of terrestrial receptors in a stimulation risk assessment. Moreover, toxicological data from laboratory mammals are unsuitable surrogates for other terrestrial receptors such as reptiles, birds, invertebrates and plants.

The following sections (5.1.1.1 to 5.1.1.2) list the sources of information and data used to collate and generate terrestrial toxicological data.

### 5.1.1.1 Toxicological Databases

Laboratory mammalian, earthworm, plant and bird data were sourced from readily available databases and literature. Acute oral LD50 laboratory data for rats, mice and rabbits were selected from sources such as the European Chemicals Agency (ECHA), U.S. National Institute of Medicine (PubChem) and USEPA ECOTOX. The studies used to generate laboratory mammal data are designed with the aim of assessing chemical hazard to human health. Consequently, the relevance of these studies to Australian mammalian receptors is uncertain. Given the paucity of terrestrial toxicological data for the stimulation fluid chemicals on Australian fauna, rabbits and mice were considered as the best surrogates for mammalian receptors potentially present on well leases.

Earthworm data were used where the toxicological endpoint was mortality or reproduction and reported in units of milligrams of chemical per kilogram soil (mg/kg). Earthworm studies with other endpoints (e.g., behaviour) and/or units in other forms (e.g., micro-grams per cm<sup>2</sup>) were not considered.

Similarly, plant data were used where the toxicological endpoint (e.g., NOEC) was reproduction or population (e.g., biomass or abundance) and reported in milligrams of chemical per kilogram of soil (mg/kg). Plant studies with other endpoints (e.g., foliar damage) and/or units in other forms (e.g., % or mg/mL of applied solution) were not considered.

### 5.1.1.2 QSARs

As indicated previously, QSARs are empirical relationships between the toxicity of contaminants to a particular test organism and one or more physicochemical properties of the contaminant (NEPC 2013). QSARs are derived for contaminants with either the same mechanism of action or similar molecular structure (NEPC 2013).

Three QSARs were used to derive additional terrestrial data for this report. NEPC (2010) reference the QSAR of Huzelbos et al. (1991) which predicts the concentration at which 50% growth inhibition (EC50, in units of micro-mol per litre) in lettuce (*Lactuca sativa*) would occur. The equation for the QSAR uses the chemical property log K<sub>ow</sub> (described in Section 4.6.4.1 and recorded on the chemical information sheets). The QSAR equation of Huzelbos et al. (1991) is:

$$\log EC50 = -0.72 \log K_{ow} + 3.37$$

The Huzelbos et al. (1991) QSAR was used to predict toxicity of organic chemicals to terrestrial plants, acknowledging that lettuce is not a native flora species, nor of relevance as receptor on a well lease. This QSAR provided the main dataset of terrestrial plant toxicity for the chemicals assessed. It could not be used for inorganic chemicals.

The second QSAR used was that of van Gestel (1992), which predicts the toxicity of earthworms (as the NOEC) in units of mg chemical per kg soil. This QSAR is referenced both by the European Commission (2003) and NEPC (2013) and uses equilibrium partitioning to predict the toxicity of a chemical in soil using

aquatic toxicity data. It is not suitable for chemicals with a log  $K_{ow}$  greater than 4 or for chemicals with a specific mode of action (e.g., endocrine disruptors).

The van Gestel (1992) QSAR was used to predict the toxicity of organic chemicals to earthworms and uses soil density (RHO in kg soil per  $m^3$  of soil) and the soil to water partitioning coefficient ( $K_d$  in  $m^3$  water per  $m^3$  soil), in combination with the NOEC (in mg/L) for the aquatic environment. The equation is:

$$NOEC_{soil} = K_d / RHO_{soil} * NOEC_{water} * 1000$$

The soil to water partitioning coefficient ( $K_d$ ,  $m^3$ water/ $m^3$ soil) is a function of both the fraction organic carbon content ( $f_{oc}$  in kg organic carbon per kg of soil) of soil and the soil organic carbon partitioning coefficient ( $K_{oc}$  in L water per kg organic carbon), and the equation is:

$$K_d = f_{oc} \times K_{oc}$$

An  $f_{oc}$  of 0.01 and bulk density of  $1.6 \text{ g/cm}^3$  for soil was assumed in the use of this QSAR.

The third QSAR used was that used in the ECOSAR™ modelling programme. The programme uses the log  $K_{ow}$  to estimate toxicity (14-day LC50) to earthworms in units of mg/L. The equation is:

$$\text{Log 14-d LC50 (mmol/L)} = -0.1037 \log K_{ow} + 0.4476$$

The programme converts the units from mmol/L to mg/L. ECOSAR™ was used to estimate the toxicity of the stimulation fluid chemicals to earthworms.

### 5.1.2 Use of Physico-chemical Data

Following guidance in NEPC (2013), the relative importance of an exposure pathway to a terrestrial receptor can be determined by assessment of the chemicals-specific properties, and the soil-specific properties that affect chemical bioavailability and environmental fate. Some physicochemical properties of chemicals, for example, partitioning between octanol and water ( $K_{ow}$ ), partitioning from soil to water ( $K_d$ ), and volatility (using Henry's law constant ( $K_H$ )), can be used to predict the most important exposure pathways for a chemical in terrestrial environments. Organic and inorganic chemicals have different physicochemical properties that control their environmental fate. Consequently, different methods apply to assessment of organic vs. inorganic chemical exposures in terrestrial environments.

The environmental fate of organic chemicals is largely controlled by the following physicochemical properties:

- Half-life ( $t_{1/2}$ ), Table 24.
- Henry's Law Constant ( $K_H$ ), Table 25; and
- The octanol-water partition coefficient ( $K_{ow}$ ) which, in general, determines a chemicals potential to cause secondary poisoning.

#### 5.1.2.1 Half-life

The half-life ( $t_{1/2}$ ) of a chemical is a measure of persistence (P) in the environment. It represents the time taken for 50% of the chemical to be lost from the environment. The loss may occur through biodegradation (microbial mediated degradation) or abiotic pathways (hydrolysis, oxidation, reduction, etc.). The more persistent a contaminant in the environment (that is, larger  $t_{1/2}$ ), the longer is the potential exposure time of species to the contaminant and the more deleterious the effects that could occur (NEPC 2013).

Table 25 (taken from NEPC 2013) provides benchmarks for assessment of persistence in terrestrial ecosystems using half-life.

**Table 24: Half Life Benchmarks**

Classification	T $\frac{1}{2}$ (Days)
Degrades Fast	<22.5
Degrades Moderately Fast	22.5 – 45
Degrades Slow	>45

### 5.1.2.2 Henry's Law Constant

Henry's law constant ( $K_H$ ) is a measure of the volatility of a chemical. The higher the volatility (or value of  $K_H$ ) the more of the contaminant will volatilise and be found in the soil air spaces and in the atmosphere.  $K_H$  is a temperature-dependent constant. Vapour transport for many contaminants may constitute an important pathway of loss and exposure to organisms (NEPC 2010). Together with half-life ( $t_{\frac{1}{2}}$ ) of the chemical,  $K_H$  was used to assess the potential for transfer and persistence of the chemical in the soil.

NEPC (2013) have provided benchmarks for assessment of volatility of chemicals in terrestrial ecosystems. This is reproduced in Table 25 below.

**Table 25: Henry's Law Constant Benchmarks**

Classification	Henry's Law Constant (dimensionless)
Highly volatile (H)	$>2.5 \times 10^{-3}$
Moderately volatile (M)	$2.5 \times 10^{-7} - 2.5 \times 10^{-3}$ *
Not volatile (L)	$< 2.5 \times 10^{-7}$

\* It is noted that NEPC (2013) provides a range for moderately volatile of  $2.5 \times 10^{-7}$  to  $2.5 \times 10^{-5}$ , leaving two orders of magnitude ( $2.5 \times 10^{-5}$  to  $2.5 \times 10^{-3}$ ) unclassified. It was assumed that this was an error and the moderately volatile range has been extended from  $2.5 \times 10^{-5}$  to  $2.5 \times 10^{-3}$ .

### 5.1.2.3 Octanol-Water Partition and Organic Carbon-water Coefficient

The octanol-water partition coefficient ( $K_{ow}$ ) is the ratio of the concentration of a chemical that is dissolved in n-octanol to that dissolved in water at equilibrium and at a specified temperature. It is used to estimate the potential for chemicals to accumulate in tissue, both plant and animal (NEPC, 2013).

Chemicals with high log  $K_{ow}$  values are more likely to accumulate in plants and soil invertebrates than chemicals with low  $K_{ow}$  values. If further magnification of these chemicals occurs in the food chain, a predator might experience toxicity while its prey does not. This effect is known as secondary poisoning. Chemicals with log  $K_{ow}$  values below 3 were not considered to biomagnify. Chemicals with log  $K_{ow}$  values greater than 4 were considered to be highly fat soluble and lipophilic, and therefore posing the potential to biomagnify and result in secondary poisoning.

For the purpose of this report, and consistent with NEPC (2013), the log  $K_{ow}$  values of chemicals were divided into two classes. These were:

- Low, log  $K_{ow} < 4$ : the chemical has a low potential to biomagnify.
- High, log  $K_{ow} \geq 4$ : the chemical has a high potential to biomagnify.

### 5.1.3 Summary of Approach

In summary, toxicological data, as guidelines, as measured endpoints (e.g., LD50) or based on measurement data (e.g. PNEC) or as modelled data from QSAR were collated in a step-wise process. Figure 1 indicates that steps followed for the collection of terrestrial toxicological data.

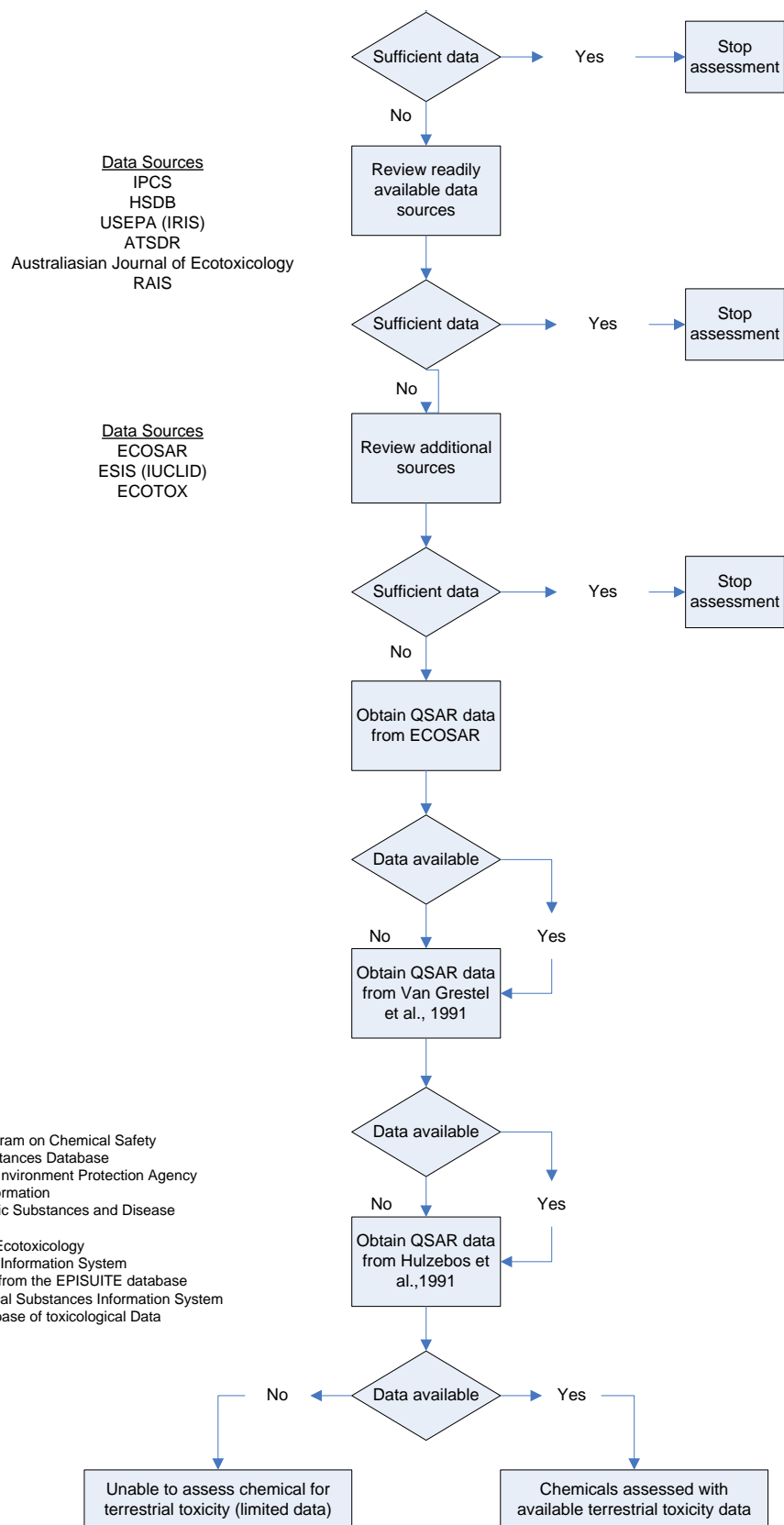


Figure 1: Approach Used for Collation and Generation of Terrestrial Toxicological Data

## 5.2 Results

Out of the thirty-nine (39) chemicals assessed (one (1) chemical was not assessed due to insufficient data and four (4) were not assessed because they were considered to be sand, refer to Table 21 and Table 22 in Section 4.6.6). In addition to the chemicals listed in Table 21 and Table 22, eight chemicals (aluminium oxide, chlorous acid sodium salt, hydrochloric acid, iron oxide, sodium chloride, sodium hydroxide, sodium iodide and titanium dioxide) were unable to be assessed for terrestrial toxicity due to lack of available data. It is noted that the chemicals unable to be assessed comprise inorganics for which bioaccumulation is unlikely to be of concern. In addition, most of these chemicals will dissociate in the environment to anions and cations.

### 5.2.1 Mammalian Acute Oral LD50

Acute oral LC50 data for mammals were found for twenty-five (25) of the chemicals. The lowest LD50 value for rats, mice and rabbits was selected and are presented in Table 26.

### 5.2.2 QSAR data

The lettuce EC50 of Huzelbos et al. (1991) was used to predict plant toxicity for fourteen (14) of the organic chemicals. Whilst the EC50 for this QSAR reports in micromole per litre, the units were not altered as the output was used as a process to rank chemicals against each other, not as an absolute measure of toxicity. Of the fourteen (14) chemicals assessed it should be noted that eleven (11) were derived using a log Kow < 1 which reduces the reliability of the outcome (as indicated in Huzelbos et al. 1991). As a result, these eleven compounds were not used in determining the final hazard assessment. The results of this QSAR are also shown in Table 26.

The QSAR of van Gestel (1992) was used to predict soil invertebrate toxicity for fourteen (14) organic chemicals. The results of this QSAR are also shown in Table 26.

The earthworm QSAR of the ECOSAR programme in EPISUITE was used to predict toxicity to earthworms of seventeen (17) chemicals. The results of this QSAR are shown in Table 26.

### 5.2.3 Summary of Toxicological Data

A summary of the terrestrial toxicological data (including measured and modelled) collated is presented in Table 26 below.

**Table 26: Summary of Terrestrial Toxicological Data**

Chemical	CAS RN	EC/LC50 Earthworm <sup>1</sup> (QSAR) (mg/L)	Lowest LD50 mammals (mg/kg/bw)	EC50 <sup>2</sup> lettuce (QSAR) (mg/L)	LC50 Soil invertebrate <sup>3</sup> (QSAR) (µg/kg)
Acetic acid	64-19-7	1649	600 <sup>4</sup>	0.210*	9.3
Alcohols, C12-C16, Ethoxylated	68551-12-2		4500 <sup>4</sup>		977120
Amine oxides, cocoalkydimethyl	61788-90-7		846 <sup>5</sup>		
Benzaldehyde	100-52-7		27.8 <sup>5</sup>	0.245	
Cinnamaldehyde	104-55-2		200 <sup>6</sup>	0.265	46.7
Citric acid	77-92-9	8030	3000 <sup>4</sup>	0.874*	27500
Diethylene glycol	111-46-6	423	3300 <sup>6</sup>	0.470*	31250
Methanol	67-56-1	105	5628 <sup>6</sup>	0.126*	231
Triethanolamine	102-71-6		2200 <sup>7</sup>	0.610*	29375
Diethanolamine	111-42-2		1100 <sup>8</sup>	0.462*	25
Ethanol	64-17-5	134	2000 <sup>8</sup>	0.167*	1800
Hydrotreated light petroleum distillate	64742-47-8	108	>5000 <sup>8</sup>		
Sodium polyacrylate	9003-04-7		>1000 <sup>9</sup>		
Alcohols, C12-C15, Ethoxylated	68131-39-5		>5000 <sup>8</sup>		
Surrogate for Amides, tall-oil, fatty, N,N-bis(hydroxyethyl)	93-83-4		10000 <sup>8</sup>		
Fatty acids, tall-oil, ethoxylated	61791-00-2	351	10000 <sup>10</sup>		
Butyl alcohol	71-36-3	170	1200 <sup>8</sup>	0.196	28779
Surrogate for Tributyl tetradecyl phosphonium chloride	2304-30-5	162	300 <sup>8</sup>	1.091*	739556
Glutaraldehyde	111-30-8		27 <sup>11</sup>	0.363*	2.3
Surrogate for Monoethanolamine borate	94095-04-2		2000 <sup>8</sup>	1.132*	2957
Guar gum	9000-30-0		7060 <sup>12</sup>		
Ethylene glycol	107-21-1	232	4000 <sup>13</sup>	0.270*	100
Aluminium oxide	1344-28-1				
Chlorous Acid, Sodium Salt	7758-19-2				
Disodium Octaborate Tetrahydrate	12008-41-2		2550 <sup>8</sup>		

Chemical	CAS RN	EC/LC50 Earthworm <sup>1</sup> (QSAR) (mg/L)	Lowest LD50 mammals (mg/kg/bw)	EC50 <sup>2</sup> lettuce (QSAR) (mg/L)	LC50 Soil invertebrate <sup>3</sup> (QSAR) (µg/kg)
Hydrochloric Acid	7647-01-0				
Iron oxide	1309-37-1				
Sodium bisulfite	7631-90-5		1420 <sup>8</sup>		
Sodium Carbonate	497-19-8	194			
Sodium Chloride	7647-14-5				
Sodium Hydroxide	1310-73-2				
Sodium Iodide	7681-82-5				
Titanium dioxide	13463-67-7				
Surrogate for Ulexite	12008-41-2		2550 <sup>8</sup>		

1 ECOSAR (2012)

2 Huzelbos et al. (1991)

3 van Gestel (1992)

4 International Uniform Chemical Information Database (IUCLID) (2012)

5 International Program for Chemical Safety (INCHEM) (2012)

6 Hazardous Substances Data Bank (HSBD) (2012)

7 U.S. National Institute of Medicine PubChem (PubChem) (2020)

8 European Chemical Agency (ECHA) (2020)

9 European Human and Environmental Risk Assessment Program (HERA) (2014)

10 European Chemical Agency (ECHA) (2018)

11 European Chemical Agency (ECHA) (2019)

12 USEPA Federal Register (FR) (2011)

13 ATSDR 2010 US Agency for Toxic Substances and Disease Registry (ATSDR) (2010)

\* based on a log Kow of <1.



## 5.3 Hazard Assessment

### 5.3.1 Toxicological Data

Examination of the data in Table 26 above does not provide consistent findings between data sources for highest hazard chemicals.

For the organic chemicals, for which the most data are available, the three most hazardous chemicals using the different techniques are shown in Table 27 below:

**Table 27: Highest Hazard Organic Chemicals for Terrestrial Receptors Using the Different Datasets**

Mammalian LD50 data	Lettuce QSAR (Huzelbos et al. 1991)*	Invertebrate QSAR (van Gestel 1992)	Earthworm QSAR (EPISUITE)
Glutaraldehyde	Butyl alcohol	Glutaraldehyde	Methanol
Benzaldehyde	Benzaldehyde	Acetic acid	Hydrotreated light petroleum distillate
Cinnamaldehyde	Cinnamaldehyde	Diethanolamine	Ethanol

\*Excluding data for those chemicals with LogKow<1

On the basis of Table 27, nine organic chemicals: glutaraldehyde, benzaldehyde cinnamaldehyde, butyl alcohol, acetic acid, diethanol amine, methanol, ethanol and hydrotreated light petroleum distillate have the highest toxicity to terrestrial plants and invertebrates. These chemicals were assessed for persistence and bioaccumulation using the physico-chemical data described in Section 5.1.2 and are discussed further in Section 5.3.2.

Data for the inorganic chemicals were limited. The three QSARs could not be used. NEPC (2013) provides only limited discussion on how the environmental fate and persistence of inorganic substances should be assessed. Further assessment of the hazards of the inorganic chemicals to terrestrial receptors has not been undertaken. The three highest hazard inorganic chemicals ranked using the mammalian LD50 data are:

- Sodium carbonate.
- Disodium carbonate tetrahydrate; and
- Sodium bisulfite.

### 5.3.2 Persistence and Bioaccumulation of the Organic Chemicals

The nine high hazard organic chemicals identified in Section 5.3.1 were classified based on the half-life as described in Section 5.1.2.1. Glutaraldehyde, benzaldehyde and cinnamaldehyde were the most persistent with moderate half-lives. Butyl alcohol, acetic acid, diethanolamine, methanol, ethanol and hydrotreated light petroleum distillate were the least persistent with fast half-lives (Table 28).

**Table 28: Soil Half-life ( $t_{1/2}$ ) Classification for High Hazard Organic Chemicals**

Chemical	CAS RN	Half-life in Soil (days)	Half-life in Soil ( $t_{1/2}$ ) Classification
Glutaraldehyde	111-30-8	30	Moderate
Benzaldehyde	100-52-7	30	Moderate
Cinnamaldehyde	104-55-2	30	Moderate
Butyl alcohol	71-36-3	17.3	Fast
Acetic acid	64-19-7	17.3	Fast

Chemical	CAS RN	Half-life in Soil (days)	Half-life in Soil (t <sub>1/2</sub> ) Classification
Diethanolamine	111-42-2	17.3	Fast
Methanol	67-56-1	17.3	Fast
Ethanol	64-17-5	17.3	Fast
Hydrotreated light petroleum distillate	64742-47-8	17.3	Fast

The nine high hazard organic chemicals identified in Table 28 were classified based on the Henry's Law constant benchmarks presented in Section 5.1.2.2; the results are summarised in Table 29. Diethanolamine was classified as low volatility, and is therefore considered to be likely to persist longer than the other organic chemicals. Glutaraldehyde, benzaldehyde, cinnamaldehyde, butyl alcohol, acetic acid, methanol and ethanol were classified as moderately volatile (M), and hydrotreated light petroleum distillate were classified as having the highest volatility (H) and therefore are the least persistent (Table 29).

**Table 29: Henry's Law Constant Classification for High Hazard Organic Chemicals**

Chemical	CAS RN	Henry's Law (atm m <sup>3</sup> /mol at 25°C)	Henry's Law (Dimensionless)	Henry's Law Constant Classification
Glutaraldehyde	111-30-8	1.10E-07	4.51E-06	Moderately volatile
Benzaldehyde	100-52-7	2.60E-05	1.07E-03	Moderately volatile
Cinnamaldehyde	104-55-2	3.50E-06	1.43E-04	Moderately volatile
Butyl alcohol	71-36-3	9.99E-06	4.09E-04	Moderately volatile
Acetic acid	64-19-7	1.00E-07	4.10E-06	Moderately volatile
Diethanolamine	111-42-2	3.90E-11	1.60E-09	Low volatility
Methanol	67-56-1	4.55E-06	1.86E-04	Moderately volatile
Ethanol	64-17-5	5.76E-06	2.36E-04	Moderately volatile
Hydrotreated light petroleum distillate	64742-47-8	9.35E-00	3.83E+02	Highly volatile

Based on the octanol-water partitioning coefficient classification in Section 5.1.2.3, hydrotreated light petroleum distillate was classified as high potential to biomagnify. The remaining eight chemicals are considered to have low potential for biomagnification (refer to Table 30).

**Table 30: Low Kow Classification for High Hazard Chemicals**

Chemical	CAS RN	Log Kow	Potential to Biomagnify
Glutaraldehyde	111-30-8	-0.36	Low
Benzaldehyde	100-52-7	1.48	Low
Cinnamaldehyde	104-55-2	1.90	Low
Butyl alcohol	71-36-3	1.00	Low
Acetic acid	64-19-7	-0.17	Low

Chemical	CAS RN	Log Kow	Potential to Biomagnify
Diethanolamine	111-42-2	-1.43	Low
Methanol	67-56-1	-0.77	Low
Ethanol	64-17-5	-0.35	Low
Hydrotreated light petroleum distillate	64742-47-8	6.10	High

### 5.3.3 Identification of Terrestrial Chemicals of Potential Concern (COPC)

Using the three physico-chemical measures in combination it was possible to identify the COPC to terrestrial receptors posing a potential high hazard (see Table 31).

**Table 31: Henry's Law Constant Classification for High Hazard Organic Chemicals**

Chemical	CAS RN	Half-life in Soil (t <sub>1/2</sub> ) Classification	Potential to Biomagnify	Henry's Law Constant Classification	Primary Exposure Route
Glutaraldehyde	111-30-8	Moderate	Low	Moderately volatile	Direct toxicity
Benzaldehyde	100-52-7	Moderate	Low	Moderately volatile	Direct toxicity
Cinnamaldehyde	104-55-2	Moderate	Low	Moderately volatile	Direct toxicity
Butyl alcohol	71-36-3	Fast	Low	Moderately volatile	Direct toxicity
Acetic acid	64-19-7	Fast	Low	Moderately volatile	Direct toxicity
Diethanolamine	111-42-2	Fast	Low	<b><i>Low volatility</i></b>	Direct toxicity
Methanol	67-56-1	Fast	Low	Moderately volatile	Direct toxicity
Ethanol	64-17-5	Fast	Low	Moderately volatile	Direct toxicity
Hydrotreated light petroleum distillate	64742-47-8	Fast	<b><i>High</i></b>	Highly volatile	Direct toxicity

***Cells in bold, underline and italics*** = Classified as persistent or possessing a high potential to biomagnify.

The organic chemicals classified as high hazard in Section 5.3.1 were assessed according to their toxicological and physio-chemical properties. The following organic chemicals were assessed to have the potential to pose a higher environmental hazard relative to the other chemicals assessed based on persistence and potential to biomagnify:

- Diethanolamine (low volatility); and
- Hydrotreated light petroleum distillate (high potential to biomagnify)

Diethanol amine has low volatility but it does not persist in the soil and does not biomagnify. Hydrotreated light petroleum distillate has a high potential to biomagnify but it does not persist in the environment based on its fast half-life and high volatility. Therefore, although these chemicals appear to pose a higher hazard than others, their risk profile to terrestrial receptors is relatively low.

The remaining chemicals were considered likely to degrade quickly or moderately quickly and/or have a high or moderate volatility. Hence, whilst direct toxicity to terrestrial receptors may occur from exposure to these chemicals either after a spill or breach of containment, or from direct exposure via accidental entry into a panel tank (refer Section 2.1.1); effects are unlikely to persist over time.

## 5.4 Limitations and Uncertainties

The terrestrial environmental hazard assessment is a relative assessment and not a comprehensive evaluation of environmental hazards. The following limitations with regard to the terrestrial hazard assessment and source data were noted:

- Sources of Australian terrestrial ecotoxicological data were consulted but the information was limited. No terrestrial ecotoxicological data on the assessed chemicals were available for Australian birds, mammals, reptiles or flora.
- The terrestrial toxicological data used in this report do not include endpoints that assess effects on soil function or secondary poisoning via bioaccumulation in the food chain. Assessment of impacts via secondary poisoning has been assessed qualitatively from the chemical-specific physical and chemical data.
- The terrestrial toxicity assessment was largely based on modelled data of lettuce and earthworm that may not be receptors present in soil on well leases. Modelled data introduces greater uncertainty compared to use of measured data.
- The effects of exposure to the inorganic chemicals identified as posing a higher hazard relative to other chemicals could not be fully assessed.
- The terrestrial toxicity assessment identifies chemicals with the highest hazard relative to the chemicals assessed. Actual hazard is based on the exposure concentration and exposure scenario, as discussed in Section 2.0.
- Toxicological data were obtained for surrogates for a number of chemicals; and
- The data collated in the chemical information sheets (presented in APPENDIX E) were treated the same regardless of whether the data were measured experimental values or modelled / calculated values.

## 6.0 HUMAN HEALTH TOXICITY ASSESSMENT

### 6.1 Objective

As discussed in Section 4.2, the assessment of toxicity represents an assessment of hazard rather than risk. In terms of elements of the risk assessment process, the hazard assessment identifies a potential due to intrinsic properties of the chemical of interest, the exposure assessment provides information on the likelihood of the hazard being realised, and the risk characterisation provides a qualitative or semi-quantitative measure of the potential for the hazard to be realised.

The aim of the hazard assessment is therefore to provide a qualitative hazard ranking of chemicals based on human health toxicity and other hazardous endpoints to identify COPC. Further evaluation of the risk posed by the COPC is provided with an evaluation of exposure pathways. There are qualifiers related to the hazard ranking process. These are summarised in the concluding comments of each human health hazard profile presented in APPENDIX D

The end result of the human health hazard assessment is to provide direction for the mitigation of environmental and occupational health hazards that have the potential to be realised. This may be achieved by suitable management measures or in some cases, additional investigations (e.g., sampling and analytical programs and further risk assessment).

### 6.2 Historical Human Health Hazard Ranking

Human health hazard ranking may adopt a variety of approaches depending on the project or site-specific needs. A variety of hazard ranking or chemical screening methods are available in the published, peer-reviewed literature. Some of these methods are described in the following paragraphs.

Pennington and Bare (2001) described two methods developed by the US EPA: the Waste Minimisation Prioritization Tool (WMPT); and the Toxic Equivalency Potential (TEP). The WMPT examines screening in terms of key physical-chemical properties and includes measures for persistence, bioaccumulation and toxicity (PBT) that are calculated. Each PBT measure is scored to provide a single measure of relative concern. TEPs evaluate chemical fate, multi-pathway exposure and toxicity using a model-based approach. The TEP approach was considered by the authors to represent a less subjective and thus improved approach. TEPs are based on a generic version of CalTox - an integrated multimedia fate, multi-pathway exposure and toxicity model initially developed for human health risk assessments. The authors further stated that "*in typical applications and given the currently available transformation data, neither approach should be used to provide insights beyond a qualitative basis such as high, medium and low concern*" (p 910).

Pittinger *et al.* (2003) described seven discrete hazard and risk assessment tools and proposed a systematic framework to assist users in selecting the appropriate tool for a given application. The framework used a hazard-risk continuum with varying amount and specificity of data requirements. The continuum commenced with toxicity and physical-chemical properties on the hazard end and progressed to site-specific risk assessment. Pittinger *et al.* (2003) discussed approaches from:

- The American Industrial Health Council (AIHC).
- European Risk Ranking Method (EURAM).
- US Chemical Hazard Evaluation for Management Strategies (CHEMS-1).
- US Risk Screening Environmental Indicators.
- US EPA Clusters Scoring System for particular tasks.
- Exposure, Fate Assessment Screening Tool (E-FAST) used in US EPA's New Chemicals Program; and
- The OECD's "Tools for R&D Screening" which is part of the OECD's Chemical Risk Management Program.

Logue et al., (2011) published an approach that used indoor air exposure data and air guidelines to rank 267 chemicals. Thirty-one chemicals were identified as posing hazards with nine as priority pollutants. Dunn (2009) presented an approach for a relative risk ranking of select substances on the Canadian National Pollutant Release Inventory using the CHEMS-1 model listed by Pittinger et al. (2003) discussed above.

OECD (2001) published an initial approach to a harmonised integrated classification system for human health and environmental hazards of chemical substances and mixtures was updated to a Globally Harmonised System of Classification and Labelling of Chemicals (GHS) in 2003, with subsequent updates in 2005, 2007, 2009 and then in 2011 (UNECE, 2011). These guidelines provide categorisation across ten toxicity parameters and provide specific guidance for separation into those categories based on available toxicological data. The approach ranks within the respective categories but not across the toxicological parameters.

While the paper by Dunn (2009) highlights the use of CHEMS-1 in the Canadian approach to the National Pollutant Release inventory, the model does not include some elements that have more recently been included in evaluations by agencies such as the US EPA Design for the Environment (DfE). DfE focuses on the principles of green chemistry and applies these principles to work towards the replacement of hazardous chemicals by safer chemicals and considers a broader range of variables.

Recent green chemistry initiatives such as “*The Green Screen for Safer Chemicals*” (Clean Production Organisation, 2009) provide comprehensive ranking approaches embodying health risk assessment principles with the objectives of achieving safer chemical use. These approaches integrate data and categorisations from the following environment agencies: US EPA, the European Union/Commission (EU), United Nations Economic Commission for Europe (UNECE) GHS, International Agency for Research on Cancer (IARC), and US National Toxicology Program (NTP) sources to establish Very High (VH), High (H), Moderate (M), and Low (L) categories. The basis of these evaluations is to produce an overall categorisation into four benchmarks with ‘Benchmark 4’ reflecting a preferred safer chemical – a “green” objective. While the green chemistry initiative objectives differ somewhat from the objectives of the stimulation hazard ranking described in this report, the basis to the use of data reflects current approaches in hazard categorisation and includes toxicological parameters drawn from the UN GHS, IARC and other reputable sources. The stimulation hazard approach also includes a consideration of endocrine disruptor potential and physical hazards such as explosive capability and flammability. The approach has been employed with suitable adjustments for human health hazard ranking of stimulation chemicals. This is discussed in the following sections.

### 6.3 Historical Hazard Assessment and Ranking Methodology

The literature described above presented a variety of models and approaches to hazard rank chemicals. There is no one model or approach that is ideally suited to assess the potential environmental distribution, potential for human exposure, and subsequent hazard of stimulation chemicals.

Golder has structured an approach which integrates a number of the above methods to assess and rank hazards to humans exposed to stimulation chemicals. The approach is summarised as follows:

- 1) The inventory of stimulation chemicals was reviewed and all substances with reported CAS numbers collated. Those with no CAS numbers were separated into a “*Separate listing for review*” and additional information sought;
- 2) All substances with CAS numbers were reviewed to determine listing on Safework Australia’s Hazardous Substances Information System (HSIS). Safework Australia’s HSIS reports chemicals that have been reviewed under the National Occupational Health and Safety Commission (NOHSC, 2004) “*Approved Criteria for Classifying Hazardous Substances, 3<sup>rd</sup> Edition*” and/or have National Exposure Standards declared under the Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment [NOHSC:1003(1995)]. These classifications are based on a range of toxicological properties consistent with international approaches used in hazard ranking and health risk assessment.

- 3) Compositional data from SDSs were not used as a screening process in this instance because of the potential for low percentage substances to alter in availability due to environmental fate and transport processes. This is in contrast to occupational settings and product use where exposure controls and chemical alteration are limited compared with environmental settings. The issue of mass input into the environment as an index of potential exposure was considered at the end of the ranking process for each health hazard profile.
- 4) Data for all substances was collated based on the following variables:
  - a. Carcinogenicity
  - b. Mutagenicity/Genotoxicity
  - c. Reproductive toxicity
  - d. Developmental toxicity/Teratogenicity
  - e. Endocrine disruption
  - f. Neurotoxicity
  - g. Acute toxicity (oral, dermal or inhalation)
  - h. Corrosion/irritation of the skin or eye
  - i. Sensitisation of the skin or respiratory system
  - j. Immune system effects
  - k. Systemic toxicity/Organ effects
  - l. Flammable potential
  - m. Explosive potential.
- 5) Thresholds were employed based on a combination of EU, IARC, US EPA, US NTP and the UNECE GHS approaches for hazard characterisation consistent with the “*Green Screen for Safer Chemicals*”.
- 6) It should be noted that the “*Green Screen for Safer Chemicals*” (described in the previous section) includes an evaluation of persistence, bioaccumulation and aquatic toxicity (PBT). Rather than use the classification outlined in the “*Green Screen for Safer Chemicals*” the PBT analysis described in Section 4.6 has been used for consistency. This is appropriate as the evaluation is a comprehensive assessment of multiple parameters. In addition the classification of high, medium and low categories in Section 4.6 utilises more conservative thresholds for the hazard cut offs than presented in the “*Green Screen for Safer Chemicals*”. Finally, the classification scheme in Section 4.6 does not differentiate within hazard classifications (such as use a ‘Very High’ grouping adopted in the human health assessment), rather any chemical classified as posing a ‘High Hazard’ is considered a COPC. The Very High grouping in “*Green Screen for Safer Chemicals*” relates only to the PB assessment, as such this grouping has not been used in this assessment.
- 7) These thresholds allowed data to be ranked into strata of High, Moderate and Low concern and numerically converted as follows.
  - a. High = 3
  - b. Moderate = 2
  - c. Low = 1

Values were then averaged based on the available data that generated each score. This ensured scores were not biased by the amount of data for any one chemical, e.g. ten sets of data, the total was divided by ten, four sets of data, the total score was divided by 4, etc; and

- 8) The values were then converted into a qualitative expression of hazard described as Low (1), Low to Moderate (1-2), Moderate (2), Moderate to High (2-3) and High (3). These hazard classes were designed to reflect a relative ranking and were further qualified in terms of key hazards and potential scenarios requiring consideration. The latter was provided in a concluding section with summary comments for the

human health hazard profiles developed. The summary comments to each profile placed the health hazard ranking in perspective.

The application of this approach is iterative and subject to further refinement should additional information and or methodologies become available. As new information becomes available these rankings may be subject to change. As a consequence, the human health hazard evaluation presents uncertainty for each chemical assessed, expressed as a percentage. The percentage is calculated based on the data availability across the 13 hazard categories investigated. The percentage uncertainty is not a measure of data quality, but data availability.

Further discussion of these parameters is provided in the Section 4.0 including the threshold values used for each parameter.

## 6.4 Human Health Hazard Assessment Parameters

A description of each parameter is provided below, along with the threshold values for each parameter as presented in the “*Green Screen for Safer Chemicals*”. The threshold values for these parameters as presented in the “*Green Screen for Safer Chemicals*” are drawn from the following sources:

- EU’s recently enacted chemicals policy legislation (Registration, Evaluation and Authorization of Chemicals–REACH) (EU 2006).
- UNECE (2011) Globally Harmonized System of Classification and Labelling of Chemicals (GHS). Fourth revised edition. United Nations, New York and Geneva.
- The International Agency for Research on Cancer (IARC) monographs on Carcinogens, available at <http://monographs.iarc.fr>.
- US Environmental Protection Agency, Design for Environment Program. (USEPA DfE) 2005. Environmental Profiles of Chemical Flame-Retardant Alternatives for Low-Density Polyurethane Foam.
- US Department of Health and Human Services, Public Health Service, National Toxicology Program (US NTP). 2005. Report on Carcinogens, Eleventh Edition.
- State of California, Environmental Protection Agency, Office of Environmental Health Hazard Assessment. 2006. Chemicals Known to the State to Cause Cancer or Reproductive Toxicity.
- Japan Ministry of Environment. 1998. Endocrine Disrupting Chemicals Database, Table of Chemicals Suspected of Having Endocrine Disrupting Effects; and
- US Department of Labour Occupational Safety and Health Administration (OSHA) List of OSHA carcinogens.

### 6.4.1 Acute Toxicity

Acute toxicity refers to the occurrence of adverse effects following exposure to a single dose of a substance or multiple doses within a 24-hour period (OECD 2009). In toxicity studies acute effects are often characterised by lethality, commonly reported in lethal dose or concentration at which 50% of the animals tested die (LD50 or LC50). Non-lethal acute effects are sometimes included. Routes of administration commonly used are the oral, dermal and inhalation pathways. The threshold values for acute toxicity are presented in Table 32.



**Table 32: Acute Toxicity (Oral, Dermal or Inhalation) Threshold Values**

High	Medium	Low
<ul style="list-style-type: none"> <li>■ LD50 &lt;50 mg/kg bodyweight (oral)</li> <li>■ LD50 &lt;200 mg/kg bodyweight (dermal)</li> <li>■ LC50 &lt;500 ppm (gas)</li> <li>■ LC50 &lt;2.0 mg/l (vapour)</li> <li>■ LC50 &lt;0.5 mg/l (dust or mist)</li> <li>■ US EPA Extremely Hazardous Substance List</li> <li>■ GHS Category 1 or 2</li> </ul>	<ul style="list-style-type: none"> <li>■ LD50 50-2000 mg/kg bodyweight (oral)</li> <li>■ LD50 200-2000 mg/kg bodyweight (dermal)</li> <li>■ LC50 500-5000 ppm (gas)</li> <li>■ LC50 2-20 mg/l (vapour)</li> <li>■ LC50 0.5-5 mg/l (dust or mist)</li> <li>■ GHS Category 3 or 4</li> </ul>	No basis for concern identified

### 6.4.2 Corrosion/Irritation of the Skin or Eye/s

Skin corrosion is the production of irreversible damage to the skin namely, visible necrosis through the epidermis and into the dermis following the application of a substance for up to four hours (OECD, 2009). Corrosion is often indicated by ulcers and bleeding and after 14 days discolouration of the skin, alopecia and scars. Skin irritation is the production of reversible damage to the skin following application of a substance (OECD, 2009).

Serious eye damage (i.e. corrosion) is indicated by tissue damage of the eye or serious physical decay of vision following application of the anterior surface of the eye which is not fully reversible within 21 days (OECD, 2009). Eye irritation is indicated by changes in the eye following application of the anterior surface of the eye which is fully reversible within 21 days (OECD, 2009).

The threshold values for corrosion/Irritation of the skin or eye are presented in Table 33.

**Table 33: Corrosion/Irritation of the Skin or Eye Threshold**

High	Medium	Low
<ul style="list-style-type: none"> <li>■ Evidence of irreversible effects in studies of human populations</li> <li>■ Weight of evidence of irreversible effects in animal studies</li> <li>■ GHS Category 1 (skin or eye)</li> </ul>	<ul style="list-style-type: none"> <li>■ Evidence of reversible effects in humans or animals</li> <li>■ GHS Category 2 or 3 — skin irritation</li> <li>■ GHS Category 2A or 2B — eye</li> </ul>	<ul style="list-style-type: none"> <li>■ No basis for concern identified</li> </ul>

### 6.4.3 Sensitisation of the Skin or Respiratory System

A respiratory sensitizer is a substance that will lead to hypersensitivity of the airways following inhalation of the substance (OECD, 2009). A skin sensitizer is a substance that will lead to an allergic response following skin contact (OECD 2009).

The threshold values for sensitisation of the skin or respiratory system are presented in Table 34.

**Table 34: Sensitisation of the Skin or Respiratory System Threshold**

High	Medium	Low
<ul style="list-style-type: none"> <li>■ Evidence of adverse effects in humans;</li> <li>■ Weight of evidence demonstrates potential for adverse effects in humans</li> <li>■ GHS Category 1 – (skin or respiratory)</li> <li>■ Positive responses in predictive Human Repeat</li> <li>■ Insult Patch Tests (HRIPT) (skin)</li> </ul>	<ul style="list-style-type: none"> <li>■ Suggestive animal studies of adverse effects</li> <li>■ Analogue data</li> <li>■ Chemical class known to produce toxicity</li> </ul>	<ul style="list-style-type: none"> <li>■ No basis for concern identified</li> </ul>

### 6.4.4 Carcinogenicity

A carcinogen is a substance or a mixture which induces cancer or increases its incidence. The classification of a substance or mixture as a carcinogenic hazard is based on its inherent properties and does not provide information on the level of human cancer risk which the use of a substance may represent (OECD, 2009).

The threshold values for carcinogenicity are presented in Table 35.

**Table 35: Carcinogenicity Thresholds**

High	Medium	Low
<ul style="list-style-type: none"> <li>■ Evidence of adverse effects in humans</li> <li>■ Weight of evidence demonstrates potential for adverse effects in humans</li> <li>■ NTP known or reasonably anticipated to be human carcinogen</li> <li>■ OSHA carcinogen</li> <li>■ California Prop 65</li> <li>■ IARC Group 1 or 2A</li> <li>■ EU Category 1 or 2</li> <li>■ GHS Category 1A or 1B</li> </ul>	<ul style="list-style-type: none"> <li>■ Suggestive animal studies of adverse effects</li> <li>■ Analogue data</li> <li>■ Chemical class known to produce toxicity</li> <li>■ IARC Group 2B</li> <li>■ EU Category 3</li> <li>■ GHS Category 2</li> </ul>	<ul style="list-style-type: none"> <li>■ No basis for concern identified</li> <li>■ IARC Group 3 or 4</li> </ul>

### 6.4.5 Developmental Toxicity

Developmental toxicity refers to the *in-utero* effects such as death, malformations, functional deficits and developmental delays (enHealth, 2004). It can also include delayed toxicity associated with epigenetic effects during the sensitive phases of foetal development.

The threshold values for developmental toxicity are presented in Table 36.

**Table 36: Developmental Toxicity Threshold**

High	Medium	Low
<ul style="list-style-type: none"> <li>■ Evidence of adverse effects in humans</li> <li>■ Weight of evidence demonstrates potential for adverse effects in humans</li> <li>■ NTP Center for the Evaluation of Risks to Human Reproduction</li> <li>■ California Prop 65</li> </ul>	<ul style="list-style-type: none"> <li>■ Suggestive animal studies of adverse effects</li> <li>■ Analogue data</li> <li>■ Chemical class known to produce toxicity</li> </ul>	<ul style="list-style-type: none"> <li>■ No basis for concern identified</li> </ul>

### 6.4.6 Mutagenicity/Genotoxicity

Mutagenesis occurs when chemicals cause changes in the genetic material which can be transmitted during cell division (Davis et al., 1994). The OECD (2009) indicates a mutagen is a chemical that may cause mutations in the germ cells of humans that can be transmitted to the progeny. A mutation is defined as a permanent change in the amount or structure of the genetic material in a cell. The more general terms genotoxic and genotoxicity apply to agents or processes which alter the structure, information content or segregation of deoxyribonucleic acid (DNA) (OECD, 2009).

The threshold values for mutagenicity and genotoxicity are presented in Table 37.

**Table 37: Mutagenicity/Genotoxicity Thresholds**

High	Medium	Low
<ul style="list-style-type: none"> <li>■ Evidence of adverse effects in humans</li> <li>■ Weight of evidence demonstrates potential for adverse effects in humans</li> <li>■ EU Category 1 or 2</li> <li>■ GHS Category 1A or 1B</li> </ul>	<ul style="list-style-type: none"> <li>■ Suggestive animal studies of adverse effects</li> <li>■ Analogue data</li> <li>■ Chemical class known to produce toxicity</li> <li>■ EU Category 3</li> <li>■ GHS Category 2</li> </ul>	<ul style="list-style-type: none"> <li>■ No basis for concern identified</li> </ul>

### 6.4.7 Reproductive Toxicity

Reproductive toxicity includes adverse effects on sexual function and fertility in adult males and female as well as developmental toxicity in the offspring (OECD, 2009). This may include effects on mating behaviour, gonadal function, oestrous cycling, conception, implantation, parturition and lactation (Draft enHealth, 2010). The threshold values for reproductive toxicology are presented in Table 38.

**Table 38: Reproductive Toxicity Thresholds**

High	Medium	Low
<ul style="list-style-type: none"> <li>■ Evidence of adverse effects in humans</li> <li>■ Weight of evidence demonstrates potential for adverse effects in humans</li> <li>■ NTP Centre for the Evaluation of Risks to Human Reproduction</li> <li>■ California Prop 65</li> <li>■ EU Category 1 or 2</li> <li>■ GHS Category 1A or 1B</li> </ul>	<ul style="list-style-type: none"> <li>■ Suggestive animal studies of adverse effects</li> <li>■ Analogue data</li> <li>■ Chemical class known to produce toxicity</li> <li>■ EU Category 3</li> <li>■ GHS Category 2</li> </ul>	<ul style="list-style-type: none"> <li>■ No basis for concern identified</li> </ul>

### 6.4.8 Neurotoxicity

Neurotoxicity refers to any adverse effects on the structure or functional integrity of the developing or adult nervous system. Neurotoxic effects may involve a spectrum of biochemical, morphological, behavioural, and physiological abnormalities whose onset can vary from immediate to delayed following exposure to a toxic substance, and whose duration may be transient or persistent (US Department of Food and Drug Administration, 2000).

The threshold values for neurotoxicity are presented in Table 39.

**Table 39: Neurotoxicity Thresholds**

High	Medium	Low
<ul style="list-style-type: none"> <li>■ Evidence of adverse effects in humans</li> <li>■ Weight of evidence demonstrates potential for adverse effects in humans</li> </ul>	<ul style="list-style-type: none"> <li>■ Suggestive animal studies of adverse effects</li> <li>■ Analogue data</li> <li>■ Chemical class known to produce toxicity</li> </ul>	<ul style="list-style-type: none"> <li>■ No basis for concern identified</li> </ul>

### 6.4.9 Endocrine Disruption

Endocrine disruptors are chemicals that may interfere with the body's endocrine system and produce adverse developmental, reproductive, neurological, and immune effects (OECD, 2009).

The threshold values for endocrine disruption are presented in Table 40.

**Table 40: Endocrine Disruption Thresholds**

High	Medium	Low
<ul style="list-style-type: none"> <li>■ Evidence of adverse effects in humans</li> <li>■ Weight of evidence demonstrates that mechanisms of action lead to adverse effects</li> </ul>	<ul style="list-style-type: none"> <li>■ Suggestive animal studies of adverse effects</li> <li>■ Analogue data</li> <li>■ Chemical class known to produce toxicity</li> <li>■ EU Draft List - Category 1 or 2</li> <li>■ Japanese list</li> </ul>	<ul style="list-style-type: none"> <li>■ No basis for concern identified</li> </ul>

### 6.4.10 Systemic Toxicity/Organ Effects

This relates to substances that produce specific non-lethal organ toxicity arising either from a single or repeated dose. All significant health effects that can impair function, reversible and irreversible, immediate and/or delayed are included (OECD, 2009).

The threshold values for systemic toxicity / organ effects are presented in Table 41.

**Table 41: Systemic Toxicity Thresholds**

High	Medium	Low
<ul style="list-style-type: none"> <li>■ Evidence of adverse effects in humans</li> <li>■ Weight of evidence demonstrates potential for adverse effects in humans</li> <li>■ GHS Category 1 — organ/systemic toxicity following single or repeated exposure</li> </ul>	<ul style="list-style-type: none"> <li>■ Suggestive animal studies of adverse effects</li> <li>■ Analogue data</li> <li>■ Chemical class known to produce toxicity</li> <li>■ GHS Category 2 or 3 single exposure</li> <li>■ Category 2 repeated exposure</li> </ul>	<ul style="list-style-type: none"> <li>■ No basis for concern identified</li> </ul>

### 6.4.11 Immune System Effects

The threshold values for immune system effects are presented in Table 42.

**Table 42: Immune System Effect Thresholds**

High	Medium	Low
<ul style="list-style-type: none"> <li>■ Evidence of adverse effects in humans</li> <li>■ Weight of evidence demonstrates potential for adverse effects in humans</li> </ul>	<ul style="list-style-type: none"> <li>■ Suggestive animal studies of adverse effects</li> <li>■ Analogue data</li> <li>■ Chemical class known to produce toxicity</li> </ul>	<ul style="list-style-type: none"> <li>■ No basis for concern identified</li> </ul>

### 6.4.12 Explosive Potential

An explosive substance is a solid or liquid which is capable by chemical reaction of producing gas at such high temperature and pressure and at such a speed as to cause damage to the surroundings (OECD, 2009).

The threshold values for explosive potential effects are presented in Table 43.

**Table 43: Explosive Potential Threshold Values**

High	Medium	Low
<ul style="list-style-type: none"> <li>■ GHS Category: Unstable Explosives or Divisions 1.1, 1.2 or 1.3</li> </ul>	<ul style="list-style-type: none"> <li>■ GHS Category: Divisions 1.4, 1.5</li> </ul>	<ul style="list-style-type: none"> <li>■ No basis for concern identified</li> </ul>

### 6.4.13 Flammable Potential

A flammable liquid has a flash point of not more than 93°C (OECD, 2009). A flammable solid is readily combustible or may cause or contribute to fire through friction. A readily combustible solid is a powdered, granular or pasty substance which is dangerous if it can be ignited by brief contact with an ignition source and the flame spreads rapidly (OECD, 2009).

The threshold values for flammable potential effects are presented in Table 44.

**Table 44: Flammable Potential Thresholds**

High	Medium	Low
<ul style="list-style-type: none"> <li>■ GHS Category 1 - Flammable Gases</li> <li>■ GHS Category 1 - Flammable Aerosols</li> <li>■ GHS Category 1 or 2 — Flammable Liquids</li> </ul>	<ul style="list-style-type: none"> <li>■ GHS Category 2- Flammable Gases</li> <li>■ GHS Category 2- Flammable Aerosols</li> <li>■ GHS Category 3 or 4 — Flammable Liquids</li> </ul>	<ul style="list-style-type: none"> <li>■ No basis for concern identified</li> </ul>

## 6.5 Historical Human Health Hazard Ranking

### 6.5.1 Process of Hazard Review

As an initial assessment of hazard, all chemicals listed in Table 4 were queried via the SafeWork Australia Hazardous Chemical Information System (HCIS) to determine if they were classified as “*hazardous*” based on the in accordance with the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) 3<sup>rd</sup> revised edition. The GHS classifications are based on a range of toxicological properties consistent with approaches used in hazard ranking and health risk assessment. A limitation of this initial search is that although the HCIS database includes over 5,000 substances, only substances that have been assessed and subsequently classified as hazardous are included. Absence of a chemical from the database does not imply a chemical is non-hazardous. The listings are summarised in Table 45. Of the total of 39 substances reviewed in this report, 26 were listed, 13 were not listed.

**Table 45: Hazardous Chemical Information System Listing**

Chemical Name	CAS RN	HCIS
Acetic acid	64-19-7	Listed
Alcohols, C12-16, ethoxylated	68551-12-2	Listed*
Amine oxides, cocoalkyldimethyl	61788-90-7	Not Listed
Benzaldehyde	100-52-7	Listed
Cinnamaldehyde	104-55-2	Listed*
Citric acid	77-92-9	Listed
Diethylene glycol	111-46-6	Listed
Methanol	67-56-1	Listed
Triethanol amine	102-71-6	Listed
Diethanol amine	111-42-2	Listed
Ethanol	64-17-5	Listed
Hydrotreated light petroleum distillate	64742-47-8	Listed

Chemical Name	CAS RN	HCIS
Sodium polyacrylate	9003-04-7	Not Listed
Alcohols, C12-C15, ethoxylated	68131-39-5	Listed
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	Not Listed
Fatty acids, tall-oil, ethoxylated	61791-00-2	Not Listed
Butyl alcohol	71-36-3	Listed
Tributyl tetradecyl phosphonium chloride	81741-28-8	Listed
Glutaraldehyde	111-30-8	Listed
Monoethanolamine borate	26038-87-9	Listed
Guar gum	9000-30-0	Not Listed
Ethylene glycol	107-21-1	Listed
Aluminium oxide	1344-28-1	Not Listed
Chlorous Acid, sodium Salt	7758-19-2	Listed*
Disodium octaborate tetrahydrate	12008-41-2	Listed*
Hydrochloric acid	7647-01-0	Listed
Iron oxide	1309-37-1	Not Listed
Sodium bisulfite	7631-90-5	Listed
Sodium carbonate	497-19-8	Listed
Sodium chloride	7647-14-5	Not Listed
Sodium hydroxide	1310-73-2	Listed
Sodium iodide	7681-82-5	Not Listed
Titanium dioxide	13463-67-7	Not Listed
Ulexite	1319-33-1	Listed
Hydroxylpropyl guar	39421-75-5	Not Listed
Aluminium silicate	1302-76-7	Not Listed
Crystalline silica, cristobalite	14464-46-1	Listed
Crystalline Silica, quartz	14808-60-7	Listed
Silica Gel	112926-00-8	Not Listed

Note: \* "These chemicals have been added to the HCIS since the previous search of the database (formerly the Hazardous Substances Information System HSIS) Golder conducted in 2012.

Of the chemicals listed in Table 45, two chemicals have not been assessed or considered further in this report:

- Sodium chloride (7647-14-5) is a naturally occurring ubiquitous salt and not considered to be a hazardous substance

- Hydroxylpropyl guar (39421-75-5) which has been considered to be sufficiently addressed by the assessment of guar gum (9000-30-0).

Readily available human health toxicity and hazard data were collated from the following online data bases:

- Safework Australia sources, specifically the Hazardous Chemical Information System (HCIS).
- National Industrial Chemicals Notification and Assessment Scheme (NICNAS)
- World Health Organisation (WHO) sources such as International Program of Chemical Safety (IPCS) INCHEM, including Concise International Chemical Assessment Documents (CICADS) and Environmental Health Criteria (EHC) monographs.
- European Chemicals Agency (ECHA) REACH registration dossiers
- United States sources such as:
  - United States National Medical Library of Medicine Toxicology (Toxnet) and Hazardous Substances Data Bank (HSDB).
  - United States Environmental Protection Agency (US EPA) Integrated Risk Information System (IRIS).
  - Agency for Toxic Substances and Disease Registry (ASTDR) toxicological profiles; and
  - Risk Assessment Information System (RAIS).

If no information was available from these databases then the search was extended to access other sources of toxicity information, preference was given to peer-reviewed data.

Toxicity information for each parameter was then categorised as High, Medium or Low concern according to the thresholds described in Section 4.6. The categories were numerically converted as follows:

- High = 3
- Moderate to High = 2-3
- Moderate = 2
- Low to Moderate = 1-2
- Low = 1

The scoring system is semi-quantitative in that scores are assigned to ranges for a particular parameter. The scores are largely assigned using some quantitative data and professional judgement following consideration of the guidance from the ranking thresholds specified for each parameter. In order to provide some measure to the availability of data an estimation of uncertainty was presented by calculating the percentage of parameters for which data were available, e.g. if data for 2 parameters only were obtained, this represented 2/13 or 15%. This allowed some appreciation of data gaps that, if available, may alter the estimated hazard assessment.

### 6.5.2 Surrogate Selection

Surrogate compounds were selected consistent with the approach described in Section 4.6.2. Where chemicals were assessed using a surrogate, this is documented in this report for transparency. Where chemicals could not be assessed using a surrogate, they were not assessed due to insufficient data. In total nine surrogates were employed for all the substances considered in this assessment. These are presented in Table 46.

**Table 46: Surrogates Used in Human Health Hazard Evaluation**

Chemical	CAS No	Surrogate Descriptor
Kaolin	1332-58-7	Surrogate for aluminium silicate

Chemical	CAS No	Surrogate Descriptor
Amides, C18-unsaturated, N,N-bis(hydroxyethyl)	93-83-4	Surrogate for Amides, tall-oil, fatty, N,N-bis(hydroxyethyl) (CAS RN 68155-20-4)
Tetra-n-butyl phosphonium chloride	2304-30-5	Surrogate for Tributyl tetradecyl phosphonium chloride (CAS RN 81741-28-8)
Reaction products of monoethanolamine and boric acid	94095-04-2	Surrogate for Monoethanolamine borate (CAS RN 26038-87-9)
Disodium octaborate tetrahydrate	12008-41-2	Surrogate for Ulexite (CAS RN 1319-33-1)

### 6.5.3 Human Health Chemicals of Potential Concern (Historical Assessment Method)

The evaluation process detailed above provided a relative ranking of human health hazard scores to enable a prioritization of COPC to be made. On this basis, chemicals ranged from a hazard score of 1.0, representing classification of “no cause for concern” to those considered “Moderate to High” cause for concern. The data completeness ranged from 31% to 100%. This data completeness measures provides some confidence in the ranking such that where data are limited there is a greater possibility that the hazard profile may change with increase information.

A summary of the available human health hazard information for each chemical is presented in the Health Hazard Profiles for each substance in APPENDIX D.

The selection of a chemical as a COPC does not indicate an unacceptable risk (which is reflection of the realisation of a hazard); rather it indicates that potential exposures to these chemicals should be evaluated in greater detail to ascertain if they may present an unacceptable risk. Furthermore, adverse health effects are a reflection of intrinsic chemical or physical toxicity, the physico-chemical parameters of the substance concerned, and the exposure setting and affected populations. Subsequently, it is not possible within a numerical ranking system to capture all possible exposure settings that may apply with product use and the possible chemical exposures. Consequently, qualitative comments have been provided for each of the ranked chemicals as concluding summary comments. These qualifying comments should be read and understood. These are presented in the human health profiles in APPENDIX D.

The recognition of human health hazards provides a basis to assigning public health protection measures to ensure exposures to substances identified as having intrinsic toxic effects are adequately controlled. Public health protection may be differentiated between occupational health and environmental health where the former involves workers and respective legislative requirements and the latter involves the general community sector. Of the 64 substances that were examined, 44 substances recorded hazard scores greater than 1.0 and these substances are have been the subject of further comment in Table 47. This table presents the substances, their hazard score, and indication of persistence and key hazard determinants and potential areas of concern. The latter provides direction on the differentiation of occupational health and environmental health concerns and provides further focus on hazard mitigation measures including assessment.

The assessment of human health hazards has been undertaken on individual substances. Assessment of the combined effects of the constituents (when present in a mixture) was outside the scope of this assessment.



**Table 47: Summary of Human Health Hazard Classification and Potential Outcomes (Historical Assessment Method)**

Substance	CAS No	Environmental Behaviour	Key Determinants and Potential Hazard Outcomes
<b>Moderate to High Hazard</b>			
Methanol	67-56-1	Dilution/biodegradation/volatile	Occupational exposure concerns – volatile and flammable/explosive.
Sodium iodide	7681-82-5	Dilution/dissociation/persistence	Occupational irritant. Toxicity concerns of iodine warrant both occupational and environmental exposure assessment.
Acetic acid	64-19-7	Dilution/dissociation/biodegradation	Concentrated form is an occupational hazard. Flammable and explosive.
<b>Moderate Hazard</b>			
Crystalline silica, quartz	14808-60-7	Dilution/Persistence	Occupational respiratory effects (cancer, silicosis)
Sodium carbonate	497-19-8	Dilution/dissociation	Occupational irritant and sensitiser – product and concentrated solutions are alkaline. May increase alkalinity of environmental waters.
Crystalline silica, cristobalite	14464-46-1	Dilution/Persistent	Occupational respiratory effects (cancer, silicosis)
<b>Low to Moderate Hazard</b>			
Chlorous acid, sodium salt	7758-19-2	Dilution/degradation	Occupational hazard – suspect mutagen and irritant. Developmental toxicity concerns (female workers).
Sodium hydroxide	1310-73-2	Dilution/dissociation	Occupational hazard - highly corrosive to skin, eyes and mucous membranes. May increase alkalinity in environmental waters.
Hydrochloric acid	7647-01-0	Dilution/dissociation	Occupational hazard – irritant, corrosive and necrotic to lung, eyes, skin and mucous membranes. May increase acidity of environmental waters.
Citric acid	77-92-9	Dilution/dissociation	Occupational hazard – skin and eye irritant. May contribute to elevations in acidity of environmental waters.
<b>Low to Moderate Hazard (cont.)</b>			
Disodium octaborate tetrahydrate	12008-41-2	Dilution/dissociation/persistence	Occupational and environmental hazard – reproductive (males and females) and developmental toxicity (female workers). May elevate boron levels in environmental surface waters.

Substance	CAS No	Environmental Behaviour	Key Determinants and Potential Hazard Outcomes
Aluminium oxide	1344-28-1	Dilution/persistence	Occupational and environmental hazard. Respiratory irritant and neurotoxin. May elevate aluminium levels in environmental waters.
Benzaldehyde	100-52-7	Dilution/biodegradation	Occupational and environmental hazard – irritant and evidence of acute and chronic toxicity. Environmental concentrations require evaluation. Flammable.
Cinnamaldehyde	104-55-2	Dilution/biodegradation	Occupational hazard – skin and eye irritant and sensitiser. Low toxicity.
Diethylene glycol	-	Dilution/biodegradation	Occupational hazard – skin and eye irritant. Low toxicity based on available information.
Surrogate for aluminium silicate	1302-76-7	Dilution/Persistent	Occupational respiratory particulate hazard. Limited evidence of developmental toxicity (by ingestion),
Amine oxides, cocoalkyldimethyl	61788-90-7	Dilution/readily biodegradation	Occupational hazard - skin, eye and respiratory irritant.
<b>Low to Moderate Hazard (cont.)</b>			
Iron oxide	1309-37-1	Limited mobility as not soluble in water but the ferric cation will persist	Occupational inhalation hazard and skin irritant and sensitiser. Low oral toxicity. May result in elevations of iron levels in environmental waters.
Alcohols, C12-16, ethoxylated	68551-12-2	Dilution/biodegradation	Occupational hazard – skin and eye irritant. Low toxicity. Volatile.
Titanium dioxide	13463-67-7	Dilution/Persistence	Occupational hazard – eye and respiratory irritant. Pulmonary effects from particulate inhalation. Low oral toxicity.

## 6.6 New Hazard Assessment Approach (IMAP Framework)

In addition to the chemicals assessed under the above described historical 'high-moderate-low' hazard ranking system, eight new chemicals were assessed using the following approach which is based on the Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework recently published by the National Industrial Chemicals Notification and Assessment Scheme (NICNAS, 2013). This framework has been designed to enable prioritisation of chemicals by hazard, exposure and use in the community for the purposes of national chemical assessment programs. This involves hazard bands, exposure bands and five broad categories: cosmetic, domestic, commercial, site-limited and non-industrial. The exposure assessment considers volumes and uses multipliers in conjunction with the hazard assessment to provide the risk characterisation for prioritisation and subsequent national assessment of the chemical. Integral to this process is review of international classifications and assessments following the prioritisation process with further increasingly detailed Tier I, Tier II and Tier III assessments.

The IMAP Framework for hazard assessment uses a hierarchy of indicators developed and agreed by the Human Health Expert Working Group (HHEWG) which reflects the following weighting:

- Carcinogenicity, Genotoxicity, Reproductive/developmental toxicity, Endocrine disruption, Neurotoxicity
- Acute toxicity
- Repeat dose toxicity
- Sensitisation
- Irritation.

This facilitates a Hazard Banding which is structured across five bands from Hazard Band 4 (highest) to Hazard Band 0 (lowest). The approaches employed within the IMAP framework adopt global harmonisation practices for classification and labelling of chemicals with assessment thresholds consistent with the previous historical approach used. The major difference is the national weighting applied for the above specific toxicological parameters.

The following chemicals have been assessed using the above approach. The results of which are included in APPENDIX D and summarised in Table 48.

- Ethylene Glycol
- Sodium bisulfite
- Triethanolamine
- Diethanolamine
- Ethanol
- Hydrotreated light petroleum distillate
- Sodium polyacrylate
- Alcohols, C12-C15, ethoxylated
- Amides, tall-oil fatty, N,N-bis(hydroxyethyl)
- Fatty acids, tall oil, ethoxylated
- Butyl alcohol
- Tributyl tetradecyl phosphonium chloride
- Glutaraldehyde
- Monoethanolamine borate

- Guar gum
- Ulexite
- Silica gel.

It should be noted that the IMAP framework has not been employed for the balance of chemicals, and so no change is reflected in previous chemical assessments.

**Table 48: Summary of Human Health Hazard Classification and Potential Outcomes (as per the IMAP Framework Ranking Approach)**

Substance	CAS No	IMAP Hazard Ranking	Environmental Behaviour	Key Determinants and Potential Hazard Outcomes
Sodium bisulfite	7631-90-5	3	Readily dissociates / dilutes in waters. Oxides of sulphur may be produced from the bisulphite anion.	Low order of toxicity. Rating reflects the hypersensitivity responses to sulphur and oxides of sulphur for sensitive populations (common) Concerns thus limited to occupational setting as sulphur (as oxide) is expected to be distributed (e.g. to atmosphere) within the environmental setting.
Ulexite	1319-33-1	4	Slightly soluble. The surrogate for ulexite, disodium octaborate is converted to boric acid and disodium borate in water. Unlikely to bioaccumulate.	Potential to cause reproductive toxicity (infertility) and its potential for damaging the unborn child. In aqueous solutions sodium borates are likely to convert to boric acid/borate and at physiological and acidic pH, predominately exist as un-dissociated boric acid. Based on this, the potential human toxicity of ulexite can be based on boric acid. The reproductive toxicity of boric acid and its salts occurs at high doses via the oral route. It is unlikely to present a reproductive toxicity hazard via skin contact and when inhaled as dust below the occupational exposure limit.
Triethanolamine	102-71-6	2	Highly soluble, readily biodegradable with a low to moderate potential to bioaccumulate	Triethanolamine has a low order of acute and chronic toxicity. It is classified as a skin sensitizer and eye irritant. It is not genotoxic, carcinogenic, or toxic to development or the reproductive system.
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	2	Readily biodegradable in soil, potential to persist and bioaccumulate	Based on chronic dermal exposure and being an eye and skin irritant.
Ethylene Glycol	107-21-1	3	Rapid degradation following dilution.	Ethylene glycol exhibits a diverse range of adverse toxicological outcomes in animal studies including reproductive, developmental and teratogenic effects and renal effects after chronic exposure, although it is not considered highly acutely toxic via the oral, dermal and inhalation pathways. In humans it is considered to be acutely toxic. Furthermore, while ECHA has not classified ethylene glycol as a reproductive toxicant, ATSDR (2010) highlight the developmental toxicity of ethylene glycol in animals.
Diethanolamine	111-42-2	3	Highly soluble, readily biodegradable with a low to moderate potential to bioaccumulate.	Based on carcinogenic and reproductive toxicity potential. Diethanolamine was assigned Group 2B by IARC indicating it is possibly carcinogenic to humans and it is classified by the ECHA dossier as Category 2 for reproductive toxicity (H361). The ECHA dossier also classifies diethanolamine for chronic (repeated dose) oral toxicity and as irritating to the skin and highly irritating to the eyes. Diethanolamine is considered to

Substance	CAS No	IMAP Hazard Ranking	Environmental Behaviour	Key Determinants and Potential Hazard Outcomes
				have moderate acute oral toxicity and low toxicity following inhalation exposure. It is considered to be not sensitising to the skin.
Fatty acids, tall-oil, ethoxylated	61791-00-2	2	Likely to persist in soils, immobile in water with a potential to bioaccumulate	Based on the potential for it to be sensitising to skin. Although it is noted that sensitising test produced mixed results. Fatty acids, tall-oil, ethoxylated has low oral acute and chronic toxicity.
Ethanol	64-17-5	1	Highly soluble, readily biodegradable with a low potential to bioaccumulate.	Based on being an eye irritant. This ranking is based on the exclusion of data specific to extremely high exposure to ethanol, as observed for consumption of alcoholic beverages. Adverse effects for several endpoints (carcinogenicity, mutagenicity/genotoxicity, reproductive/developmental toxicity and chronic toxicity) were observed at high dose rate. However, these dose rates are not considered relevant when considering industrial uses and potential occupational exposure.
Sodium polyacrylate	9003-04-7	3	Highly soluble in water.	Based on the potential effects of inhalation of the respirable dust of the polymer. It is noted that this is based upon a no observed effect concentration, which was the highest concentration in a study. Given the limited information, it is concluded that there is the potential for toxicity effects due to chronic inhalation of respirable dust. Potential inhalation exposures would require management.
Butyl alcohol	71-36-3	3	Highly soluble, readily biodegradable with a low potential to bioaccumulate.	Because it is corrosive to the eyes, causing serious and irreversible eye damage (classified as Category 1, H318: "Causes serious eye irritation"). It is also a skin irritant (classified as Category 2, H315: Causes skin irritation). As typical of alcohols, butyl alcohol can result in transient effects on the central nervous systems (CNS) consistent with general impairments of neurological and behavioural functions (drowsiness and dizziness). As such, butyl alcohol is also classified as specific target organ toxicity (STOT) Single Exposure Category 3 (H335: May cause respiratory irritation/ H336: May cause drowsiness or dizziness), and is also classified for acute oral toxicity as Category 4 (H302: Harmful if swallowed).
Tributyl tetradecyl phosphonium chloride	81741-28-8	3	Insoluble in water, readily biodegradable with a low potential to bioaccumulate	Due to acute inhalation and dermal toxicity, and corrosivity to skin and eyes. It is considered fatal if inhaled, toxic following contact with the skin and harmful if swallowed. It is also considered corrosive to the skin and eyes and sensitising to the skin. Data is lacking for the assessment of the chronic toxicity, reproductive toxicity and respiratory sensitization potential of tetrabutylphosphonium chloride.

Substance	CAS No	IMAP Hazard Ranking	Environmental Behaviour	Key Determinants and Potential Hazard Outcomes
Guar gum	9000-30-0	3	Insoluble in water, biodegradable and unlikely to bioaccumulate	Based on reported occupational asthma suggestive of Type 1 hypersensitivity responses while dermal and eye irritancy is the other main consideration. The potential for dust generation with such a product may result in both of these adverse outcomes under conditions of occupational exposure and subsequently warrant management measures. In addition, as the product is an organic dust, ignition and explosion are further concerns related to worker safety during on-site use of this product during chemical stimulation activities.
Hydrotreated light petroleum distillate	64742-47-8	3	Insoluble in water, readily biodegradable with a low potential to bioaccumulate	Based on a classification of Aspiration Hazard – Category 1; H304 (May be fatal if swallowed and enters airways). In addition, Kerosines are classified as Skin Irritation Category 2 (H315), irritating to the skin, and have the hazard statement AUH066 (Repeated exposure may cause skin dryness and cracking). Other than these hazards, studies reported low acute and chronic toxicity via the oral, dermal and inhalation route.
Alcohols, C12-C15, ethoxylated	68131-39-5	1	Volatile, low potential to bioaccumulate	Reflects a low order of acute toxicity and its associated irritant properties, the latter of greater concern for the occupational setting. Overall, alcohols, C10-16, ethoxylated, propoxylated, exhibit a lack of carcinogenic, genotoxic, reproductive and developmental toxicities with the latter only evidenced at maternally toxic doses. It is not considered a sensitiser.
Glutaraldehyde	111-30-8	3	Insoluble in water, readily biodegradable with a low potential to bioaccumulate	Based on the potential for it to be corrosive to the skin and eyes, a respiratory sensitiser and acutely toxic via the oral route of exposure.
Monoethanolamine borate	26038-87-9	4	Soluble, biodegradable and unlikely to bioaccumulate	Based on potential reproductive and developmental toxicity, Safe Work Australia (2020) has classified Monoethanolamine borate as Category 1B for reproductive and developmental toxicity (H360FD May damage fertility. May damage the unborn child). This is based on the classification of sodium borate, anhydrous (CAS No. 1330-43-4), tetraboron disodium heptaoxide, hydrate (CAS No. 12267-73-1) and orthoboric acid, sodium salt (CAS No. 13840-56-7) as Category 1B and the recommendation by NICNAS to extent this classification to the group ('salts of boric acid').

Substance	CAS No	IMAP Hazard Ranking	Environmental Behaviour	Key Determinants and Potential Hazard Outcomes
Silica gel	112926-00-8	0	Porous and water absorbing. Chemically stable (unlikely to react with other substances in the environment).	<p>Amorphous silica is chemically and biologically inert when ingested in any of its many physical forms such as amorphous siliceous earth (diatomaceous earth, diatomite, kieselguhr) or colloidal silica gels and is not classifiable as to its carcinogenicity to humans. SAS is not considered as having acute or chronic health effects when administered via oral, dermal and inhalation exposure pathways nor as having any reproductive, development/teratogenicity and mutagenicity/genotoxicity effects. SAS is not classified as a skin sensitiser nor does it cause irreversible irritation of the skin or eye. For this reason it is categorized as Hazard Band 0.</p> <p>Safe Work Australia has listed amorphous silica as a hazardous substance under the respective legislation and developed an exposure standard for amorphous silica dust which is the generic standard for dusts. Due to its low solubility, amorphous silica in aqueous solution and as introduced during chemical stimulation activities would settle into soils and sediments and become indistinguishable from those materials. The principle hazard is subsequently the generation of dusts under occupational settings which require management.</p>



## 6.7 Uncertainty Analysis and Concluding Comments

The evaluation of the hazards presented in Table 48 is based on the available data obtained from the selected sources presented in Section 6.5. As a consequence, the hazard evaluation is limited to the quantity and quality of information available in those sources. An assessment of the quality of the available data is beyond the scope of this report. In the absence of verifying the data by going to the primary literature sources, the selection of data for use in the assessment has been confined to established, robust and reputable sources such as NICNAS, EU, IARC, WHO and US EPA where available. As new toxicological data are generated and become available in the published literature, the information presented in this hazard evaluation and the associated conclusions may be subject to change. Specific areas where such information is being generated include the areas of endocrine disruptors and nanotoxicity. The latter has at this stage not been a focus of these current evaluations due to the paucity of available peer-reviewed information but may be required as new information becomes available.

The hazard evaluation for human health suggests that the dominant concerns are related to occupational hazards such as carcinogenicity, silicosis, skin, eye and respiratory irritancy or corrosivity and sensitisation. In some cases, physical hazards of flammability and explosion prevail and are identified in this report. While extensive dilution of the stimulation chemicals is anticipated such that exposure concentrations will be much reduced compared to concentrations injected into the well, and in flowback fluid, there are a number of environmental hazards that are suggested from this human health evaluation. These include the potential for:

- Residual elevation of organic moieties. e.g. some salts have an organic part that will be present following dissociation that may increase in environmental waters.
- Changes in pH of environmental waters due to alkaline or acidic components.
- Elevations of certain metal concentrations in environmental waters.
- Some additives to exert endocrine disruption effects.
- Certain inorganic substances to generate atmospheric particulates that may impact nearby communities; and
- Volatile components to comprise nuisance or irritant effects should atmospheric concentrations be elevated in close proximity to communities.

These environmental hazards may be assessed further, and/or managed as required.

## 7.0 RISK CHARACTERISATION

Risk characterisation is the final step in a risk assessment process. It traditionally involves the incorporation of the exposure assessment and toxicological dose-response data. In this qualitative risk assessment, the process has embodied a hazard assessment and discussion of potential exposure pathways as part of a qualitative assessment of risk.

### 7.1 Discussion of Hazard Assessment

A hazard assessment of the chemicals used in the stimulation process by Santos contractor Halliburton have been assessed through the evaluation of persistence, bioaccumulation and aquatic toxicity (PBT) for aquatic receptors, terrestrial toxicity, and human health toxicity including physical hazards such as fire and explosion. The review of hazards is qualitative in that it has provided a relative ranking of chemicals considered to represent a high, moderate or low hazard in respect to the ecological or human health end points.

It should be noted that the selection of a substance as a COPC does not indicate an unacceptable risk; rather it indicates that potential exposures to these chemicals should be evaluated in greater detail to assess whether they might present an unacceptable risk. Further assessment usually entails evaluation of likely environmental concentrations and refinement of the exposure assessment.

The hazard assessment incorporates the assessment of toxicity and is based on the assumption that the pure substance is present; this is not true of either the stimulation fluid or the resultant concentration in the environment. The concentration of chemicals in the stimulation fluid during a release into the environment is expected to be less than the starting concentration calculated in the mass balance. The concentrations are expected to be reduced due to chemical processes during the stimulation process that result in transformation of the chemicals to simpler end products. In addition, chemicals will be subject to degradation, dispersion and adsorption all of which will result in attenuation of chemical concentrations with distance from the radius of stimulation.

#### 7.1.1 Aquatic and Terrestrial Assessment

Based on the hazard classification of the stimulation chemicals (as presented in Table 4), the seven chemicals classified as a high hazard for aquatic receptors were considered to be COPC and these were alcohols, C12-C15, ethoxylated; surrogate for amides, tall-oil, fatty, N,N-bis(hydroxyethyl); chlorous acid, sodium salt; disodium octaborate tetrahydrate, sodium bisulfite, sodium iodide and surrogate for ulexite.

The certainty of the hazard classification varies depending on the extent of data gaps and the reliance on modelled data. The percent of data gaps were calculated and are presented in Table 23. The percentage data gaps for the high hazard chemicals ranged from relatively low (Alcohols, C12-C15, Ethoxylated) to relatively high (Sodium iodide).

In terms of terrestrial receptors, the following organic chemicals were assessed to have the potential to pose a higher environmental hazard relative to the other chemicals assessed based on persistence and potential to biomagnify:

- Diethanolamine; and
- Hydrotreated light petroleum distillate.

Diethanolamine has low volatility but it does not persist in the soil and does not biomagnify. Hydrotreated light petroleum distillate has a high potential to biomagnify but it does not persist in the environment based on its fast half-life and high volatility. Therefore, although these chemicals appear to pose a higher hazard than others, their risk profile to terrestrial receptors is relatively low.

The remaining chemicals were considered likely to degrade quickly or moderately quickly and/or have a high or moderate volatility. Hence, whilst direct toxicity to terrestrial receptors may occur from exposure to these chemicals either after a spill or breach of containment, the effect will likely be reduced over time.

### 7.1.2 Human Health Assessment

The hazard evaluation for human health undertaken in accordance with the 'low-medium-high' hazard ranking methodology indicated three of the twenty chemicals assessed to have a 'moderate to high' relative ranking:

- Methanol
- Sodium iodide
- Acetic acid.

The hazard evaluation for human health undertaken in accordance with the IMAP Framework hazard ranking methodology indicated twelve of the seventeen chemicals assessed under this methodology to be a Hazard Rank of 4 or 3.

- Ethylene Glycol
- Sodium bisulfite
- Ulexite
- Diethanolamine
- Sodium polyacrylate
- Butyl alcohol
- Tributyl tetradecyl phosphonium chloride
- Guar gum
- Hydrotreated light petroleum distillate
- Glutaraldehyde
- Monoethanolamine borate.

The hazard evaluation for human health suggests that the dominant concerns are related to occupational hazards such as carcinogenicity, silicosis, skin, eye and respiratory irritancy or corrosivity and sensitisation. In some cases, physical hazards of flammability and explosion prevail and are identified in this report. While extensive dilution of the stimulation chemicals is anticipated such that potential exposure concentrations will be much reduced compared to concentrations injected into the well and in flowback fluid, there are a number of hazards that are suggested from this human health evaluation. These include the potential for:

- Residual elevations of organic moieties, e.g. some salts have an organic part that will be present following dissociation that may increase in environmental waters.
- Changes in pH of environmental waters due to alkaline or acidic components.
- Elevations of certain metal concentrations in environmental waters.
- Some additives to exert endocrine disruption effects.
- Certain inorganic substances to generate atmospheric particulates that may impact nearby communities in close proximity; and
- Volatile components to comprise nuisance or irritant effects should atmospheric concentrations be elevated in close proximity to communities.

These environmental hazards may be assessed further, and/or managed as required. Some of the exposure pathways identified (linking source to receptor) may be absent.

## 7.2 Discussion of Exposure Assessment

Potential exposure pathways were evaluated for on-site (i.e. within the lease) and those relevant for off-site (i.e. anything beyond the well lease boundary). Potentially complete exposure pathways were evaluated for workers, trespassers, native fauna and flora and livestock. The environment immediately surrounding the well lease (i.e. off-site) throughout the study area may vary from lease to lease, but was considered to potentially include homesteads (adult and child residents), water supply bores, creeks or waterholes, livestock and native flora and fauna.

The on-site assessment indicated that the majority of potential exposure pathways were unlikely or incomplete, given the application of operational controls by Santos. These operational controls include:

- OH&S procedures implemented during stimulation operations to prevent workers from direct contact and inhalation exposure to chemicals during spills and when handling flowback water or sediments.
- Implementation of spill containment procedures during operations to prevent migration of and exposure to chemicals.
- Vacuum removal of sediments and fluids contained within panel tanks, to prevent exposure to contaminants in windborne dust.
- Installation of signs to indicate the well lease (including the panel tank) is a work zone to be accessed by authorised personnel; and
- The use of panel tanks of approximately 2 m in height to prevent access by livestock and large native fauna.

One potentially complete exposure pathway was identified, which is direct contact to the flowback water in the panel tank for birds and flying mammals such as bats. All reasonable measures will be implemented to discourage entry of small native fauna into the well lease area during stimulation operations.

Potential off-site exposure pathways were evaluated for homesteads, livestock, native flora and fauna and aquatic ecosystems. Three possible sources were identified: stimulation fluids, sediments from the panel tank and flowback water. The exposure assessment concluded:

- Based on understanding of the Eromanga and Cooper Basin geology and hydrogeology, and Santos' well integrity testing procedures and operational monitoring, exposure to residual stimulation chemicals through subsurface pathways is considered unlikely and incomplete; and
- At the surface, a spill or leak of flowback water from the panel tank was considered possible, however the implementation of operational controls, including use of liners in the tank, removal of fluid and sediment using vacuum techniques and engineering and operational controls (grading of well leases and stormwater controls) is considered sufficient to limit the potential for uncontrolled releases of flowback water to the environment. A further margin of safety is provided by Santos' evaluation of 'environmentally sensitive areas' when establishing well leases, which includes the establishment of buffers between petroleum (and stimulation) activities and features of potential environmental concern. Subsequently, the potential off-site exposure scenarios are considered unlikely and incomplete.

## 7.3 Qualitative Risk Assessment of Fluids

In 2012 Santos collected seven fluid samples during South Australian stimulation activities for chemical analysis. Two of these fluids ('DFS-BCG(H) (formally HyborH) Treatments' and 'High Temperature Acid Spearheads') are still in use or proposed for use by Haliburton in SWQ stimulation activities. The other two

fluids assessed in this report (*'DeltaFrac(H) Treatments'* and *'DFS-BCG Treatments'*) were not assessed in the qualitative assessment of fluids.

A preliminary characterisation of stimulation fluids, makeup and site waters, and flowback quality was performed, comprising a broad suite of chemical analyses with the purpose of initial identification of the types of chemicals present, relative concentrations of chemicals detected, and to assess the concentrations against readily available benchmarks<sup>19</sup>. The initial suite may be refined progressively as required.

The initial chemical suite and assessment was to assist in further identification of potential hazards to humans and the environment using reported concentrations of stimulation fluid constituents at a Santos wellsite targeting conventional gas in Cooper Basin, South Australia. While located in a different jurisdiction, the stratigraphy, geology and fracture stimulation methodology was similar to that proposed for SWQ and is therefore considered to be representative. Direct contact with flowback fluid in the panel tanks has been identified as a potentially complete exposure pathway for human and ecological receptors. This preliminary assessment of flowback fluid quality will inform the scope of future investigations, where required.

At the time of reporting, no information on fluid chemical composition for the two new fluids (*'DeltaFrac(H) Treatments'* and *'DFS-BCG Treatments'*) had been provided to Golder and has therefore not been included in this report.

### 7.3.1 Methodology for Qualitative Risk Assessment

#### 7.3.1.1 Field Work and Sampling Approach

The objective of the sampling was to provide a preliminary perspective of substances in stimulation flowback fluids. The approach is not a definitive representation of chemical or physical contamination, as this would ideally require a larger number of samples over a longer time frame. It does, however, provide some confidence to the hazard assessment process.

Santos indicated that the following sampling procedure was adopted:

- When collecting a sample from a pond or pit, a surface water sampler with a dedicated sampling container was used to collect a sample from 100 mm below the surface of the water in the pit. Prior to sampling, the sampling container was rinsed out three times with fluid obtained from that Flare Pit or vessel (as relevant).
- The fluid sample was placed in a sample jar prepared by the analytical laboratory. The sample bottle was filled to the top to minimise loss of volatile chemicals, and oxidation of the sample.
- Disposable gloves were used during sampling.
- The fluid sample was placed in a chilled, insulated container and delivered to the laboratory under a chain of custody (COC) procedure within recommended holding times for the specific analytical suite; and
- Subsequent samples were obtained with a new sampling container to minimise cross contamination.

#### 7.3.1.2 Analytical Approach

ALS Environmental (ALS) was engaged to perform chemical analyses. ALS is registered by the National Association of Testing Authorities (NATA) for the analyses performed. Analysis of the flowback fluid sample included a range of parameters consistent with those traditionally examined to assess water quality and to account for information from stimulation mixtures as follows:

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<sup>19</sup> Assessment of individual chemicals used in stimulation was not proposed because the number of stimulation chemicals used at sites varies and because some stimulation chemicals cannot be readily analysed by commercial laboratories. For some stimulation chemicals, reliable measurement in environmental media requires the laboratory to develop in-house analytical techniques, which is demanding in time and cost. Furthermore, readily available risk-based screening benchmarks for environmental media do not exist for many of the stimulation chemicals.

- Metals and metalloids (Al, As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Hg, Li, Mn, Mo, Ni, Pb, Se, Sn, Sr, U, V, Zn).
- pH
- TDS
- Major cations and anions
- Nutrients (ammonia, nitrate, nitrite, total nitrogen, total phosphorous, reactive phosphorous, Total Kjeldahl Nitrogen (TKN)).
- Cyanide
- Total organic carbon
- Volatile organic compounds (VOC)
- Semi-volatile organic compounds (SVOC)
- Phenols
- Surfactants
- Formaldehyde
- Silica
- Chlorine
- Iodide
- Monocyclic aromatic hydrocarbons (MAH)
- Polycyclic aromatic hydrocarbons (PAH)
- Petroleum hydrocarbons (PHC)
- Organochlorine pesticides; and
- Organophosphorus pesticides.

These analyses represent a broad screen of organic and inorganic chemicals that may be present in stimulation or flowback fluids and may be used in a toxicity assessment of the fluid. The analytical suite is broad and is designed to capture the majority of substances of potential concern. There may be some unique proprietary substances that may not have been included and further evaluation of these may be required. The tabulated results of the fluid, waters and flowback analysis are presented in full in APPENDIX F at the end of this report. The laboratory certificates are also presented in APPENDIX F. Chemicals exceeding adopted benchmarks are discussed below in Sections 7.3.2.1 and 7.3.2.2.

### 7.3.2 Flowback Fluid Risk Assessment

The purpose of the flowback fluid assessment was a preliminary, qualitative assessment of risk to humans and the environment.

The analytical suite for assessment of the flowback fluid was developed after consideration of the following information and guidance documents:

- *Baseline Assessment Guideline*, DERM, May 2011; and
- Santos GLNG CSG *Groundwater Baseline Suite*, CSG *Water Characterisation Suite* and *Hydraulic Stimulation Suite*.

In review of these documents it is noted that the EVs for aquatic ecosystems and for human uses of water (e.g. water for drinking, farm supply, agriculture, industry and recreational use) under the Queensland Environmental Protection (Water) Policy 2009 (EPP Water) have not yet been developed for SWQ. In the

absence of regionally defined water quality objectives for the study area, adoption of national water quality guidelines for screening are considered appropriate, namely:

- **Ecological receptors (aquatic ecosystems, livestock drinking water, crop irrigation):** *Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand “Australian and New Zealand Guidelines for Fresh and Marine Water Quality”.*
- **Human health, potable water:** *National Health and Medical Research Council (NHMRC) and Natural Resource Management Ministerial Council (NRMMC) (2011). Guidelines for Drinking Water Quality in Australia; and*
- **Human health, recreational water:** *NHMRC (2008). Guidelines for Managing Risks in Recreational Water.*

The above water quality guidelines are suitable for qualitative assessment of flowback water with regard to sensitive environmental receptors and humans. In addition, consideration was given to benchmarks for petroleum hydrocarbon fractions prepared by international regulatory and research agencies or ministerial councils, namely the Dutch National Institute for Public Health and the Environment (RIVM), the Canadian Council of Ministers of the Environment (CCME), and the American Petroleum Institute (API). It is noted that comparison of flowback water quality to potable water quality guidelines constitutes a conservative, screening level assessment as the exposure scenario upon which the guidelines were derived (i.e. chronic exposure from direct ingestion of water) is not strictly relevant to the management of flowback fluids.

The screening assessment of risk from the flowback fluid to ecological receptors and people is presented in Sections 7.3.2.1 and 7.3.2.2, respectively.

### 7.3.2.1 Ecological Assessment

Fluid data reported from the Tindilpie Pad Fluid Pit were evaluated against the following ecological benchmarks:

- ANZECC and ARMCANZ (2000) 95% Species Protection Level and Low Reliability Trigger Values for Freshwater.
- ANZECC and ARMCANZ (2000) Livestock Drinking Water Guidelines.
- ANZECC and ARMCANZ (2000) Crop Irrigation Guidelines.
- CCME (2008) Toxicity Aquatic Life Benchmarks.
- American Petroleum Institute (API) Risk Based Screening Levels (2004) for livestock; and
- RIVM (2004) Serious Risk Concentrations for Ecological Receptors (SRC eco).

Table 49 presents the chemical concentrations that exceeded the adopted benchmarks for the flowback fluid sample.

**Table 49: Concentrations of Chemicals above Adopted Ecological Benchmarks**

Chemical	Lowest Ecological Benchmark (mg/L)	Benchmark Reference	Concentration (mg/L)
<b>Chemical Parameters</b>			
Total dissolved solids (TDS)	4,000	ANZG (2018)	<b>10,100</b>
<b>Anions and Cations</b>			
Chloride	40	ANZG (2018) <sup>[3]</sup>	<b>3,710</b>
Sodium	115	ANZG (2018) <sup>[3]</sup>	<b>2,810</b>
Fluoride	1	ANZG (2018) <sup>[3]</sup>	<b>1.8</b>
<b>Metals and Metalloids</b>			
Arsenic	0.013	ANZG (2018)	<b>0.182</b>
Boron	0.37	ANZG (2018)	<b>57.9</b>
Copper	0.0014	ANZG (2018)	<b>0.061</b>
Lead	0.0034	ANZG (2018)	<b>0.088</b>
Manganese	1.9	ANZG (2018)	<b>2.68</b>
Nickel	0.011	ANZG (2018)	<b>0.028</b>
Zinc	0.008	ANZG (2018)	<b>0.052</b>
Aluminium	0.055	ANZG (2018)	<b>0.09</b>
<b>BTEX</b>			
Xylene (o-)	0.35	ANZG (2018)	<b>1.35</b>
Xylene (m+p)	0.275	ANZG (2018)	<b>7.21</b>
<b>PAH</b>			
Naphthalene	0.016	ANZG (2018)	<b>0.156</b>
Phenanthrene	0.002	ANZG (2018) LR <sup>[1]</sup>	<b>0.032</b>
<b>Miscellaneous Organics</b>			
Phenol	0.32	ANZG (2018)	<b>0.418</b>
<b>Nutrients</b>			
Ammonia (as N)	0.025	ANZG (2018) <sup>[2]</sup>	<b>55.4</b>
Nitrogen (total)	1	ANZG (2018) <sup>[2]</sup>	<b>166</b>
Phosphorous	0.025	ANZG (2018) <sup>[2]</sup>	<b>2.22</b>



Chemical	Lowest Ecological Benchmark (mg/L)	Benchmark Reference	Concentration (mg/L)
<b>Petroleum Hydrocarbons</b>			
Aromatic >EC7-8 <sup>[5]</sup>	1.6	RIVM (2004)	<b>4.42</b>
Aromatic >EC8-10	0.14	CCME (2008)	<b>10.1</b>
Aromatic >EC10-12	0.096	RIVM (2004)	<b>4.1</b>
Aromatic >EC12-16	0.0554	CCME (2008)	<b>3.66</b>
Aromatic >EC16-21	0.071	RIVM (2004)	<b>2.78</b>
Aromatic >EC21-35	0.0061	RIVM (2004)	<b>0.64</b>
Aliphatic >EC5-6	0.33	RIVM (2004)	<b>3.44</b>
Aliphatic >EC6-8	0.0465	CCME (2008)	<b>24.1</b>
Aliphatic >EC8-10	0.0076	CCME (2008)	<b>47.4</b>
Aliphatic >EC10-12	0.00118	CCME (2008)	<b>5.18</b>
Aliphatic >EC12-16	0.000074	CCME (2008)	<b>12.5</b>

**Notes:**

- [1] Low Reliability Trigger Value
- [2] Default Trigger Value for South Central Australia – low rainfall areas, freshwater lakes and reservoirs
- [3] Crop irrigation
- [4] Livestock Drinking Water
- [5] EC represents an equivalent carbon range (EC).

Chemicals reported below the laboratory limit of reporting (LOR), even where the screening benchmarks were below the LOR, were considered unlikely to pose a risk and were not considered further.

### 7.3.2.2 Human Health Assessment

Flowback fluid data reported from the Tindilpie Pad Frac Pit were screened against the following human health benchmarks:

- NHMRC (2011) Drinking Water Guidelines.
- NHMRC (2008) Recreational (Primary contact recreation).
- WHO (2005) Petroleum Products in Drinking Water.
- USEPA (2012b) Tap Water Guideline; and
- TPHCWG (1997) Total Petroleum Hydrocarbon Criteria Working Group.

Table 50 reports the concentrations in the flowback sample that exceeded adopted human health benchmarks.

**Table 50: Concentrations of Chemicals above Adopted Human Health Benchmarks**

Chemical	NHMRC 2008 (Primary Contact Recreation) mg/L	NHMRC 2011 (Human Health) mg/L	Concentration (mg/L)
<b>Chemical Parameters</b>			
Total Dissolved Solids @180°C	-	600	<b>10,100</b>
<b>Anions and Cations</b>			
Fluoride	1.5	1.5	<b>1.8</b>
Sodium	-	180	<b>2810</b>
Chloride	-	250	<b>3710</b>
Iodide	0.1	0.5	<b>1.29</b>
<b>Metals and Metalloids</b>			
Arsenic	0.007	0.01	<b>0.182</b>
Barium	0.7	2	<b>31.6</b>
Boron	4	4	<b>57.9</b>
Copper	2	2	<b>0.061</b>
Iron	-	0.3	<b>15.6</b>
Lead	0.01	0.01	<b>0.088</b>
Manganese	0.5	0.1	<b>2.68</b>
Nickel	0.02	0.02	<b>0.028</b>
Zinc	-	3	<b>0.052</b>
Aluminium	-	0.2	<b>0.09</b>
<b>Miscellaneous Organics</b>			
2,4-dimethylphenol	-	0.27 <sup>[1]</sup>	<b>0.337</b>
2-methylnaphthalene	-	0.027 <sup>[1]</sup>	<b>0.33</b>
1,2,4-trimethylbenzene	-	0.015 <sup>[1]</sup>	<b>2.55</b>
1,3,5-trimethylbenzene	-	0.087 <sup>[1]</sup>	<b>1.76</b>
n-propylbenzene	-	0.53 <sup>[2]</sup>	<b>0.628</b>
Formaldehyde	-	0.5	<b>2.9</b>
<b>PAH<sup>[6]</sup></b>			
Naphthalene	-	0.00014 <sup>[1]</sup>	<b>0.156</b>
<b>BTEX</b>			
Benzene	0.001	0.001	<b>0.848</b>
Ethylbenzene	0.3	0.003	<b>0.533</b>

Chemical	NHMRC 2008 (Primary Contact Recreation) mg/L	NHMRC 2011 (Human Health) mg/L	Concentration (mg/L)
Toluene	0.8	0.025	<b>5.32</b>
Xylene (o)	-	0.5	<b>1.35</b>
Xylenes (m & p)	-	0.5	<b>7.21</b>
<b>Petroleum Hydrocarbons</b>			
Aromatic >EC5-7 <sup>[5]</sup>	-	0.001 <sup>[3]</sup>	<b>0.837</b>
Aromatic >EC7-8	-	0.025 <sup>[3]</sup>	<b>4.42</b>
Aromatic >EC8-10	-	0.003 <sup>[4]</sup>	<b>10.1</b>
Aromatic >EC10-16	-	0.1 <sup>[4]</sup>	<b>7.76</b>
Aromatic >EC16-35	-	0.09 <sup>[4]</sup>	<b>3.42</b>
Aliphatic >EC5-8	-	15 <sup>[4]</sup>	<b>27.54</b>
Aliphatic >EC8-16	-	0.3 <sup>[4]</sup>	<b>65.08</b>

**Notes:**

[1] USEPA (2012b) tap water guideline

[2] N propylbenzene USEPA (2012b) tap water guideline

[3] WHO (2005)

[4] Benchmark for Ethylbenzene.

[5] EC represents an equivalent carbon range (EC).

[6] This has not included a Toxic Equivalency Factor (TEF) approach which examines the combined effects of PAHs based on their potency against benzo(a)pyrene.

Chemicals reported below the laboratory LOR, even where the screening benchmarks were below the LOR, were considered unlikely to pose a risk and were not considered further. The exclusions here are benzo(a)pyrene where the laboratory LOR exceeded the NHMRC (2011) guideline value, some chlorinated hydrocarbons and some of the pesticides such as the organochlorines aldrin, dieldrin and heptachlor. This uncertainty is not considered to be significant on this occasion as many other chemicals exceeded the potable and recreation water quality criteria.

In addition, the evaluation of PAHs as a mixture has not been undertaken at this stage as the naphthalene guideline is already exceeded. This would normally involve the calculation of BaP equivalents (BaPE) using potency data for other PAHs against BaP and their summation and comparison against the BaP guideline. This could be addressed in subsequent evaluation.

### 7.3.2.3 Chemicals for which Guidelines were Unavailable

The following chemicals were reported above the laboratory detection limit but there were no available guidelines or benchmarks for risk assessment:

- 2- methylphenol (0.5 mg/L);
- 3- and 4- methylphenol (0.35 mg/L);
- Fluorene (0.01 mg/L);
- Isopropyltoluene (2.7 mg/L);
- 1-propanol (23 mg/L); and
- 2-propanol (2.8 mg/L).

### 7.3.2.4 Discussion

Analysis of the flowback fluid sample analytical results identified concentrations of PHC, phenolics, BTEX, some PAH, metals, formaldehyde, nutrients, and cations and anions in excess of a large number of the adopted human health and ecological benchmarks. Based on the chemical information disclosed by the stimulation service provider in relation to the SWQ study area, it is considered likely that the petroleum hydrocarbon constituents reported in the flowback fluid sample are 'geogenic' and originated from the sandstone formation being fractured. The results are summarised as follows:

- The highest reported concentrations relative to guidelines were some PHC fractions, some BTEX compounds, PAHs such as naphthalene and BaP equivalents, and nutrients (ammonia and total nitrogen) were many times greater (orders of magnitude) than the applicable ecological and/or human health benchmarks.
- Greater concentrations of aliphatic petroleum hydrocarbon fractions (equivalent carbon chain length) were reported relative to aromatic fractions. The aliphatic carbon chain lengths which dominated the analyses were >EC6-C8 (24 mg/L<sup>20</sup>), >EC5-C8 (28 mg/L) and >EC8-C10 (47 mg/L<sup>21</sup>). The aromatic carbon chain lengths which dominated the analyses were >EC8-C10 (10 mg/L<sup>22</sup>) and >EC10-C16 (8 mg/L). These are all volatile hydrocarbon fractions and may present additional risks associated with inhalation exposure.
- The BTEX compounds: benzene (0.8 mg/L), toluene (5 mg/L), ethyl benzene (0.5 mg/L), and the PAH: naphthalene (0.15 mg/L) were 100 or more times greater than the applicable human health benchmarks. These substances are also volatile and may in addition present inhalation exposure risk.
- The presence of reported concentrations of solvents (ethanol and propanol) in the flowback fluid. These are volatile alcohols.
- The following metals were reported in the flowback fluid above adopted screening benchmarks: iron, manganese, barium, boron, arsenic, lead, nickel, aluminium, copper and zinc.
- The following cations and anions were reported in flowback fluid above adopted screening benchmarks: sodium, chloride, iodide, fluoride.
- The flowback fluid was of neutral pH (pH 7.5) and reported total dissolved solids (TDS<sup>23</sup>) concentrations that were considered to be moderately saline based on a reported concentration of 10,100 TDS mg/L compared to rainwater (<1 mg/L), surface<sup>24</sup>, ground or sea water (35,000 mg/L); and
- The reported concentrations of nutrients (phosphorous, total nitrogen, ammonia) were elevated above the default<sup>25</sup> ecological benchmarks.

The following chemicals were not detected in the flowback fluid sample: OCPs and OPPs. Petroleum-based constituents are included in some stimulation fluid additive products (DEC, 2011). Review of TPHCWG (1998) reports that crude oil includes some of the individual chemicals reported in the flowback fluid, such as BTEX, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, n-propylbenzene, and PAHs. Based on the chemical information indicated or disclosed to Golder by Santos or its contractors in relation to the SWQ study area, no PHC constituents have been identified or proposed for use in the fluid systems assessed in this report. It is considered highly likely that the PHC constituents reported in the flowback fluid sample originated from the sandstone formation being fractured (i.e. a hydrocarbon reservoir).

<sup>20</sup> Several hundred times above the lowest adopted ecological screening benchmark.

<sup>21</sup> Several thousand times above the lowest adopted ecological screening benchmark.

<sup>22</sup> Several thousand times above the lowest adopted human health screening benchmark

<sup>23</sup> TDS is a measure of all inorganic salts dissolved in water.

<sup>24</sup> Surface waters generally have TDS concentrations lower than groundwaters and higher than rainwater.

<sup>25</sup> The default trigger values for physical and chemicals stressors (i.e., different to toxicants) in ANZECC and ARMCANZ (2000) are not risk-based benchmarks. The default trigger values are indicative of unmodified or slightly-modified ecosystems reference or 'background' ranges for Central South Australia – low rainfall areas, freshwater lakes and reservoirs.

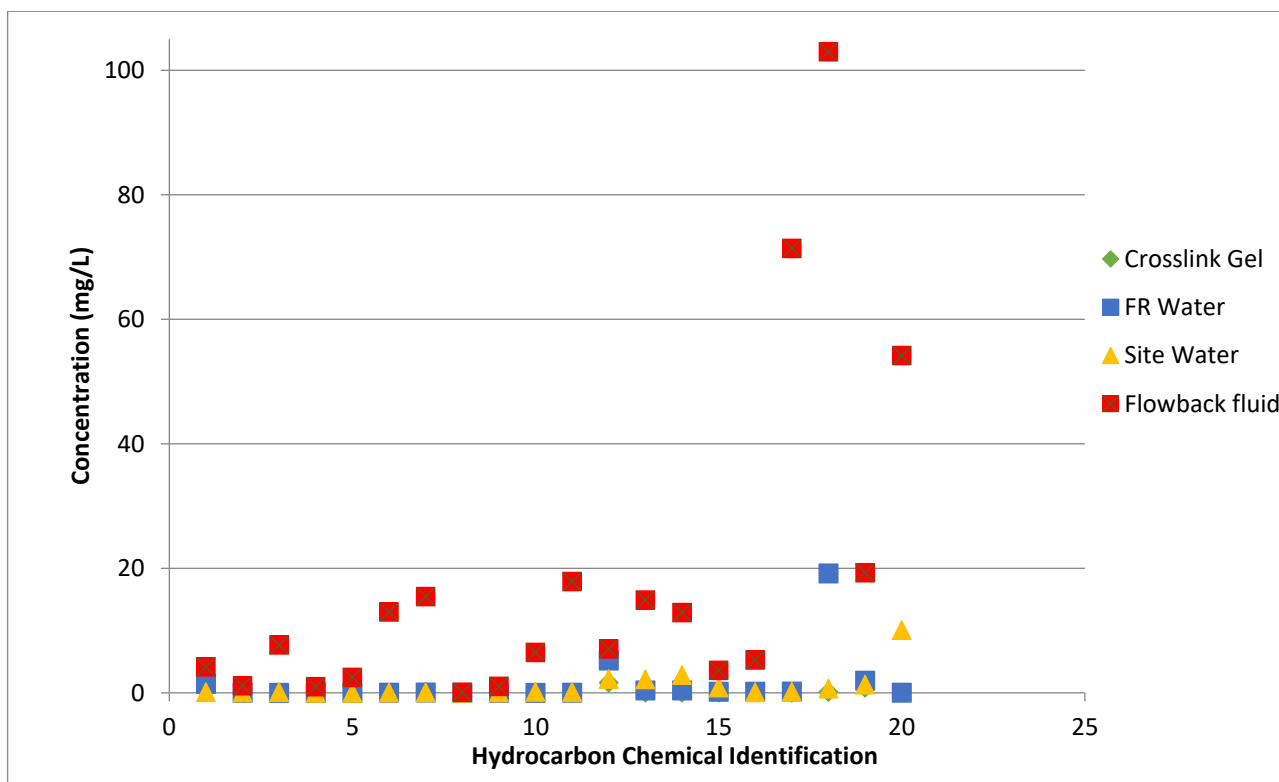
Some substances such as PHC, phenolics, BTEX, PAH, metals, nutrients, anions and cations reported in the flowback fluid may originate from the reservoir geology and/or the stimulation fluid constituents used. The reported concentrations of nutrients were considered likely to reflect organic inputs from stimulation chemicals rather than those naturally present in the formation. However, without additional information (namely, characterisation of (i) the produced water before mixture with stimulation fluid additives, (ii) mixed stimulation fluid prior to injection into the well, and (iii) background groundwater quality data) relative contributions from the stimulation fluid compared to naturally occurring concentrations cannot be assessed.

While some substances such as formaldehyde and the alcohols are not expected within the geological formations the presence of BTEX requires further evaluation as these are explicitly excluded from use in stimulation as stipulated by the EA.

As an initial step to examine this issue, stimulation mixtures were formulated with distilled water and subsequently analysed consistent with the previous analytical suites. These are discussed in Section 7.3.3.

### **7.3.3 Halliburton Stimulation Fluid Evaluations**

As a preliminary step in the evaluation of hydrocarbon components in stimulation mixes two mixtures were formulated with distilled water and submitted for broad screen analyses consistent with the previous analytical profiles. Complete results are presented in Figure 2 and the results summarised in Table 52.



**Figure 2: Hydrocarbon Concentrations in Stimulation Fluids (mg/L)**

Review of the information suggests that the flowback fluids are substantially higher in residual concentrations of hydrocarbons that are considered to represent geogenically-derived substances, and these exceed conservative, potable water quality guideline concentrations.

Examination of the make up water drawn from formation water sources suggests the hydrocarbon concentrations are substantially lower, although still detectable, and range from concentrations below the limits of reporting to those concentrations approaching or in some cases exceeding certain water quality guidelines. This includes both potable water quality guidelines and ecological guidelines from both the Netherlands (RIVM, 2004) and Canada (CCME, 2008). These exceedances only apply to the TPH fractional ranges and the aesthetics-based health values for ethyl benzene and total xylenes.

The distilled water formulations (Crosslink Gel and FR Water) present a similar PHC concentration profile to the make up water with generally lower concentrations albeit with exceptions in some TPH fractional ranges and for p-isopropyltoluene. The latter are within an order of magnitude of the make up water concentrations. The BTEX results for the distilled water formulations are summarised in Table 51 below. The reported BTEX concentrations were either below the laboratory LOR or, where detected, were below the DEHP regulated criteria for stimulation fluid additives in Queensland.

**Table 51: Summary of BTEX Analytical Results for Distilled Water Formulations (mg/L)**

Analyte	DEHP Criteria	Crosslink Gel	FR Water
Benzene	0.001	<0.001	<0.01 <sup>1</sup>
Toluene	0.18	0.013	0.026
Ethylbenzene	0.08	<0.002	<0.01 <sup>1</sup>
o-Xylene	0.35	<0.002	<0.01 <sup>1</sup>
m & p-Xylene	0.275 <sup>2</sup>	0.017	0.05

## Notes:

1. The laboratory reported that this sample was diluted prior to analysis due to matrix interferences, and the LOR was raised accordingly. While the raised LOR exceeds the benzene criterion of 0.001 mg/L, it does not represent an actual benzene concentration in the sample in exceedance of the criterion.
2. The m & p-Xylene criterion is the sum of the criteria for the individual m- and p-Xylene isomers (0.075 and 0.2 mg/L, respectively). Neither of the reported concentrations exceeds the lower of the individual isomer criteria.

Table 52 presents a comparison of the hydrocarbon results across the distilled water formulations and the (formation) makeup water and the flowback fluid results. It also provides the respective water guidelines based on either the NHMRC/NMMRC potable water quality guidelines and recreational contact guidelines and the ANZECC (2000) ecological guidelines where available. Where Australian guidelines were unavailable, specifically the TPH fractions, human health data were drawn from WHO (2005) and the ecological criteria drawn consistently from RIVM (2004) for this table as a guide.

These results suggest that generally formulations are not contributing substantial amounts of BTEX and TPH into the subsurface regions, however, some qualification of this statement is required as a result of residual uncertainties. These uncertainties require further exploration and reflect:

- Limited sampling frequencies for the respective fluids examined.
- Confidence in the sampling integrity and any potential for introduction of extraneous contamination. This potential is considered possible in view of the immediate environmental surrounds of the stimulation conditions; and
- The sampling process and its consistency with stimulation procedures at the time of sampling including spatial and temporal references, i.e. what was happening at the time of sampling and process locations, etc.

**Table 52: Preliminary Stimulation Fluid Makeup Analyses and Fluid Flowback Comparisons (mg/L)**

Chemical	NHMRC 2008 Human Health,(Primary Contact Recreation)	NHMRC 2011 (Human Health, Potable)	RIVM (2004); CCME (2008); ANZECC (2000) (Ecological)	Concentration			
				Crosslink Gel	FR Water	Make up water	Flow back fluids
(1) p-isopropyltoluene	NA	NA	NA	0.316	1.45	<0.005-0.11	1.83-4.19
(2) benzene	0.001	0.001	0.95	<0.001	<0.01	0.002-0.065	0.848-1.16
(3) toluene	0.8	0.025	0.18	0.013	0.026	0.004-0.148	5.32-7.7
(4) ethyl benzene	0.3	0.003 (aesthetic) 0.3 (health)	0.08	<0.002	<0.01	<0.002-0.011	0.533-0.995
(5) o-xylene	NA	NA	0.35	<0.002	<0.01	<0.002-0.023	1.35-2.48
(6) m- and p-xylene		NA	0.275	0.017	0.05	<0.002-0.08	7.21-13
(7) xylenes	As for potable	0.02 (aesthetic) 0.6 (health)	NA	<0.19	<0.06	<0.004-0.103	8.56-15.48
(8) iodomethane	NA	NA	NA	0.019	<0.01	<0.005	<0.1
(9) Aromatic EC5-7 <sup>a</sup>	(0.001)	(0.001)	2.6	<0.005	<0.01	<0.005-0.07	0.837-1.04
(10) Aromatic >EC7-8 <sup>b</sup>	(0.8)	(0.025)	1.8	0.012	0.023	<0.005-0.164	4.42-6.49
(11) Aromatic >EC8-10	NA	0.003 <sup>c</sup>	1.3	0.018	0.047	<0.005-0.142	10.1-17.9
(12) Aromatic>EC10-12	NA		0.94	1.64	5.2	<0.05-2.24	4.1-7.07
(13) Aromatic >EC12-16 <sup>e</sup>	NA		0.67	<0.05	0.41	<0.05-2.18	3.66-14.9
(14) Aromatic >EC16-21 <sup>e</sup>	NA	0.09	0.6	<0.05	0.41	<0.05-2.86	2.78-12.9
(15) Aromatic >EC21-35	NA		1.2	0.056	0.205	0.099-0.871	0.64-3.61
(16) Aliphatic EC5-6	NA	15.0 <sup>d</sup>	0.42	0.038	<0.2	<0.02-0.086	3.44-5.3



Chemical	NHMRC 2008 Human Health,(Primary Contact Recreation)	NHMRC 2011 (Human Health, Potable)	RIVM (2004); CCME (2008); ANZECC (2000) (Ecological)	Concentration			
(17) Aliphatic >EC6-8	NA		0.17	<0.02	0.216	0.02-0.162	22-71.4
(18) Aliphatic >EC8-10	NA	0.3	0.094	0.155	19.2	<0.02-0.688	47.1-103
(19) Aliphatic >EC10-12	NA		0.16	0.85	1.98	<0.05-1.34	5.18-19.3
(20) Aliphatic >EC12-16	NA		1.7	<0.05	<0.05	<0.05-10.1	12.5-54.2

## Footnotes:

- a. This fractional TPH group is based on benzene.
- b. This fractional TPH group is based on toluene.
- c. This fractional range includes ethylbenzene for which an aesthetic guideline of 0.003 mg/L has been established but also xylenes and methylethylbenzene that exhibit low taste and odour thresholds.
- d. This value exceeds solubility threshold.
- e. As PAHs are found within this fractional range these should be evaluated separately.

### 7.3.4 Assumptions and Limitations

The preliminary assessment of flowback data is subject to the following assumptions and limitations.

- The screening is conservative in that the benchmarks are intended for screening freshwater waters protective of ecological receptors (aquatic plants and animals, livestock drinking water, and plants<sup>26</sup>), and waters for recreation or for potable use by humans. The likelihood of these exposure pathways being realised differs for the receptors identified as discussed in Section 2.0. However, a conservative approach adopts the precautionary principle in risk assessment and provides additional confidence when there are uncertainties.
- The small sample size (six primary samples) for which variance in the flowback fluid cannot be assessed. The exact mix of the flowback fluid may be influenced by the aquifer being fractured and may vary between fracture locations. This may change in space and time so additional sampling strategies would seek to address spatial and temporal variance.
- Limited (one duplicate) quality assurance / quality control (QA/QC) samples were included in this investigation. Consideration of other sources of chemicals/contaminants: the quality and chemical characterisation of the make-up water; contamination status of the tankers used to transport and store water and to mix stimulation fluids: note this to a degree was addressed by making up representative samples of fracture chemicals using distilled water.
- Sampling was performed by non-Golder personnel, although managed by experienced Santos personnel in consultation with Golder. It is uncertain whether the sample represented a homogeneous sample of the distribution of contaminants throughout the water column, although all reasonable efforts were made to address this.
- The screening benchmarks adopted do not account for risk to humans via the vapour inhalation exposure pathway. A number of substances are volatile and present an inhalation hazard from ambient or confined atmospheric sources; and
- Further review of stimulation chemical constituents and mass balance data was not performed.

The combined effects of the stimulation chemical mixture were not assessed as it was considered outside the scope of a preliminary screening level risk assessment. Such an assessment reflects the ability for components to biologically interact and result in enhanced or minimised effects.

### 7.3.5 Conclusions

Based on this preliminary qualitative risk assessment, some substances (refer to Table 52) reported in the flowback fluid may originate from the reservoir geology and the reported concentrations of these chemicals may pose unacceptable risks to humans and ecological receptors exposed to flowback fluids. Further risk assessment would assist in better defining these risks and preliminary evaluations. It is noted that limited presence of toluene, xylenes and some TPH components were reported albeit at or near target acceptable concentrations. These may require further exploration and clarification to reduce residual uncertainties.

However, these risks may be managed by appropriate occupational and environmental health safety procedures and controls provided there is consistency in materials and methods. Changes in materials would require re-evaluation.

## 7.4 Overall Evaluation of Risk

Considering the hazard and exposure assessment and operational controls discussed, the overall risk to human health and environment associated with the chemicals involved in stimulation are expected to be low. These operational controls include:

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<sup>26</sup> Crop irrigation.

- OH&S procedures implemented during stimulation operations to prevent workers from direct contact and inhalation exposure to chemicals during spills and when handling flowback water or sediments.
- Assigning buffers during establishment of well leases between petroleum operations and potential “environmentally sensitive areas” identified through database review and site-specific ecological assessment where warranted.
- Implementation of spill containment procedures during operations to prevent migration of and exposure to chemicals.
- Removal of sediments and fluids contained within drained panel tanks to prevent exposure to contaminants in windborne dust.
- Installation of signs to indicate well leases (including panel tanks) are a work zones to be accessed by authorised personnel.
- The use of panel tanks of approximately 2m in height to prevent access by livestock and large native fauna.
- Santos operational procedures regarding well integrity verification and fracture design to stay within the target formation.
- Double lining of panel tanks as a minimum standard, to prevent seepage of flowback water into the underlying aquifer; and
- Engineering and operational controls (grading of well leases and stormwater controls to limit the potential for uncontrolled surface releases of flowback water to the environment.

## 7.5 Other Considerations

### 7.5.1 Noise and Vibration

The activities associated with stimulation have the potential to generate noise or vibration that could potentially impact nearby receptors. However, given the remote nature of Cooper Basin stimulation activities the presence of nearby receptors is considered unlikely. In addition, whilst the proposed activities will take place on a continuous basis, they will be undertaken sequentially for short periods of time at different sites over a wide area. As a result, individual sensitive receivers are only likely to be exposed to the effects of noise and vibration from these activities for a few weeks at a time. On this basis, risk associated with noise and vibration to offsite receptors has not been considered further in this report.

Potential for onsite noise and vibration exposure to workers exist during stimulation activities. Santos and stimulation service provider’s equipment are subject to noise emission testing by a professional third party. Prevention of exposure to workers is managed through Santos OH&S procedures.

### 7.5.2 Cumulative Impacts

Cumulative underground impacts from stimulation processes in a well lease are not anticipated based on the controls described in this report. Stimulation will be confined to the target sequences and vertical fracturing into overlying aquifer units is highly unlikely to occur.

Potential cumulative impacts associated with the development activities on a well lease may be associated with extraction of water from the reservoirs (after completion of the stimulation activities) and associated aquifer systems within respective formations. These cumulative impacts have been assessed separately and a groundwater monitoring and management plan developed which includes “make-good” provisions for potentially affected wells which may see reductions in water levels and associated yield.

## 8.0 CONCLUSIONS

### 8.1 Environmental Setting

Santos operates conventional gas and oil fields across petroleum tenements within an approximately 30,000 km<sup>2</sup> portion of Southwest Queensland. These tenements and the land surrounding the Santos tenement boundaries comprise the Santos SWQ *study area*.

The terrain in the study area is generally characterised by low undulating topography (hills and ridges) between the drainage channel systems of the Cooper Creek. The area is sparsely developed, and generally comprises rural communities and homesteads that are largely engaged in farming and livestock.

It is within the stratigraphy that comprises the Eromanga Basin and the underlying Cooper Basin that oil and gas reservoirs are located which contain the proposed target formations for stimulation. A detailed description of key geological and hydrogeological features is provided in Volume One, including geological models for the study area, target hydrocarbon-bearing sandstone formations (oil in the Eromanga Basin formations at depths ranging from 700 to 1,200 mbgl, and gas in the Cooper Basin formations at depths of 1,500 to greater than 2,000 mbgl), their hydraulic characteristics, adjacent aquifers and aquitards, structural features including faults and fracture characteristics (and their potential to behave as barriers or conduits), regional and local seismicity characteristics, aquifer environmental values and the location of groundwater users.

In terms of the environmental setting, Volume One of the SWQ HSRA has provided specific information which addresses the requirements anticipated of the EA conditions regarding stimulation that will apply to existing and new areas.

Based on understanding of the environmental setting, this qualitative risk assessment considered the key environmental values as follows:

#### Groundwater Environmental Values:

- Town water supply
- Stock and domestic water supply
- Sandstone aquifers of the GAB; and
- GDEs.

#### Surface Water Environmental Values:

- Protection of aquatic ecosystems
- Recreation and aesthetics: primary recreation with direct contact, and visual appreciation with no contact; and
- Cultural and spiritual values.

#### Terrestrial Environmental Values:

- Protection of flora and fauna, such as small mammals, reptiles and birds.

The report has considered each in terms of the risk to aquatic ecosystems, terrestrial ecosystems and human health.

### 8.2 Stimulation Process Description Summary

With regard to the process of stimulation, information addressing the EA blueprint conditions (with reference to the model conditions) are located within Volume One of the SWQ HSRA, including:

- Practices and procedures to ensure that the stimulation activity(ies) is designed to be contained within the target gas producing formation.

- Provide details of where, when and how often stimulation is to be undertaken on the tenures covered by this environmental authority.
- A description of the well mechanical integrity testing program.
- Process control and assessment techniques to be applied for determining extent of stimulation activity(ies) (e.g. microseismic measurements, modelling etc); and
- A process description of the stimulation activity to be applied, including equipment and a comparison to best international practice.

### 8.3 Toxicological Evaluation

The toxicity of the chemicals used in the stimulation process by Halliburton has been assessed for persistence, bioaccumulation and aquatic toxicity (PBT), terrestrial toxicity and human health toxicity including the physical hazards of fire and explosion. The review of toxicity is qualitative and has provided a ranking of chemicals considered to represent a high, moderate or low hazard in respect to the ecological or human health end points with qualification as appropriate.

A preliminary quantitative assessment has also been undertaken, with Santos and Halliburton in 2012 collecting a total of seven fluid samples during South Australian stimulation activities for chemical analysis. These stimulation activities are undertaken by Halliburton and are considered reasonably indicative of the proposed SWQ activities. At the data of reporting no quantitative assessment had been undertaken for DeltaFrac(H) and DFS-BCG(H).

Concentrations of toluene, xylenes and PHC fractions were reported in two samples of distilled water mixed with stimulation fluid additives, prepared by Halliburton. The concentrations were reported below the DEHP (2012) BTEX standard.

Review of the data indicates that the flowback fluids contain substantially higher concentrations of hydrocarbons, which are considered to represent geogenically derived substances and these exceed the respective water quality guideline concentrations (where available).

Examination of the make up water drawn from formation water sources suggests the hydrocarbon concentrations are lower and range from concentrations below the limits of reporting to concentrations approaching or in some cases exceeding the respective water quality guidelines. This includes both potable water quality guidelines and ecological guidelines from both the Netherlands (RIVM, 2004) and Canada (CCME, 2008), which were referenced in the absence of water quality guidelines for hydrocarbon fractions in Australia. These exceedances only apply to the TPH fractional ranges and the aesthetics-based health values for ethyl benzene and total xylenes.

The distilled water fluid formulations present a similar hydrocarbon concentration profile to the make up water, with generally lower concentrations albeit with exceptions in some TPH fractional ranges and for p-isopropyltoluene. The latter are within an order of magnitude of the make up water concentrations. In the case of the BTEX group the distilled water formulations have not identified BTEX concentrations exceeding BTEX water quality criteria specified in the Queensland Environmental Protection Regulation.

These results suggest that stimulation fluid formulations are not contributing substantial amounts of BTEX and TPH into the subsurface regions, and certainly at concentrations that are both below the regulated criteria (where available) and below the concentrations in the hydrocarbon reservoirs being fractured. Some qualification of this statement is required as a result of residual uncertainties.

## 8.4 Evaluation of Exposure Pathways

Potential exposure pathways were evaluated for on-site (i.e. within the well lease), and those relevant for off-site (i.e. anything beyond the well lease boundary). The on-site assessment indicated that the majority of possible exposures were unlikely or incomplete. One complete exposure pathway was identified, which is direct contact to the flowback water in the panel tanks for small fauna (i.e. birds and flying mammals such as bats). All reasonable measures will be conducted to discourage entry of small native fauna into the well lease area during stimulation operations. Improvement of flowback water containment will further reduce the potential for this exposure scenario to occur.

For the off-site exposure assessment, it was assumed that potential off-site receptors could include homesteads (adult and child residents), water supply bores, creeks and waterholes, livestock and native flora and fauna. Three possible chemical sources were identified: injected stimulation fluids, sediments from panel tanks and flowback water. The exposure assessment concluded:

- Subsurface exposure to stimulation fluids is controlled by Santos' well integrity testing procedures and operational monitoring, and this pathway (whereby stimulation fluids could escape into the formation and contaminate adjacent aquifers that are used for domestic or stock water supply) is considered unlikely or incomplete.
- Based on an understanding of the Eromanga and Cooper Basin geology and hydrogeology, and the nature and extent of groundwater supply development, exposure to residual stimulation chemicals through subsurface pathways is considered unlikely and incomplete; and
- At the surface, a spill or leak of flowback water from the panel tank was considered as a possible exposure scenario, however the implementation of operational controls, including use of liners in panel tanks, removal of fluid and sediment using vacuum techniques and engineering and operational controls (grading of well leases and stormwater controls) is considered sufficient to limit the potential for uncontrolled releases of flowback water to the environment. A further margin of safety is provided by Santos' evaluation of 'environmentally sensitive areas' when establishing well leases, which includes the establishment of buffers between petroleum (and stimulation) activities and features of potential environmental concern. Subsequently, the potential off-site exposure scenarios are considered unlikely and incomplete.

## 8.5 Overall Risk Evaluation

Considering the hazard, exposure assessment and qualitative assessment of fluids, although unlikely, flowback water at surface presents some inherent risk. However, with Santos operational controls and management, the overall or residual risk to human health and environment associated with the chemicals involved in stimulation are expected to be low. The management measures implemented through operational controls include:

- OH&S procedures implemented during stimulation operations to prevent workers from direct contact with chemicals during spills and when handling flowback water or sediments.
- Santos operational procedures regarding well integrity verification and fracture design to stay within the target formation.
- Assigning buffers during establishment of well leases between petroleum operations and potential "environmentally sensitive areas" identified through database review and site-specific ecological assessment where warranted.
- Implementation of spill containment procedures during operations to prevent migration of and exposure to chemicals.
- Vacuum removal of sediments and fluids contained within panel tanks, to prevent exposure to contaminants in fluids and windborne dust.

- Installation of signs to indicate that well leases (including panel tanks) are work zones to be accessed by authorised personnel.
- The use of panel tanks of approximately 2m in height to prevent access by livestock and large native fauna. Double lining of panel tanks to prevent seepage of flowback water into the underlying aquifer; and
- Engineering and operational controls (grading of well leases and stormwater controls) to limit the potential for uncontrolled surface releases of flowback water to the environment.

The adequacy and appropriateness of these exposure controls will be routinely evaluated by Santos and modifications and revisions made, where necessary, to achieve continuous improvement.

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## Signature Page

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**APPENDIX A**

**Limitations**

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

This Report constitutes or is part of services ("Services") provided by Golder to its client ("Client") under and subject to a contract between Golder and its Client ("Contract"). The contents of this page are not intended to and do not alter Golder's obligations (including any limits on those obligations) to its Client under the Contract.

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At any location relevant to the Services conditions may exist which were not detected by Golder, in particular due to the specific scope of the investigation Golder has been engaged to undertake. Conditions can only be verified at the exact location of any tests undertaken. Variations in conditions may occur between tested locations and there may be conditions which have not been revealed by the investigation and which have not therefore been taken into account in this Report.

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Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have retained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

By date, or revision, the Report supersedes any prior report or other document issued by Golder dealing with any matter that is addressed in the Report.

**Any uncertainty as to the extent to which this Report can be used or relied upon in any respect should be referred to Golder for clarification**

**APPENDIX B**

**Safety Data Sheets**

# SAFETY DATA SHEET

## ACETIC ACID 55%-90%

Revision Date: 20-Aug-2018

Revision Number: 3

### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

#### 1.1. Product Identifier

**Product Name** ACETIC ACID 55%-90%

#### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** MC600186

#### Recommended use of the chemical and restrictions on use

**Recommended Use** Scale Control  
**Uses advised against** Consumer use

#### Supplier's name, address and phone number

**Manufacturer/Supplier** Multi-Chem Mintech  
 1 Ward Road  
 East Rockingham  
 WA 6168  
 Australia

Telephone Number: 61 (08) 9419 5300  
 Fax Number: 61 (08) 9439 1055  
 Emergency Telephone Number: + 61 1 800 686 951  
 fdunexchem@halliburton.com

#### **E-mail Address**

#### Emergency phone number

+ 61 1 800 686 951  
 Global Incident Response Access Code: 334305  
 Contract Number: 14012

#### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
 Police or Fire Brigade: - 000 (exchange): - 1100

### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

#### Classification of the hazardous chemical

Skin Corrosion/Irritation	Category 1 - H314
Serious Eye Damage/Irritation	Category 1 - H318
Specific Target Organ Toxicity - (Single Exposure)	Category 3 - H335
Flammable liquids.	Category 3 - H226



**Label elements, including precautionary statements****Hazard Pictograms****Signal Word**

DANGER

**Hazard Statements:**

H226 - Flammable liquid and vapor  
 H314 - Causes severe skin burns and eye damage  
 H318 - Causes serious eye damage  
 H335 - May cause respiratory irritation

**Precautionary Statements****Prevention**

P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.  
 P233 - Keep container tightly closed  
 P240 - Ground and bond container and receiving equipment.  
 P241 - Use explosion-proof electrical/ventilating/lighting/equipment  
 P242 - Use only non-sparking tools  
 P243 - Take action to prevent static discharges.  
 P260 - Do not breathe dust/fume/gas/mist/vapors/spray  
 P261 - Avoid breathing dust/fume/gas/mist/vapors/spray  
 P271 - Use only outdoors or in a well-ventilated area  
 P280 - Wear protective gloves/protective clothing/eye protection/face protection

**Response**

P301 + P330 + P331 - IF SWALLOWED: rinse mouth. Do NOT induce vomiting  
 P303 + P361 + P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower].  
 P363 - Wash contaminated clothing before reuse  
 P304 + P340 - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing  
 P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
 P310 - Immediately call a POISON CENTER or doctor/physician  
 P370 + P378 - In case of fire: Use water spray for extinction  
 P403 + P233 - Store in a well-ventilated place. Keep container tightly closed  
 P403 + P235 - Store in a well-ventilated place. Keep cool  
 P405 - Store locked up  
 P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Storage****Disposal**

**Contains Substances**  
 Acetic acid

**CAS Number**  
 64-19-7

**Other hazards which do not result in classification**

This mixture contains no substance considered to be persistent, bioaccumulating nor toxic (PBT).  
 This mixture contains no substance considered to be very persistent nor very bioaccumulating (vPvB).

For the full text of the H-phrases mentioned in this Section, see Section 16

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Acetic acid	64-19-7	60 - 100%	Skin Corr. 1A (H314) Eye Corr. 1 (H318) STOT SE 3 (H335) Flam. Liq. 3 (H226)

### 4. First aid measures

#### Description of necessary first aid measures

<b>Inhalation</b>	If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
<b>Eyes</b>	In case of contact, immediately flush eyes with plenty of water for at least 30 minutes. Remove contact lenses after the first 5 minutes and continue washing. Seek immediate medical attention/advice. Suitable emergency eye wash facility should be immediately available
<b>Skin</b>	In case of contact, immediately flush skin with plenty of soap and water for at least 30 minutes and remove contaminated clothing, shoes and leather goods immediately. Get medical attention immediately.
<b>Ingestion</b>	Rinse mouth with water many times. Get medical attention, if symptoms occur

#### Symptoms caused by exposure

Causes severe skin irritation with tissue destruction. Causes severe eye irritation which may damage tissue. May cause respiratory irritation.

#### Medical Attention and Special Treatment

**Notes to Physician** Treat symptomatically

### 5. Fire Fighting Measures

#### Suitable extinguishing equipment

#### **Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

#### **Extinguishing media which must not be used for safety reasons**

Do NOT spray pool fires directly with water. A solid stream of water directed into hot burning liquid can cause splattering.

#### Specific hazards arising from the chemical

#### **Special exposure hazards in a fire**

Decomposition in fire may produce harmful gases.

#### Special protective equipment and precautions for fire fighters

#### **Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

### 6. Accidental release measures

#### 6.1. Personal precautions, protective equipment and emergency procedures

Ensure adequate ventilation. Use appropriate protective equipment. Do not breathe dust/fume/gas/mist/vapors/spray. Remove sources of ignition. Take precautionary measures against static discharges All equipment used when handling the product must be grounded Avoid contact with skin, eyes and clothing.

#### 6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

### **6.3. Methods and material for containment and cleaning up**

Dike far ahead of liquid spill for later disposal. Soak up with inert absorbent material. Pick up and transfer to properly labeled containers. Remove ignition sources and work with non-sparking tools.

## 7. Handling and storage

### **7.1. Precautions for safe handling**

#### **Handling Precautions**

Do not breathe dust/fume/gas/mist/vapors/spray. Ensure adequate ventilation. Use appropriate protective equipment. Remove sources of ignition. Ground and bond containers when transferring from one container to another. Avoid contact with eyes, skin, or clothing.

#### **Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

### **7.2. Conditions for safe storage, including any incompatibilities**

#### **Storage Information**

Store in a cool well ventilated area. Keep from heat, sparks, and open flames.

#### **Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

### **Control parameters - exposure standards, biological monitoring**

#### **Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Acetic acid	64-19-7	TWA: 10 ppm TWA: 25 mg/m <sup>3</sup> STEL: 15 ppm STEL: 37 mg/m <sup>3</sup>	TWA: 10 ppm STEL: 15 ppm

### **Appropriate engineering controls**

#### **Engineering Controls**

Ensure adequate ventilation, especially in confined areas

### **Personal protective equipment (PPE)**

#### **Personal Protective Equipment**

If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

#### **Respiratory Protection**

If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.

#### **Hand Protection**

Use gloves which are suitable for the chemicals present in this product as well as other environmental factors in the workplace.

#### **Skin Protection**

Wear impervious protective clothing, including boots, gloves, lab coat, apron, rain jacket, pants or coverall, as appropriate, to prevent skin contact.

#### **Eye Protection**

None known.

#### **Other Precautions**

None known.

#### **Environmental Exposure Controls**

No information available

## 9. Physical and Chemical Properties

### **9.1. Information on basic physical and chemical properties**

<b>Physical State:</b>	Liquid	<b>Color</b>	Light Amber to Dark Amber , Clear to Slightly Hazy
<b>Odor:</b>	Pungent	<b>Odor Threshold:</b>	No information available

<u>Property</u>	<u>Values</u>
<u>Remarks/ - Method</u>	
<b>pH:</b>	2.5-3.8 (10% in 1:1 IPA:H2O)
<b>Freezing Point / Range</b>	No data available
<b>Melting Point / Range</b>	No data available
<b>Boiling Point / Range</b>	No data available
<b>Flash Point</b>	> 40 °C / > 104 °F (SFCC)
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	1.0653-1.0903 (20 °C/68 °F)
<b>Water Solubility</b>	Soluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available
<b>9.2. Other information</b>	
<b>VOC Content (%)</b>	No data available
<b>Liquid Density</b>	8.88-9.09 lbs/gal
<b>Bulk Density</b>	1065-1090 kg/m <sup>3</sup>

## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

### 10.2. Chemical stability

Stable

### 10.3. Possibility of hazardous reactions

Will Not Occur

### 10.4. Conditions to avoid

Keep away from heat, sparks and flame.

### 10.5. Incompatible materials

Strong oxidizers.

### 10.6. Hazardous decomposition products

Carbon oxides.

## 11. Toxicological Information

### Information on routes of exposure

**Principle Route of Exposure** Skin contact. Eye contact. Inhalation.

### Symptoms related to exposure

#### **Most Important Symptoms/Effects**

Causes severe skin irritation with tissue destruction. Causes severe eye irritation which may damage tissue. May cause respiratory irritation.

### Toxicology data for the components

<b>Substances</b>	<b>CAS Number</b>	<b>LD50 Oral</b>	<b>LD50 Dermal</b>	<b>LC50 Inhalation</b>
Acetic acid	64-19-7	No data available	1060 mg/kg-bw (rabbit)	11.4 mg/L (rat, 4 h, vapor)

### Immediate, delayed and chronic health effects from exposure

**Inhalation** May cause respiratory irritation.  
**Eye Contact** Causes serious eye damage.  
**Skin Contact** Causes severe burns.

**Ingestion**

Causes burns of the mouth, throat and stomach.

**Exposure Levels**

No data available

**Interactive effects**

No data available

**Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Acetic acid	64-19-7	Extremely corrosive and destructive to tissue Skin, rabbit:
Substances	CAS Number	Serious eye damage/irritation
Acetic acid	64-19-7	Eye, rabbit: Causes serious eye damage
Substances	CAS Number	Skin Sensitization
Acetic acid	64-19-7	Not regarded as a sensitizer.
Substances	CAS Number	Respiratory Sensitization
Acetic acid	64-19-7	No information available
Substances	CAS Number	Mutagenic Effects
Acetic acid	64-19-7	In vivo tests did not show mutagenic effects. In vitro tests did not show mutagenic effects.
Substances	CAS Number	Carcinogenic Effects
Acetic acid	64-19-7	Did not show carcinogenic effects in animal experiments
Substances	CAS Number	Reproductive toxicity
Acetic acid	64-19-7	Did not show teratogenic effects in animal experiments. Animal testing did not show any effects on fertility.
Substances	CAS Number	STOT - single exposure
Acetic acid	64-19-7	May cause respiratory irritation. No information available
Substances	CAS Number	STOT - repeated exposure
Acetic acid	64-19-7	No significant toxicity observed in animal studies at concentration requiring classification.
Substances	CAS Number	Aspiration hazard
Acetic acid	64-19-7	Not applicable

## 12. Ecological Information

**Ecotoxicity****Product Ecotoxicity Data**

Product is not classified as hazardous to the environment.

**Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Acetic acid	64-19-7	EC50(72 h)=55.22 mg/L (Anabaena flos-aquae)	LC50(96 h)=251 mg/L (Gambusia affinis) LC50(96 h)=75 mg/L (Lepomis macrochirus)	NOAEC (16 h) =1150 mg/L (Pseudomonas putida)	EC50(48 h)=65 mg/L (Daphnia magna)

**12.2. Persistence and degradability**

Substances	CAS Number	Persistence and Degradability
Acetic acid	64-19-7	Readily biodegradable (99% @ 7d)

**12.3. Bioaccumulative potential**

Substances	CAS Number	Bioaccumulation
Acetic acid	64-19-7	LogPow-0.17

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Acetic acid	64-19-7	No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

<b>13. Disposal Considerations</b>
------------------------------------

**Safe handling and disposal methods**

Disposal should be made in accordance with federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

<b>14. Transport Information</b>
----------------------------------

**Transportation Information****Australia ADG**

**UN Number** UN2789  
**UN proper shipping name:** Acetic Acid Solution  
**Transport Hazard Class(es):** 8 (3)  
**Packing Group:** III  
**Environmental Hazards:** Not applicable

**IMDG/IMO**

**UN Number** UN2789  
**UN proper shipping name:** Acetic Acid Solution  
**Transport Hazard Class(es):** 8 (3)  
**Packing Group:** III  
**Environmental Hazards:** Not applicable  
**EMS:** EmS F-E, S-C

**IATA/ICAO**

**UN Number** UN2789  
**UN proper shipping name:** Acetic Acid Solution  
**Transport Hazard Class(es):** 8 (3)  
**Packing Group:** III  
**Environmental Hazards:** Not applicable

**Special precautions during transport**

None

**HazChem Code**

•2P

<b>15. Regulatory Information</b>
-----------------------------------

**Safety, health and environmental regulations specific for the product**

**International Inventories****Australian AICS Inventory**

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

**New Zealand Inventory of Chemicals**

All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

**EINECS (European Inventory of Existing Chemical Substances)**

This product, and all its components, complies with EINECS

**US TSCA Inventory**

All components listed on inventory or are exempt.

**Canadian Domestic Substances List (DSL)**

All components listed on inventory or are exempt.

**Poisons Schedule number**

S6

**International Agreements**

**Montreal Protocol - Ozone Depleting Substances:**

Does not apply.

**Stockholm Convention - Persistent Organic Pollutants:**

Does not apply

**Rotterdam Convention - Prior Informed Consent:**

Does not apply.

**Basel Convention - Hazardous Waste:**

Does not apply.

## 16. Other information

**Date of preparation or review**

**Revision Date:** 20-Aug-2018

**Revision Note**

Update to Format

**Full text of H-Statements referred to under sections 2 and 3**

H226 - Flammable liquid and vapor

H314 - Causes severe skin burns and eye damage

H318 - Causes serious eye damage

H335 - May cause respiratory irritation

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight

CAS – Chemical Abstracts Service

EC50 – Effective Concentration 50%

LC50 – Lethal Concentration 50%

LD50 – Lethal Dose 50%

LL50 – Lethal Loading 50%

mg/kg – milligram/kilogram

mg/L – milligram/liter

NOEC – No Observed Effect Concentration

OEL – Occupational Exposure Limit

PBT – Persistent Bioaccumulative and Toxic

ppm – parts per million

STEL – Short Term Exposure Limit

TWA – Time-Weighted Average

vPvB – very Persistent and very Bioaccumulative

h - hour

mg/m<sup>3</sup> - milligram/cubic meter

mm - millimeter

mmHg - millimeter mercury

w/w - weight/weight

d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

**Disclaimer Statement**

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**End of Safety Data Sheet**



## SAFETY DATA SHEET

### ACETIC ACID 60%

Revision Date: 26-Jun-2019

Revision Number: 11

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** ACETIC ACID 60%

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM004481

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Solvent  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road, Jandakot, WA 6164  
Australia  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-mail Address** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951  
Global Incident Response Access Code: 334305  
Contract Number: 14012

##### Australian Poisons Information Centre

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Skin Corrosion/Irritation	Category 1 - H314
Serious Eye Damage/Irritation	Category 1 - H318
Specific Target Organ Toxicity - (Single Exposure)	Category 3 - H335
Flammable liquids.	Category 3 - H226

##### Label elements, including precautionary statements

##### Hazard Pictograms

**Signal Word**

DANGER

**Hazard Statements:**

H314 - Causes severe skin burns and eye damage  
 H318 - Causes serious eye damage  
 H335 - May cause respiratory irritation  
 H226 - Flammable liquid and vapor

**Precautionary Statements****Prevention**

P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.  
 P233 - Keep container tightly closed  
 P240 - Ground and bond container and receiving equipment.  
 P241 - Use explosion-proof electrical/ventilating/lighting/equipment  
 P242 - Use only non-sparking tools  
 P243 - Take action to prevent static discharges.  
 P260 - Do not breathe dust/fume/gas/mist/vapors/spray  
 P264 - Wash face, hands and any exposed skin thoroughly after handling  
 P271 - Use only outdoors or in a well-ventilated area  
 P280 - Wear protective gloves/protective clothing/eye protection/face protection

**Response**

P301+ P330 + P331 - IF SWALLOWED: Rinse mouth. Do NOT induce vomiting  
 P303 + P361 + P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower].  
 P363 - Wash contaminated clothing before reuse  
 P312 - Call a POISON CENTER or doctor/physician if you feel unwell  
 P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
 P310 - Immediately call a POISON CENTER or doctor/physician  
 P370 + P378 - In case of fire: Use water spray for extinction  
 P304 + P340 - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing

**Storage**

P403 + P233 - Store in a well-ventilated place. Keep container tightly closed  
 P403 + P235 - Store in a well-ventilated place. Keep cool

**Disposal**

P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Contains****Substances**

Acetic acid

**CAS Number**

64-19-7

**Other hazards which do not result in classification**

None known

*For the full text of the H-phrases mentioned in this Section, see Section 16*

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Acetic acid	64-19-7	60 - 100%	Skin Corr. 1A (H314) Eye Corr. 1 (H318) STOT SE 3 (H335)

Flam. Liq. 3 (H226)

## 4. First aid measures

### Description of necessary first aid measures

<b>Inhalation</b>	If inhaled, move victim to fresh air and seek medical attention.
<b>Eyes</b>	Immediately flush eyes with large amounts of water for at least 30 minutes. Seek prompt medical attention.
<b>Skin</b>	In case of contact, immediately flush skin with plenty of soap and water for at least 30 minutes and remove contaminated clothing, shoes and leather goods immediately. Get medical attention immediately.
<b>Ingestion</b>	Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

### Symptoms caused by exposure

Causes severe eye irritation which may damage tissue. Causes severe skin irritation with tissue destruction. May cause respiratory irritation.

### Medical Attention and Special Treatment

**Notes to Physician** Treat symptomatically

## 5. Fire Fighting Measures

### Suitable extinguishing equipment

#### **Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

#### **Extinguishing media which must not be used for safety reasons**

None known.

### Specific hazards arising from the chemical

#### **Special exposure hazards in a fire**

Use water spray to cool fire exposed surfaces. Decomposition in fire may produce harmful gases. Do not allow runoff to enter waterways.

### Special protective equipment and precautions for fire fighters

#### **Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## 6. Accidental release measures

### 6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment.

### 6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

### 6.3. Methods and material for containment and cleaning up

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Neutralize to pH of 6-8. Scoop up and remove.

## 7. Handling and storage

### 7.1. Precautions for safe handling

#### **Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.

#### **Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Store in a cool well ventilated area. Keep container closed when not in use. Product has a shelf life of 24 months. Store locked up.

**Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

**Control parameters - exposure standards, biological monitoring****Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Acetic acid	64-19-7	TWA: 10 ppm TWA: 25 mg/m <sup>3</sup> STEL: 15 ppm STEL: 37 mg/m <sup>3</sup>	TWA: 10 ppm STEL: 15 ppm

**Appropriate engineering controls****Engineering Controls**

Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.

**Personal protective equipment (PPE)****Personal Protective Equipment**

If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

**Respiratory Protection**

Organic vapor/acid gas respirator.

**Hand Protection**

Impervious rubber gloves.

**Skin Protection**

Full protective chemical resistant clothing.

**Eye Protection**

Chemical goggles; also wear a face shield if splashing hazard exists.

**Other Precautions**

Eyewash fountains and safety showers must be easily accessible.

**Environmental Exposure Controls**

No information available

## 9. Physical and Chemical Properties

**9.1. Information on basic physical and chemical properties**

**Physical State:** Liquid

**Color:** Clear

**Odor:** Acrid

**Odor Threshold:** No information available

PropertyValues

Remarks/ - Method

**pH:**

1.38

**Freezing Point / Range**

16 °C

**Melting Point / Range**

No data available

**Pour Point / Range**

No data available

**Boiling Point / Range**

117 °C / 244 °F

**Flash Point**

55 °C / 131 °F (PMCC)

**Upper flammability limit**

16%

**Lower flammability limit**

5.4%

**Evaporation rate**

No data available

**Vapor Pressure**

11.7 mmHg @ 20 C

**Vapor Density**

No data available

**Specific Gravity**

1.05

**Water Solubility**

Soluble in water

**Solubility in other solvents**

No data available

**Partition coefficient: n-octanol/water**

No data available

**Autoignition Temperature**

No data available

**Decomposition Temperature**

No data available

**Viscosity**

No data available

**Explosive Properties**

No information available

**Oxidizing Properties**

No information available

**9.2. Other information****Molecular Weight**

60.6 (g/mole)

**VOC Content (%)**

No data available

**10. Stability and Reactivity****10.1. Reactivity**

Not expected to be reactive.

**10.2. Chemical stability**

Stable

**10.3. Possibility of hazardous reactions**

Will Not Occur

**10.4. Conditions to avoid**

Keep away from heat, sparks and flame.

**10.5. Incompatible materials**

Strong alkalis.

**10.6. Hazardous decomposition products**

Carbon monoxide and carbon dioxide.

**11. Toxicological Information****Information on routes of exposure****Principle Route of Exposure** Eye or skin contact, inhalation.**Symptoms related to exposure****Most Important Symptoms/Effects**

Causes severe eye irritation which may damage tissue. Causes severe skin irritation with tissue destruction. May cause respiratory irritation.

**Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Acetic acid	64-19-7	No data available	1060 mg/kg-bw (rabbit)	11.4 mg/L (rat, 4 h, vapor)

**Immediate, delayed and chronic health effects from exposure****Inhalation** Causes severe respiratory irritation.**Eye Contact** Causes eye burns**Skin Contact** Causes skin burns which may not be immediately painful or visible.**Ingestion** Causes burns of the mouth, throat and stomach.**Chronic Effects/Carcinogenicity** Prolonged, excessive exposure may cause erosion of the teeth.**Exposure Levels**

No data available

**Interactive effects**

Skin disorders.

**Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Acetic acid	64-19-7	Extremely corrosive and destructive to tissue Skin, rabbit:

Substances	CAS Number	Serious eye damage/irritation
Acetic acid	64-19-7	Eye, rabbit: Causes serious eye damage

Substances	CAS Number	Skin Sensitization
Acetic acid	64-19-7	Not regarded as a sensitizer.

<b>Substances</b>	<b>CAS Number</b>	<b>Respiratory Sensitization</b>
Acetic acid	64-19-7	No information available
<b>Substances</b>	<b>CAS Number</b>	<b>Mutagenic Effects</b>
Acetic acid	64-19-7	In vivo tests did not show mutagenic effects. In vitro tests did not show mutagenic effects.
<b>Substances</b>	<b>CAS Number</b>	<b>Carcinogenic Effects</b>
Acetic acid	64-19-7	Did not show carcinogenic effects in animal experiments
<b>Substances</b>	<b>CAS Number</b>	<b>Reproductive toxicity</b>
Acetic acid	64-19-7	Did not show teratogenic effects in animal experiments. Animal testing did not show any effects on fertility.
<b>Substances</b>	<b>CAS Number</b>	<b>STOT - single exposure</b>
Acetic acid	64-19-7	May cause respiratory irritation. No information available
<b>Substances</b>	<b>CAS Number</b>	<b>STOT - repeated exposure</b>
Acetic acid	64-19-7	No significant toxicity observed in animal studies at concentration requiring classification.
<b>Substances</b>	<b>CAS Number</b>	<b>Aspiration hazard</b>
Acetic acid	64-19-7	Not applicable

## 12. Ecological Information

### Ecotoxicity

#### Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Acetic acid	64-19-7	EC50(72 h)=55.22 mg/L (Anabaena flos-aquae)	LC50(96 h)=251 mg/L (Gambusia affinis) LC50(96 h)=75 mg/L (Lepomis macrochirus)	NOAEC (16 h) =1150 mg/L (Pseudomonas putida)	EC50(48 h)=65 mg/L (Daphnia magna)

### 12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Acetic acid	64-19-7	Readily biodegradable (99% @ 7d)

### 12.3. Bioaccumulative potential

Substances	CAS Number	Bioaccumulation
Acetic acid	64-19-7	LogPow-0.17

### 12.4. Mobility in soil

Substances	CAS Number	Mobility
Acetic acid	64-19-7	No information available

### 12.6. Other adverse effects

#### Endocrine Disruptor Information

This product does not contain any known or suspected endocrine disruptors

## 13. Disposal Considerations

### Safe handling and disposal methods

Disposal should be made in accordance with federal, state, and local regulations.

### Disposal of any contaminated packaging

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

**14. Transport Information****Transportation Information****Australia ADG**

UN Number	UN2790
UN proper shipping name:	Acetic Acid Solution
Transport Hazard Class(es):	8
Packing Group:	II
Environmental Hazards:	Not applicable

**IMDG/IMO**

UN Number	UN2790
UN proper shipping name:	Acetic Acid Solution
Transport Hazard Class(es):	8
Packing Group:	II
Environmental Hazards:	Not applicable
EMS:	EmS F-A, S-B

**IATA/ICAO**

UN Number	UN2790
UN proper shipping name:	Acetic Acid Solution
Transport Hazard Class(es):	8
Packing Group:	II
Environmental Hazards:	Not applicable

**Special precautions during transport**

None

**HazChem Code**

2R

**15. Regulatory Information****Safety, health and environmental regulations specific for the product****International Inventories****Australian AICS Inventory**

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

**New Zealand Inventory of Chemicals**

All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

**US TSCA Inventory**

All components listed on inventory or are exempt.

**Canadian Domestic Substances List (DSL)**

All components listed on inventory or are exempt.

**Poisons Schedule number**

S6

**International Agreements****Montreal Protocol - Ozone Depleting Substances:**

Does not apply.

**Stockholm Convention - Persistent Organic Pollutants:**

Does not apply

**Rotterdam Convention - Prior Informed Consent:**

Does not apply.

**Basel Convention - Hazardous Waste:**

Does not apply.

**16. Other information****Date of preparation or review**

**Revision Date:** 26-Jun-2019

**Revision Note**

SDS sections updated:  
2

**Full text of H-Statements referred to under sections 2 and 3**

H226 - Flammable liquid and vapor  
H314 - Causes severe skin burns and eye damage  
H318 - Causes serious eye damage  
H335 - May cause respiratory irritation

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight  
CAS – Chemical Abstracts Service  
EC50 – Effective Concentration 50%  
LC50 – Lethal Concentration 50%  
LD50 – Lethal Dose 50%  
LL50 – Lethal Loading 50%  
mg/kg – milligram/kilogram  
mg/L – milligram/liter  
NOEC – No Observed Effect Concentration  
OEL – Occupational Exposure Limit  
PBT – Persistent Bioaccumulative and Toxic  
ppm – parts per million  
STEL – Short Term Exposure Limit  
TWA – Time-Weighted Average  
vPvB – very Persistent and very Bioaccumulative  
h - hour  
mg/m<sup>3</sup> - milligram/cubic meter  
mm - millimeter  
mmHg - millimeter mercury  
w/w - weight/weight  
d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)  
NZ CCID

**Disclaimer Statement**

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**End of Safety Data Sheet**



## SAFETY DATA SHEET

### BC-140C

Revision Date: 01-Oct-2015

Revision Number: 18

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** BC-140C

##### Other means of Identification

**Synonyms:** None

**Product Code:** HM000110

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Crosslinker

**Uses Advised Against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road  
Jandakot  
WA 6164  
Australia

ACN Number: 009 000 775

Telephone Number: + 61 1 800 686 951

Fax Number: 61 (08) 9455 5300

**E-Mail address:** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951

##### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26

Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Not classified

##### Label elements, including precautionary statements

##### **Hazard Pictograms**

**Signal Word** Not Hazardous

**Hazard Statements** Not Classified

**Precautionary Statements**

**Prevention** None

**Response** None

**Storage** None

**Disposal** None

**Contains**

**Substances**

Contains no hazardous substances in concentrations above cut-off values according to the competent authority

**CAS Number**

NA

**Other hazards which do not result in classification**

This mixture contains no substance considered to be persistent, bioaccumulating nor toxic (PBT).

This mixture contains no substance considered to be very persistent nor very bioaccumulating (vPvB).

**Australia Classification**

For the full text of the H-phrases mentioned in this Section, see Section 16

**Classification** Not Classified

**Risk Phrases** None

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	60 - 100%	Not Applicable

### 4. First aid measures

**Description of necessary first aid measures**

**Inhalation**

If inhaled, move victim to fresh air and seek medical attention.

**Eyes**

In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

**Skin**

In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.

**Ingestion**

Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

**Symptoms caused by exposure**

No significant hazards expected.

**Medical Attention and Special Treatment**

**Notes to Physician**

Treat symptomatically

### 5. Fire Fighting Measures

**Suitable extinguishing equipment**

**Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical****Special Exposure Hazards**

Decomposition in fire may produce harmful gases.

**Special protective equipment and precautions for fire fighters****Special Protective Equipment for Fire-Fighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

**6. Accidental release measures****6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment. Avoid contact with skin, eyes and clothing. Avoid breathing vapors. Ensure adequate ventilation.

**6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas.

**6.3. Methods and material for containment and cleaning up**

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

**7. Handling and storage****7.1. Precautions for Safe Handling****Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Ensure adequate ventilation. Wash hands after use. Launder contaminated clothing before reuse. Use appropriate protective equipment.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Store away from oxidizers. Store in a cool well ventilated area. Keep container closed when not in use. Product has a shelf life of 36 months.

**Other Guidelines**

No information available

**8. Exposure Controls/Personal Protection****Control parameters - exposure standards, biological monitoring****Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	Not applicable	Not applicable

**Appropriate engineering controls****Engineering Controls**

Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.

**Personal protective equipment (PPE)****Respiratory Protection**Not normally needed. But if significant exposures are possible then the following respirator is recommended:  
Organic vapor respirator.**Hand Protection**

Impervious rubber gloves.

**Skin Protection**

Rubber apron.

**Eye Protection**

Safety glasses.

**Other Precautions** None known.  
**Environmental Exposure Controls** Do not allow material to contaminate ground water system

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

**Physical State:** Liquid      **Color:** Blue  
**Odor:** Amine      **Odor Threshold:** No information available

<u>Property</u>	<u>Values</u>
Remarks/ - Method	
<b>pH:</b>	7.9
<b>Freezing Point/Range</b>	No data available
<b>Melting Point/Range</b>	No data available
<b>Boiling Point/Range</b>	No data available
<b>Flash Point</b>	No data available
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	1.16
<b>Water Solubility</b>	Soluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

### 9.2. Other information

**VOC Content (%)** No data available  
**Liquid Density** 9.66 lbs/gal @ 20 C

## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

### 10.2. Chemical Stability

Stable

### 10.3. Possibility of Hazardous Reactions

Will Not Occur

### 10.4. Conditions to Avoid

None anticipated

### 10.5. Incompatible Materials

Strong oxidizers. Dehydrating agents.

### 10.6. Hazardous Decomposition Products

Toxic fumes. Carbon monoxide and carbon dioxide.

## 11. Toxicological Information

### Information on routes of exposure

**Principle Route of Exposure** Eye or skin contact, inhalation.

### Symptoms related to exposure

#### **Most Important Symptoms/Effects**

No significant hazards expected.

### Numerical measures of toxicity

### Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No data available	No data available	No data available

**Immediate, delayed and chronic health effects from exposure**

<b>Inhalation</b>	May cause mild respiratory irritation.
<b>Eye Contact</b>	May cause mild eye irritation.
<b>Skin Contact</b>	May cause mild skin irritation.
<b>Ingestion</b>	None known.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

**Exposure Levels**

No data available

**Interactive effects**

Skin disorders. Eye ailments.

**Data limitations**

No data available

## 12. Ecological Information

**Ecotoxicity****Product Ecotoxicity Data**

No data available

**Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available	No information available	No information available	No information available

**12.2. Persistence and degradability**

Substances	CAS Number	Persistence and Degradability
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.3. Bioaccumulative potential**

Substances	CAS Number	Log Pow
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

<b>13. Disposal Considerations</b>
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**Safe handling and disposal methods**

Disposal should be made in accordance with federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

<b>14. Transport Information</b>
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**Transportation Information**

<b>UN Number:</b>	Not restricted
<b>UN Proper Shipping Name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

<b>15. Regulatory Information</b>
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**Safety, health and environmental regulations specific for the product****International Inventories**

<b>Australian AICS Inventory</b>	All components listed on inventory or are exempt.
<b>New Zealand Inventory of Chemicals</b>	All components listed on inventory or are exempt.

<b>EINECS Inventory</b>	This product, and all its components, complies with EINECS
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<b>US TSCA Inventory</b>	All components listed on inventory or are exempt.
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<b>Canadian DSL Inventory</b>	All components listed on inventory or are exempt.
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**Poisons Schedule number**

None Allocated

<b>16. Other information</b>
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**Date of preparation or review**

**Revision Date:** 01-Oct-2015

**Revision Note**

SDS sections updated: 2

**Full text of R-phrases referred to under Sections 2 and 3**

None

**Full text of H-Statements referred to under sections 2 and 3**

None

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight

CAS – Chemical Abstracts Service

EC50 – Effective Concentration 50%

LC50 – Lethal Concentration 50%

LD50 – Lethal Dose 50%

LL50 – Lethal Loading 50%

mg/kg – milligram/kilogram

mg/L – milligram/liter

NOEC – No Observed Effect Concentration

OEL – Occupational Exposure Limit

PBT – Persistent Bioaccumulative and Toxic

ppm – parts per million

STEL – Short Term Exposure Limit

TWA – Time-Weighted Average

vPvB – very Persistent and very Bioaccumulative

h - hour

mg/m<sup>3</sup> - milligram/cubic meter

mm - millimeter

mmHg - millimeter mercury

w/w - weight/weight

d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

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**End of Safety Data Sheet**

## SAFETY DATA SHEET

### BE-9

Revision Date: 13-Oct-2017

Revision Number: 20

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** BE-9

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HB006583

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Biocide  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road, Jandakot, WA 6164  
Australia  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-mail Address** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951  
Global Incident Response Access Code: 334305  
Contract Number: 14012

##### Australian Poisons Information Centre

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Skin Corrosion/Irritation	Category 1 - H314
Serious Eye Damage/Irritation	Category 1 - H318
Acute Aquatic Toxicity	Category 1 - H400
Chronic Aquatic Toxicity	Category 2 - H411

##### Label elements, including precautionary statements

##### Hazard Pictograms



**Signal Word**

DANGER

**Hazard Statements:**

H314 - Causes severe skin burns and eye damage  
 H318 - Causes serious eye damage  
 H400 - Very toxic to aquatic life  
 H411 - Toxic to aquatic life with long lasting effects

**Precautionary Statements****Prevention**

P260 - Do not breathe dust/fume/gas/mist/vapors/spray  
 P273 - Avoid release to the environment

**Response**

P280 - Wear protective gloves/protective clothing/eye protection/face protection  
 P301 + P330 + P331 - IF SWALLOWED: rinse mouth. Do NOT induce vomiting  
 P303 + P361 + P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower].  
 P363 - Wash contaminated clothing before reuse  
 P304 + P340 - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing  
 P310 - Immediately call a POISON CENTER or doctor/physician  
 P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
 P391 - Collect spillage  
 P405 - Store locked up  
 P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Storage****Disposal****Contains****Substances**

Tributyl tetradecyl phosphonium chloride

**CAS Number**

81741-28-8

**Other hazards which do not result in classification**

None known

For the full text of the H-phrases mentioned in this Section, see Section 16

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Tributyl tetradecyl phosphonium chloride	81741-28-8	5 - 10%	Acute Tox. 4 (H302) Acute Tox. 2 (H330) Skin Corr. 1B (H314) Eye Corr. 1 (H318) Aquatic Acute 1 (H400) Aquatic Chronic 1 (H410)

### 4. First aid measures

**Description of necessary first aid measures****Inhalation**

If inhaled, move victim to fresh air and seek medical attention.

**Eyes**

Immediately flush eyes with large amounts of water for at least 30 minutes. Seek prompt medical attention.

<b>Skin</b>	In case of contact, immediately flush skin with plenty of soap and water for at least 30 minutes and remove contaminated clothing, shoes and leather goods immediately. Get medical attention immediately.
<b>Ingestion</b>	Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

**Symptoms caused by exposure**

Causes severe eye irritation which may damage tissue. Causes severe skin irritation with tissue destruction.

**Medical Attention and Special Treatment**

**Notes to Physician** Treat symptomatically

## 5. Fire Fighting Measures

**Suitable extinguishing equipment****Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical****Special exposure hazards in a fire**

Decomposition in fire may produce harmful gases. Do not allow runoff to enter waterways. Use water spray to cool fire exposed surfaces.

**Special protective equipment and precautions for fire fighters****Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## 6. Accidental release measures

**6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment.

**6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas.

**6.3. Methods and material for containment and cleaning up**

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

## 7. Handling and storage

**7.1. Precautions for safe handling****Handling Precautions**

Avoid contact with eyes, skin, or clothing. Wash hands after use. Launder contaminated clothing before reuse. Do NOT consume food, drink, or tobacco in contaminated areas.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Store in a cool well ventilated area. Keep container closed when not in use. Store away from direct sunlight. Store in a dry location. Store in a manner to prevent commingling with incompatible materials. Store away from alkalis. Store away from reducing agents. Store locked up.

**Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

**Control parameters - exposure standards, biological monitoring****Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Tributyl tetradecyl phosphonium chloride	81741-28-8	Not applicable	Not applicable

**Appropriate engineering controls****Engineering Controls**

Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.

**Personal protective equipment (PPE)****Personal Protective Equipment**

If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

**Respiratory Protection**

If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.

Dust/mist respirator. (N95, P2/P3)

**Hand Protection**

Chemical-resistant protective gloves (EN 374) Suitable materials for longer, direct contact (recommended: protection index 6, corresponding to > 480 minutes permeation time as per EN 374): Neoprene gloves. (>= 0.75 mm thickness)

This information is based on literature references and on information provided by glove manufacturers, or is derived by analogy with similar substances. Please note that in practice the working life of chemical-resistant protective gloves may be considerably shorter than the permeation time determined in accordance with EN 374 as a result of the many influencing factors (e.g. temperature). If signs of wear and tear are noticed then the gloves should be replaced. Manufacturer's directions for use should be observed because of great diversity of types.

**Skin Protection**

Wear impervious protective clothing, including boots, gloves, lab coat, apron, rain jacket, pants or coverall, as appropriate, to prevent skin contact.

**Eye Protection**

Chemical goggles; also wear a face shield if splashing hazard exists.

**Other Precautions**

Eyewash fountains and safety showers must be easily accessible.

**Environmental Exposure Controls**

No information available

## 9. Physical and Chemical Properties

**9.1. Information on basic physical and chemical properties**

**Physical State:** Liquid

**Color:** Clear colorless

**Odor:** Slight

**Odor Threshold:** No information available

PropertyValues

Remarks/ - Method

**pH:**

6-8

**Freezing Point / Range**

-8 - -10 °C

**Melting Point / Range**

No data available

**Boiling Point / Range**

100 °C / 212 °F

**Flash Point**

No data available

**Evaporation rate**

No data available

**Vapor Pressure**

No data available

**Vapor Density**

No data available

**Specific Gravity**

0.95 - 1.0

**Water Solubility**

Miscible with water

**Solubility in other solvents**

No data available

**Partition coefficient: n-octanol/water**

No data available

**Autoignition Temperature**

No data available

**Decomposition Temperature**

No data available

**Viscosity**

No data available

**Explosive Properties**

No information available

**Oxidizing Properties**

No information available

**9.2. Other information****VOC Content (%)**

No data available

**10. Stability and Reactivity****10.1. Reactivity**

Not expected to be reactive.

**10.2. Chemical stability**

Stable

**10.3. Possibility of hazardous reactions**

Will Not Occur

**10.4. Conditions to avoid**

None anticipated

**10.5. Incompatible materials**

Reducing agents. Strong alkalis.

**10.6. Hazardous decomposition products**

Chlorine. Phosphorus acids. Carbon monoxide and carbon dioxide.

**11. Toxicological Information****Information on routes of exposure****Principle Route of Exposure** Eye or skin contact, inhalation.**Symptoms related to exposure****Most Important Symptoms/Effects**

Causes severe eye irritation which may damage tissue. Causes severe skin irritation with tissue destruction.

**Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Tributyl tetradecyl phosphonium chloride	81741-28-8	= 611 mg/kg (rat)	No data of sufficient quality are available	> 0.908 mg/L (rat, 4hr, mist)

**Immediate, delayed and chronic health effects from exposure****Inhalation**

May cause respiratory irritation.

**Eye Contact**

Causes severe eye irritation which may damage tissue. May cause eye burns.

**Skin Contact**

Causes severe skin irritation with tissue destruction.

**Ingestion**

Irritation of the mouth, throat, and stomach. May cause abdominal pain, vomiting, nausea, and diarrhea.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.**Exposure Levels**

No data available

**Interactive effects**

Lung disorders. Skin disorders.

**Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Tributyl tetradecyl phosphonium chloride	81741-28-8	Causes burns (Rabbit)

Substances	CAS Number	Serious eye damage/irritation
Tributyl tetradecyl phosphonium chloride	81741-28-8	Causes severe eye irritation which may damage tissue. (Rabbit)

Substances	CAS Number	Skin Sensitization
Tributyl tetradecyl phosphonium chloride	81741-28-8	No information available

Substances	CAS Number	Respiratory Sensitization
Tributyl tetradecyl phosphonium chloride	81741-28-8	No information available

Substances	CAS Number	Mutagenic Effects
Tributyl tetradecyl phosphonium chloride	81741-28-8	No data of sufficient quality are available.

Substances	CAS Number	Carcinogenic Effects
Tributyl tetradecyl phosphonium chloride	81741-28-8	No information available

Substances	CAS Number	Reproductive toxicity
Tributyl tetradecyl phosphonium chloride	81741-28-8	No information available

Substances	CAS Number	STOT - single exposure
Tributyl tetradecyl phosphonium chloride	81741-28-8	No information available

Substances	CAS Number	STOT - repeated exposure
Tributyl tetradecyl phosphonium chloride	81741-28-8	No data of sufficient quality are available.

Substances	CAS Number	Aspiration hazard
Tributyl tetradecyl phosphonium chloride	81741-28-8	No information available

## 12. Ecological Information

### Ecotoxicity

#### Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Tributyl tetradecyl phosphonium chloride	81741-28-8	No information available	LC50 (96 h) 0.46 mg/L (Oncorhynchus mykiss) LC50 (96 h) 0.06 mg/L (Lepomis macrochirus)	No information available	EC50 (48 h) 0.025 mg/L (Daphnia sp.)

### 12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Tributyl tetradecyl phosphonium chloride	81741-28-8	(0% @ 28d)

### 12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Tributyl tetradecyl phosphonium chloride	81741-28-8	< 3

### 12.4. Mobility in soil

Substances	CAS Number	Mobility
Tributyl tetradecyl phosphonium chloride	81741-28-8	No information available

### 12.6. Other adverse effects

#### Endocrine Disruptor Information

This product does not contain any known or suspected endocrine disruptors

### 13. Disposal Considerations

#### Safe handling and disposal methods

Disposal should be made in accordance with federal, state, and local regulations. Incineration recommended in approved incinerator according to federal, state, and local regulations. Substance should NOT be deposited into a sewage facility.

#### Disposal of any contaminated packaging

Follow all applicable national or local regulations.

#### Environmental regulations

Not applicable

### 14. Transport Information

#### Transportation Information

##### Australia ADG

<b>UN Number</b>	UN2922
<b>UN proper shipping name:</b>	Corrosive Liquid, Toxic, N.O.S. (contains Tributyl Tetradecyl Phosphonium Chloride)
<b>Transport Hazard Class(es):</b>	8, (6.1)
<b>Packing Group:</b>	II
<b>Environmental Hazards:</b>	Marine Pollutant

##### IMDG/IMO

<b>UN Number</b>	UN2922
<b>UN proper shipping name:</b>	Corrosive Liquid, Toxic, N.O.S. (contains Tributyl Tetradecyl Phosphonium Chloride)
<b>Transport Hazard Class(es):</b>	8, (6.1)
<b>Packing Group:</b>	II
<b>Environmental Hazards:</b>	Marine Pollutant
<b>EMS:</b>	EmS F-A, S-B

##### IATA/ICAO

<b>UN Number</b>	UN2922
<b>UN proper shipping name:</b>	Corrosive Liquid, Toxic, N.O.S. (contains Tributyl Tetradecyl Phosphonium Chloride)
<b>Transport Hazard Class(es):</b>	8, (6.1)
<b>Packing Group:</b>	II
<b>Environmental Hazards:</b>	Marine Pollutant

#### Special precautions during transport

None

#### HazChem Code

2X

### 15. Regulatory Information

#### Safety, health and environmental regulations specific for the product

##### International Inventories

##### Australian AICS Inventory

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

##### New Zealand Inventory of Chemicals

All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

##### EINECS (European Inventory of Existing Chemical Substances)

This product, and all its components, complies with EINECS

##### US TSCA Inventory

All components listed on inventory or are exempt.

##### Canadian Domestic Substances List (DSL)

All components listed on inventory or are exempt.

#### Poisons Schedule number

None Allocated

**International Agreements**

<b>Montreal Protocol - Ozone Depleting Substances:</b>	Does not apply
<b>Stockholm Convention - Persistent Organic Pollutants:</b>	Does not apply
<b>Rotterdam Convention - Prior Informed Consent:</b>	Does not apply
<b>Basel Convention - Hazardous Waste:</b>	Does not apply

**16. Other information****Date of preparation or review**

**Revision Date:** 13-Oct-2017

**Revision Note**

SDS sections updated:

2

**Full text of H-Statements referred to under sections 2 and 3**

H302 - Harmful if swallowed

H314 - Causes severe skin burns and eye damage

H318 - Causes serious eye damage

H330 - Fatal if inhaled

H400 - Very toxic to aquatic life

H401 - Toxic to aquatic life

H410 - Very toxic to aquatic life with long lasting effects

H411 - Toxic to aquatic life with long lasting effects

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight

CAS – Chemical Abstracts Service

EC50 – Effective Concentration 50%

LC50 – Lethal Concentration 50%

LD50 – Lethal Dose 50%

LL50 – Lethal Loading 50%

mg/kg – milligram/kilogram

mg/L – milligram/liter

NOEC – No Observed Effect Concentration

OEL – Occupational Exposure Limit

PBT – Persistent Bioaccumulative and Toxic

ppm – parts per million

STEL – Short Term Exposure Limit

TWA – Time-Weighted Average

vPvB – very Persistent and very Bioaccumulative

h - hour

mg/m<sup>3</sup> - milligram/cubic meter

mm - millimeter

mmHg - millimeter mercury

w/w - weight/weight

d - day

**Key literature references and sources for data**

www.ChemADVISOR.com/

NZ CCID

**Disclaimer Statement**

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

**End of Safety Data Sheet**



## SAFETY DATA SHEET

### CAUSTIC SODA LIQUID

Revision Date: 16-Apr-2015

Revision Number: 8

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** CAUSTIC SODA LIQUID

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM005652

##### Recommended use of the chemical and restrictions on use

**Recommended Use** pH Control  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road, Jandakot, WA 6164  
Australia  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-mail Address** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951  
Global Incident Response Access Code: 334305  
Contract Number: 14012

##### Australian Poisons Information Centre

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Skin Corrosion/Irritation	Category 1 - H314
Serious Eye Damage/Irritation	Category 1 - H318
Specific Target Organ Toxicity - (Single Exposure)	Category 3 - H335
Substances/mixtures corrosive to metal.	Category 1 - H290

##### Label elements, including precautionary statements

##### Hazard Pictograms

**Signal Word**

DANGER

**Hazard Statements:**

H290 - May be corrosive to metals  
 H314 - Causes severe skin burns and eye damage  
 H318 - Causes serious eye damage  
 H335 - May cause respiratory irritation

**Precautionary Statements****Prevention**

P234 - Keep only in original packaging.  
 P260 - Do not breathe dust/fume/gas/mist/vapors/spray  
 P261 - Avoid breathing dust/fume/gas/mist/vapors/spray  
 P264 - Wash face, hands and any exposed skin thoroughly after handling  
 P271 - Use only outdoors or in a well-ventilated area  
 P280 - Wear protective gloves/eye protection/face protection

**Response**

P301 + P330 + P331 - IF SWALLOWED: rinse mouth. Do NOT induce vomiting  
 P303 + P361 + P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower].  
 P363 - Wash contaminated clothing before reuse  
 P310 - Immediately call a POISON CENTER or doctor/physician  
 P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
 P390 - Absorb spillage to prevent material damage  
 P304 + P340 - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing  
 P403 + P233 - Store in a well-ventilated place. Keep container tightly closed  
 P405 - Store locked up  
 P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Storage****Disposal****Contains****Substances**

Sodium hydroxide

**CAS Number**

1310-73-2

**Other hazards which do not result in classification**

None known

*For the full text of the H-phrases mentioned in this Section, see Section 16*

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Sodium hydroxide	1310-73-2	30 - 60%	Skin Corr. 1A (H314) Eye Corr. 1 (H318) STOT SE 3 (H335) Met. Corr. 1 (H290)

### 4. First aid measures

**Description of necessary first aid measures****Inhalation**

If inhaled, move victim to fresh air and seek medical attention.

<b>Eyes</b>	Immediately flush eyes with large amounts of water for at least 30 minutes. Seek prompt medical attention.
<b>Skin</b>	Remove contaminated clothing and launder before reuse. Destroy or properly dispose of contaminated shoes. In case of contact, immediately flush skin with plenty of soap and water for at least 30 minutes and remove contaminated clothing, shoes and leather goods immediately. Get medical attention immediately.
<b>Ingestion</b>	Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

**Symptoms caused by exposure**

May cause eye and skin burns. May cause respiratory irritation. Causes severe skin irritation with tissue destruction. Causes severe eye irritation which may damage tissue.

**Medical Attention and Special Treatment**

**Notes to Physician** Treat symptomatically

## 5. Fire Fighting Measures

**Suitable extinguishing equipment****Suitable Extinguishing Media**

All standard fire fighting media

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical****Special exposure hazards in a fire**

May form explosive mixtures with strong acids. Reaction with steel and certain other metals generates flammable hydrogen gas.

**Special protective equipment and precautions for fire fighters****Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## 6. Accidental release measures

**6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment.

**6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas.

**6.3. Methods and material for containment and cleaning up**

Contain spill with sand or other inert materials. Neutralize to pH of 6-8. Scoop up and remove. Isolate spill and stop leak where safe.

## 7. Handling and storage

**7.1. Precautions for safe handling****Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Store away from acids. Store in a cool well ventilated area. Keep container closed when not in use. Product has a shelf life of 12 months.

**Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

### Control parameters - exposure standards, biological monitoring

#### Exposure Limits

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Sodium hydroxide	1310-73-2	2 mg/m <sup>3</sup>	Not applicable

### Appropriate engineering controls

#### Engineering Controls

Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.

### Personal protective equipment (PPE)

#### Personal Protective Equipment

If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

#### Respiratory Protection

If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.  
Dust/mist respirator. (N95, P2/P3)

#### Hand Protection

Chemical-resistant protective gloves (EN 374) Suitable materials for longer, direct contact (recommended: protection index 6, corresponding to > 480 minutes permeation time as per EN 374): Butyl rubber gloves. (>= 0.7 mm thickness)  
This information is based on literature references and on information provided by glove manufacturers, or is derived by analogy with similar substances. Please note that in practice the working life of chemical-resistant protective gloves may be considerably shorter than the permeation time determined in accordance with EN 374 as a result of the many influencing factors (e.g. temperature). If signs of wear and tear are noticed then the gloves should be replaced. Manufacturer's directions for use should be observed because of great diversity of types.

#### Skin Protection

Full protective chemical resistant clothing.

#### Eye Protection

Chemical goggles; also wear a face shield if splashing hazard exists.

#### Other Precautions

Eyewash fountains and safety showers must be easily accessible.

#### Environmental Exposure Controls

No information available

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

**Physical State:** Liquid

**Color:** Clear colorless

**Odor:** Odorless

**Odor Threshold:** No information available

#### Property

#### Values

Remarks/ - Method

**pH:**

14

**Freezing Point / Range**

12 °C

**Melting Point / Range**

No data available

**Boiling Point / Range**

144 °C / 291 °F

**Flash Point**

No data available

**Evaporation rate**

No data available

**Vapor Pressure**

13 mmHg

**Vapor Density**

No data available

**Specific Gravity**

1.52

**Water Solubility**

Miscible with water

**Solubility in other solvents**

No data available

**Partition coefficient: n-octanol/water**

No data available

**Autoignition Temperature**

No data available

**Decomposition Temperature**

No data available

**Viscosity**

No data available

**Explosive Properties**  
**Oxidizing Properties**No information available  
No information available**9.2. Other information****Molecular Weight**  
**VOC Content (%)**40  
No data available**10. Stability and Reactivity****10.1. Reactivity**

Not expected to be reactive.

**10.2. Chemical stability**

Stable

**10.3. Possibility of hazardous reactions**

Will Not Occur

**10.4. Conditions to avoid**

None anticipated

**10.5. Incompatible materials**

Strong acids. Peroxides. Halogenated compounds. Amphoteric metals such as aluminum, magnesium, lead, tin, or zinc.

**10.6. Hazardous decomposition products**

None known.

**11. Toxicological Information****Information on routes of exposure****Principle Route of Exposure** Eye or skin contact, inhalation.**Symptoms related to exposure****Most Important Symptoms/Effects**

May cause eye and skin burns. May cause respiratory irritation. Causes severe skin irritation with tissue destruction. Causes severe eye irritation which may damage tissue.

**Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Sodium hydroxide	1310-73-2	Not applicable due to corrosivity of the substance.	Not applicable due to corrosivity of the substance.	Not applicable due to corrosivity of the substance.

**Immediate, delayed and chronic health effects from exposure**

**Inhalation** Causes severe respiratory burns.  
**Eye Contact** Causes severe eye burns.  
**Skin Contact** Causes severe burns.  
**Ingestion** Causes burns of the mouth, throat and stomach.

**Chronic Effects/Carcinogenicity** Prolonged, excessive exposure may cause erosion of the teeth.**Exposure Levels**

No data available

**Interactive effects**

Skin disorders.

**Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Sodium hydroxide	1310-73-2	Causes severe burns

Substances	CAS Number	Serious eye damage/irritation
Sodium hydroxide	1310-73-2	Causes severe eye burns (Rabbit)

<b>Substances</b>	<b>CAS Number</b>	<b>Skin Sensitization</b>
Sodium hydroxide	1310-73-2	Did not cause sensitization on laboratory animals (guinea pig)
<b>Substances</b>	<b>CAS Number</b>	<b>Respiratory Sensitization</b>
Sodium hydroxide	1310-73-2	No information available
<b>Substances</b>	<b>CAS Number</b>	<b>Mutagenic Effects</b>
Sodium hydroxide	1310-73-2	Did not show mutagenic effects in animal experiments In vitro tests did not show mutagenic effects.
<b>Substances</b>	<b>CAS Number</b>	<b>Carcinogenic Effects</b>
Sodium hydroxide	1310-73-2	No data of sufficient quality are available.
<b>Substances</b>	<b>CAS Number</b>	<b>Reproductive toxicity</b>
Sodium hydroxide	1310-73-2	No information available
<b>Substances</b>	<b>CAS Number</b>	<b>STOT - single exposure</b>
Sodium hydroxide	1310-73-2	May cause respiratory irritation.
<b>Substances</b>	<b>CAS Number</b>	<b>STOT - repeated exposure</b>
Sodium hydroxide	1310-73-2	No significant toxicity observed in animal studies at concentration requiring classification. Not applicable due to corrosivity of the substance.
<b>Substances</b>	<b>CAS Number</b>	<b>Aspiration hazard</b>
Sodium hydroxide	1310-73-2	Not applicable

## 12. Ecological Information

### Ecotoxicity

#### Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Sodium hydroxide	1310-73-2	No information available	LC50(48h) 189 mg/L (Leuciscus idus melanotus) LLC50(48h) 189 mg/L (Leuciscus melanotus) LC50(24h) 145 mg/L (Poecilia reticulata) LC50(96h) 125 mg/L (Gambusia affinis) LOEL(150 d) = 25 mg/L (Lebistes reticulatus)	No information available	EC50 (48h) 40.4 mg/L (Ceriodaphnia sp.)

### 12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Sodium hydroxide	1310-73-2	The methods for determining biodegradability are not applicable to inorganic substances.

### 12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Sodium hydroxide	1310-73-2	No information available

### 12.4. Mobility in soil

Substances	CAS Number	Mobility
Sodium hydroxide	1310-73-2	No information available

### 12.6. Other adverse effects

#### Endocrine Disruptor Information

This product does not contain any known or suspected endocrine disruptors

### 13. Disposal Considerations

#### Safe handling and disposal methods

Disposal should be made in accordance with federal, state, and local regulations.

#### Disposal of any contaminated packaging

Follow all applicable national or local regulations.

#### Environmental regulations

Not applicable

### 14. Transport Information

#### Transportation Information

##### Australia ADG

UN Number	UN1824
UN proper shipping name:	Sodium Hydroxide Solution
Transport Hazard Class(es):	8
Packing Group:	II
Environmental Hazards:	Not applicable

##### IMDG/IMO

UN Number	UN1824
UN proper shipping name:	Sodium Hydroxide Solution
Transport Hazard Class(es):	8
Packing Group:	II
Environmental Hazards:	Not applicable
EMS:	EmS F-A, S-B

##### IATA/ICAO

UN Number	UN1824
UN proper shipping name:	Sodium Hydroxide Solution
Transport Hazard Class(es):	8
Packing Group:	II
Environmental Hazards:	Not applicable

#### Special precautions during transport

None

#### HazChem Code

2R

### 15. Regulatory Information

#### Safety, health and environmental regulations specific for the product

##### International Inventories

##### Australian AICS Inventory

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

##### New Zealand Inventory of Chemicals

All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

##### EINECS (European Inventory of Existing Chemical Substances)

This product, and all its components, complies with EINECS

##### US TSCA Inventory

All components listed on inventory or are exempt.

##### Canadian Domestic Substances List (DSL)

All components listed on inventory or are exempt.

#### Poisons Schedule number

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None Allocated

**International Agreements**

<b>Montreal Protocol - Ozone Depleting Substances:</b>	Does not apply
<b>Stockholm Convention - Persistent Organic Pollutants:</b>	Does not apply
<b>Rotterdam Convention - Prior Informed Consent:</b>	Does not apply
<b>Basel Convention - Hazardous Waste:</b>	Does not apply

<b>16. Other information</b>
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**Date of preparation or review**

**Revision Date:** 16-Apr-2015

**Revision Note****Full text of H-Statements referred to under sections 2 and 3**

H290 - May be corrosive to metals  
H314 - Causes severe skin burns and eye damage  
H318 - Causes serious eye damage  
H335 - May cause respiratory irritation

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight  
CAS – Chemical Abstracts Service  
EC50 – Effective Concentration 50%  
LC50 – Lethal Concentration 50%  
LD50 – Lethal Dose 50%  
LL50 – Lethal Loading 50%  
mg/kg – milligram/kilogram  
mg/L – milligram/liter  
NOEC – No Observed Effect Concentration  
OEL – Occupational Exposure Limit  
PBT – Persistent Bioaccumulative and Toxic  
ppm – parts per million  
STEL – Short Term Exposure Limit  
TWA – Time-Weighted Average  
vPvB – very Persistent and very Bioaccumulative  
h - hour  
mg/m<sup>3</sup> - milligram/cubic meter  
mm - millimeter  
mmHg - millimeter mercury  
w/w - weight/weight  
d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

**Disclaimer Statement**

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

**End of Safety Data Sheet**



## SAFETY DATA SHEET

### CERAMIC PROP PLUS

Revision Date: 28-Sep-2018

Revision Number: 18

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** CERAMIC PROP PLUS

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM004807

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Proppant  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road, Jandakot, WA 6164  
Australia  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-mail Address** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951  
Global Incident Response Access Code: 334305  
Contract Number: 14012

##### Australian Poisons Information Centre

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Carcinogenicity	Category 1A - H350
Specific Target Organ Toxicity - (Repeated Exposure)	Category 1 - H372

##### Label elements, including precautionary statements

##### Hazard Pictograms



**Signal Word**

DANGER

**Hazard Statements:**

H350 - May cause cancer by inhalation  
 H372 - Causes damage to organs through prolonged or repeated exposure if inhaled

**Precautionary Statements**

**Prevention**

P201 - Obtain special instructions before use  
 P202 - Do not handle until all safety precautions have been read and understood  
 P260 - Do not breathe dust/fume/gas/mist/vapors/spray  
 P264 - Wash face, hands and any exposed skin thoroughly after handling  
 P270 - Do not eat, drink or smoke when using this product

**Response**

P281 - Use personal protective equipment as required  
 P308 + P313 - IF exposed or concerned: Get medical advice/attention  
 P314 - Get medical attention/advice if you feel unwell

**Storage**

P405 - Store locked up

**Disposal**

P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Contains**

**Substances**

Crystalline silica, cristobalite

**CAS Number**

14464-46-1

**Other hazards which do not result in classification**

This substance is not considered to be persistent, bioaccumulating nor toxic (PBT).  
 This substance is not considered to be very persistent nor very bioaccumulating (vPvB).

*For the full text of the H-phrases mentioned in this Section, see Section 16*

**3. Composition/information on Ingredients**

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Crystalline silica, cristobalite	14464-46-1	10 - 30%	Carc. 1A (H350) STOT RE 1 (H372)

**4. First aid measures**

**Description of necessary first aid measures**

**Inhalation**

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

**Eyes**

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

**Skin**

Remove contaminated clothing. wash skin with water, using soap if available. Get medical attention if irritation persists.

**Ingestion**

Rinse mouth with water many times.

**Symptoms caused by exposure**

Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

**Medical Attention and Special Treatment**

**Notes to Physician** Treat symptomatically

**5. Fire Fighting Measures**

**Suitable extinguishing equipment**

**Suitable Extinguishing Media**

All standard fire fighting media

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical**

**Special exposure hazards in a fire**

Not applicable

**Special protective equipment and precautions for fire fighters**

**Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

**6. Accidental release measures**

**6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment. Avoid creating and breathing dust. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing.

**6.2. Environmental precautions**

None known.

**6.3. Methods and material for containment and cleaning up**

Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

**7. Handling and storage**

**7.1. Precautions for safe handling**

**Handling Precautions**

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities**

**Storage Information**

Store in a cool well ventilated area. Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use.

**Other Guidelines**

No information available

**8. Exposure Controls/Personal Protection**

**Control parameters - exposure standards, biological monitoring**

**Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Crystalline silica, cristobalite	14464-46-1	TWA: 0.1 mg/m <sup>3</sup>	TWA: 0.025 mg/m <sup>3</sup>

**Appropriate engineering controls**

<b>Engineering Controls</b>	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits.
<b>Personal protective equipment (PPE)</b>	
<b>Personal Protective Equipment</b>	If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.
<b>Respiratory Protection</b>	Wear a NIOSH certified, European Standard EN 149 (FFP2/FFP3), AS/NZS 1715, or equivalent respirator when using this product.
<b>Hand Protection</b>	Normal work gloves.
<b>Skin Protection</b>	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
<b>Eye Protection</b>	Wear safety glasses or goggles to protect against exposure.
<b>Other Precautions</b>	None known.
<b>Environmental Exposure Controls</b>	No information available

<b>9. Physical and Chemical Properties</b>
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**9.1. Information on basic physical and chemical properties**

<b>Physical State:</b>	Granules	<b>Color</b>	Gray to tan
<b>Odor:</b>	Odorless	<b>Odor Threshold:</b>	No information available

<u>Property</u>	<u>Values</u>
<u>Remarks/ - Method</u>	
<b>pH:</b>	No data available
<b>Freezing Point / Range</b>	No data available
<b>Melting Point / Range</b>	No data available
<b>Pour Point / Range</b>	No data available
<b>Boiling Point / Range</b>	No data available
<b>Flash Point</b>	No data available
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	2.7
<b>Water Solubility</b>	Insoluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

**9.2. Other information**

<b>VOC Content (%)</b>	No data available
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<b>10. Stability and Reactivity</b>
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**10.1. Reactivity**

Not expected to be reactive.

**10.2. Chemical stability**

Stable

**10.3. Possibility of hazardous reactions**

Will Not Occur

**10.4. Conditions to avoid**

None anticipated

**10.5. Incompatible materials**

Hydrofluoric acid.

**10.6. Hazardous decomposition products**

Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).

**11. Toxicological Information**
**Information on routes of exposure**

**Principle Route of Exposure** Eye or skin contact, inhalation.

**Symptoms related to exposure****Most Important Symptoms/Effects**

Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

**Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Crystalline silica, cristobalite	14464-46-1	> 15000 mg/kg (human) (similar substance)	No information available	No data available

**Immediate, delayed and chronic health effects from exposure****Inhalation**

Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).

Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).

**Eye Contact**

May cause mechanical irritation to eye.

**Skin Contact**

None known.

**Ingestion**

None known.

**Chronic Effects/Carcinogenicity**

**Silicosis:** Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

**Cancer Status:** The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2). There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

**Exposure Levels**

No data available

**Interactive effects**

Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.

**Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Crystalline silica, cristobalite	14464-46-1	Non-irritating to the skin

Substances	CAS Number	Serious eye damage/irritation
Crystalline silica, cristobalite	14464-46-1	Mechanical irritation of the eyes is possible.

Substances	CAS Number	Skin Sensitization
Crystalline silica, cristobalite	14464-46-1	No information available

Substances	CAS Number	Respiratory Sensitization
Crystalline silica, cristobalite	14464-46-1	No information available

Substances	CAS Number	Mutagenic Effects
Crystalline silica, cristobalite	14464-46-1	Not regarded as mutagenic.

Substances	CAS Number	Carcinogenic Effects
Crystalline silica, cristobalite	14464-46-1	Contains crystalline silica which may cause silicosis, a delayed and progressive lung disease. The IARC and NTP have determined there is sufficient evidence in humans of the carcinogenicity of crystalline silica with repeated respiratory exposure. Based on available scientific evidence, this substance is a threshold carcinogen with a mode of action involving indirect genotoxicity secondary to lung injury.

Substances	CAS Number	Reproductive toxicity
Crystalline silica, cristobalite	14464-46-1	No information available

Substances	CAS Number	STOT - single exposure
Crystalline silica, cristobalite	14464-46-1	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	STOT - repeated exposure
Crystalline silica, cristobalite	14464-46-1	Causes damage to organs through prolonged or repeated exposure if inhaled: (Lungs)

Substances	CAS Number	Aspiration hazard
Crystalline silica, cristobalite	14464-46-1	Not applicable

**12. Ecological Information**

**Ecotoxicity**

**Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Crystalline silica, cristobalite	14464-46-1	No information available	LL0(96 h)=10000 mg/L (Danio rerio)	No information available	LL50(24 h)>10000 mg/L (Daphnia magna)

**12.2. Persistence and degradability**

Substances	CAS Number	Persistence and Degradability
Crystalline silica, cristobalite	14464-46-1	The methods for determining biodegradability are not applicable to inorganic substances.

**12.3. Bioaccumulative potential**

Substances	CAS Number	Bioaccumulation
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Crystalline silica, cristobalite	14464-46-1	Not bioaccumulative
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**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Crystalline silica, cristobalite	14464-46-1	No information available

**12.6. Other adverse effects**

**Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

**13. Disposal Considerations**

**Safe handling and disposal methods**

Bury in a licensed landfill according to federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

**14. Transport Information**

**Transportation Information**

**Australia ADG**

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

**IMDG/IMO**

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

**IATA/ICAO**

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

**15. Regulatory Information**

**Safety, health and environmental regulations specific for the product**

**International Inventories**

**Australian AICS Inventory**

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

**New Zealand Inventory of**

All components are listed on the NZIoC or are subject to a relevant exemption, permit, or

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**Chemicals** assessment certificate.  
**US TSCA Inventory** All components listed on inventory or are exempt.  
**Canadian Domestic Substances List (DSL)** All components listed on inventory or are exempt.

### Poisons Schedule number

None Allocated

### International Agreements

<b>Montreal Protocol - Ozone Depleting Substances:</b>	Does not apply.
<b>Stockholm Convention - Persistent Organic Pollutants:</b>	Does not apply
<b>Rotterdam Convention - Prior Informed Consent:</b>	Does not apply.
<b>Basel Convention - Hazardous Waste:</b>	Does not apply.

## 16. Other information

### Date of preparation or review

**Revision Date:** 28-Sep-2018

### **Revision Note**

SDS sections updated:  
2

### **Full text of H-Statements referred to under sections 2 and 3**

H350 - May cause cancer by inhalation

H372 - Causes damage to organs through prolonged or repeated exposure if inhaled

### **Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

### Key abbreviations or acronyms used

bw – body weight  
CAS – Chemical Abstracts Service  
EC50 – Effective Concentration 50%  
LC50 – Lethal Concentration 50%  
LD50 – Lethal Dose 50%  
LL50 – Lethal Loading 50%  
mg/kg – milligram/kilogram  
mg/L – milligram/liter  
NOEC – No Observed Effect Concentration  
OEL – Occupational Exposure Limit  
PBT – Persistent Bioaccumulative and Toxic  
ppm – parts per million  
STEL – Short Term Exposure Limit  
TWA – Time-Weighted Average  
vPvB – very Persistent and very Bioaccumulative  
h - hour  
mg/m<sup>3</sup> - milligram/cubic meter  
mm - millimeter  
mmHg - millimeter mercury  
w/w - weight/weight  
d - day

### **Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

### **Disclaimer Statement**



## **CERAMIC PROP PLUS**

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This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

**End of Safety Data Sheet**

## SAFETY DATA SHEET

### PREMIUM PROP

Revision Date: 18-Sep-2018

Revision Number: 13

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** PREMIUM PROP

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM004809

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Proppant  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road, Jandakot, WA 6164  
Australia  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-mail Address** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951  
Global Incident Response Access Code: 334305  
Contract Number: 14012

##### Australian Poisons Information Centre

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Carcinogenicity	Category 1A - H350
Specific Target Organ Toxicity - (Repeated Exposure)	Category 1 - H372

##### Label elements, including precautionary statements

##### Hazard Pictograms



<b>Signal Word</b>	DANGER
<b>Hazard Statements:</b>	H350 - May cause cancer by inhalation H372 - Causes damage to organs through prolonged or repeated exposure if inhaled
<b>Precautionary Statements</b>	
<b>Prevention</b>	P201 - Obtain special instructions before use P202 - Do not handle until all safety precautions have been read and understood P260 - Do not breathe dust/fume/gas/mist/vapors/spray P264 - Wash face, hands and any exposed skin thoroughly after handling P270 - Do not eat, drink or smoke when using this product P281 - Use personal protective equipment as required
<b>Response</b>	P308 + P313 - IF exposed or concerned: Get medical advice/attention P314 - Get medical attention/advice if you feel unwell
<b>Storage</b>	P405 - Store locked up
<b>Disposal</b>	P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Contains****Substances**

Crystalline silica, cristobalite

**CAS Number**

14464-46-1

**Other hazards which do not result in classification**

This substance is not considered to be persistent, bioaccumulating nor toxic (PBT).

This substance is not considered to be very persistent nor very bioaccumulating (vPvB).

*For the full text of the H-phrases mentioned in this Section, see Section 16*

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Crystalline silica, cristobalite	14464-46-1	1 - 5%	Carc. 1A (H350) STOT RE 1 (H372)

### 4. First aid measures

**Description of necessary first aid measures**

<b>Inhalation</b>	If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
<b>Eyes</b>	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
<b>Skin</b>	Get medical attention if irritation persists.
<b>Ingestion</b>	Under normal conditions, first aid procedures are not required.

**Symptoms caused by exposure**

Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

**Medical Attention and Special Treatment**

**Notes to Physician** Treat symptomatically

## 5. Fire Fighting Measures

**Suitable extinguishing equipment**

**Suitable Extinguishing Media**

All standard fire fighting media

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical**

**Special exposure hazards in a fire**

Not applicable

**Special protective equipment and precautions for fire fighters**

**Special protective equipment for firefighters**

Not applicable

## 6. Accidental release measures

**6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment. Avoid creating and breathing dust.

**6.2. Environmental precautions**

None known.

**6.3. Methods and material for containment and cleaning up**

Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

## 7. Handling and storage

**7.1. Precautions for safe handling**

**Handling Precautions**

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities**

**Storage Information**

Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use.

**Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

**Control parameters - exposure standards, biological monitoring**

**Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Crystalline silica, cristobalite	14464-46-1	TWA: 0.1 mg/m <sup>3</sup>	TWA: 0.025 mg/m <sup>3</sup>

**Appropriate engineering controls**

**Engineering Controls**

Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits.

**Personal protective equipment (PPE)**

<b>Personal Protective Equipment</b>	If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.
<b>Respiratory Protection</b>	Wear a NIOSH certified, European Standard EN 149 (FFP2/FFP3), AS/NZS 1715, or equivalent respirator when using this product.
<b>Hand Protection</b>	Normal work gloves.
<b>Skin Protection</b>	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
<b>Eye Protection</b>	Wear safety glasses or goggles to protect against exposure.
<b>Other Precautions</b>	None known.
<b>Environmental Exposure Controls</b>	No information available

## 9. Physical and Chemical Properties

**9.1. Information on basic physical and chemical properties**

<b>Physical State:</b>	Solid	<b>Color</b>	Dark brown
<b>Odor:</b>	Odorless	<b>Odor Threshold:</b>	No information available

<u>Property</u> <u>Remarks/ - Method</u>	<u>Values</u>
<b>pH:</b>	No data available
<b>Freezing Point / Range</b>	No data available
<b>Melting Point / Range</b>	No data available
<b>Pour Point / Range</b>	No data available
<b>Boiling Point / Range</b>	No data available
<b>Flash Point</b>	No data available
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	3.17
<b>Water Solubility</b>	Insoluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

**9.2. Other information**

<b>Molecular Weight</b>	228.1
<b>VOC Content (%)</b>	No data available

## 10. Stability and Reactivity

**10.1. Reactivity**

Not expected to be reactive.

**10.2. Chemical stability**

Stable

**10.3. Possibility of hazardous reactions**

Will Not Occur

**10.4. Conditions to avoid**

None anticipated

**10.5. Incompatible materials**

Hydrofluoric acid.

**10.6. Hazardous decomposition products**

Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).

## 11. Toxicological Information

### Information on routes of exposure

**Principle Route of Exposure** Eye or skin contact, inhalation.

### Symptoms related to exposure

#### **Most Important Symptoms/Effects**

Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

### Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Crystalline silica, cristobalite	14464-46-1	> 15000 mg/kg (human) (similar substance)	No information available	No data available

### Immediate, delayed and chronic health effects from exposure

#### **Inhalation**

Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).

Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).

#### **Eye Contact**

May cause mechanical irritation to eye.

#### **Skin Contact**

None known.

#### **Ingestion**

None known.

#### **Chronic Effects/Carcinogenicity**

**Silicosis:** Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

**Cancer Status:** The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2). There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

### Exposure Levels

No data available

### Interactive effects

## PREMIUM PROP

Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.

### Data limitations

No data available

Substances	CAS Number	Skin corrosion/irritation
Crystalline silica, cristobalite	14464-46-1	Non-irritating to the skin

Substances	CAS Number	Serious eye damage/irritation
Crystalline silica, cristobalite	14464-46-1	Mechanical irritation of the eyes is possible.

Substances	CAS Number	Skin Sensitization
Crystalline silica, cristobalite	14464-46-1	No information available

Substances	CAS Number	Respiratory Sensitization
Crystalline silica, cristobalite	14464-46-1	No information available

Substances	CAS Number	Mutagenic Effects
Crystalline silica, cristobalite	14464-46-1	Not regarded as mutagenic.

Substances	CAS Number	Carcinogenic Effects
Crystalline silica, cristobalite	14464-46-1	Contains crystalline silica which may cause silicosis, a delayed and progressive lung disease. The IARC and NTP have determined there is sufficient evidence in humans of the carcinogenicity of crystalline silica with repeated respiratory exposure. Based on available scientific evidence, this substance is a threshold carcinogen with a mode of action involving indirect genotoxicity secondary to lung injury.

Substances	CAS Number	Reproductive toxicity
Crystalline silica, cristobalite	14464-46-1	No information available

Substances	CAS Number	STOT - single exposure
Crystalline silica, cristobalite	14464-46-1	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	STOT - repeated exposure
Crystalline silica, cristobalite	14464-46-1	Causes damage to organs through prolonged or repeated exposure if inhaled: (Lungs)

Substances	CAS Number	Aspiration hazard
Crystalline silica, cristobalite	14464-46-1	Not applicable

## 12. Ecological Information

### Ecotoxicity

#### Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Crystalline silica, cristobalite	14464-46-1	No information available	LL0(96 h)=10000 mg/L (Danio rerio)	No information available	LL50(24 h)>10000 mg/L (Daphnia magna)

#### 12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Crystalline silica, cristobalite	14464-46-1	The methods for determining biodegradability are not applicable to inorganic substances.

#### 12.3. Bioaccumulative potential

Substances	CAS Number	Bioaccumulation
Crystalline silica, cristobalite	14464-46-1	Not bioaccumulative

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Crystalline silica, cristobalite	14464-46-1	No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

**13. Disposal Considerations****Safe handling and disposal methods**

Bury in a licensed landfill according to federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

**14. Transport Information****Transportation Information****Australia ADG**

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

**IMDG/IMO**

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

**IATA/ICAO**

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

**15. Regulatory Information****Safety, health and environmental regulations specific for the product****International Inventories****Australian AICS Inventory**

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

**New Zealand Inventory of Chemicals**

All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

**US TSCA Inventory**

All components listed on inventory or are exempt.



**Canadian Domestic Substances List** All components listed on inventory or are exempt.  
**(DSL)**

**Poisons Schedule number**

None Allocated

**International Agreements**

**Montreal Protocol - Ozone Depleting Substances:**

Does not apply.

**Stockholm Convention - Persistent Organic Pollutants:**

Does not apply

**Rotterdam Convention - Prior Informed Consent:**

Does not apply.

**Basel Convention - Hazardous Waste:**

Does not apply.

**16. Other information**

**Date of preparation or review**

**Revision Date:** 18-Sep-2018

**Revision Note**

SDS sections updated:

2

**Full text of H-Statements referred to under sections 2 and 3**

H350 - May cause cancer by inhalation

H372 - Causes damage to organs through prolonged or repeated exposure if inhaled

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight

CAS – Chemical Abstracts Service

EC50 – Effective Concentration 50%

LC50 – Lethal Concentration 50%

LD50 – Lethal Dose 50%

LL50 – Lethal Loading 50%

mg/kg – milligram/kilogram

mg/L – milligram/liter

NOEC – No Observed Effect Concentration

OEL – Occupational Exposure Limit

PBT – Persistent Bioaccumulative and Toxic

ppm – parts per million

STEL – Short Term Exposure Limit

TWA – Time-Weighted Average

vPvB – very Persistent and very Bioaccumulative

h - hour

mg/m<sup>3</sup> - milligram/cubic meter

mm - millimeter

mmHg - millimeter mercury

w/w - weight/weight

d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

**Disclaimer Statement**

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all

**PREMIUM PROP**

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conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

**End of Safety Data Sheet**

## SAFETY DATA SHEET

### CERAMIC PROP

Revision Date: 07-Jun-2018

Revision Number: 12

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** CERAMIC PROP

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM004805

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Proppant  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road, Jandakot, WA 6164  
Australia  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-mail Address** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951  
Global Incident Response Access Code: 334305  
Contract Number: 14012

##### Australian Poisons Information Centre

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Carcinogenicity	Category 1A - H350
Specific Target Organ Toxicity - (Repeated Exposure)	Category 1 - H372

##### Label elements, including precautionary statements

##### Hazard Pictograms

**Signal Word**

DANGER

**Hazard Statements:**

H350 - May cause cancer by inhalation  
 H372 - Causes damage to organs through prolonged or repeated exposure if inhaled

**Precautionary Statements****Prevention**

P201 - Obtain special instructions before use  
 P202 - Do not handle until all safety precautions have been read and understood  
 P260 - Do not breathe dust/fume/gas/mist/vapors/spray  
 P264 - Wash face, hands and any exposed skin thoroughly after handling  
 P270 - Do not eat, drink or smoke when using this product  
 P281 - Use personal protective equipment as required

**Response**

P308 + P313 - IF exposed or concerned: Get medical advice/attention  
 P314 - Get medical attention/advice if you feel unwell

**Storage**

P405 - Store locked up

**Disposal**

P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Contains****Substances**

Crystalline silica, cristobalite

**CAS Number**

14464-46-1

**Other hazards which do not result in classification**

This substance is not considered to be persistent, bioaccumulating nor toxic (PBT).

This substance is not considered to be very persistent nor very bioaccumulating (vPvB).

*For the full text of the H-phrases mentioned in this Section, see Section 16*

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Crystalline silica, cristobalite	14464-46-1	10 - 30%	Carc. 1A (H350) STOT RE 1 (H372)

### 4. First aid measures

**Description of necessary first aid measures****Inhalation**

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

**Eyes**

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

**Skin**

Wash with soap and water. Get medical attention if irritation persists.

**Ingestion**

Under normal conditions, first aid procedures are not required.

**Symptoms caused by exposure**

Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

**Medical Attention and Special Treatment**

**Notes to Physician**

Treat symptomatically

<b>5. Fire Fighting Measures</b>
----------------------------------

**Suitable extinguishing equipment****Suitable Extinguishing Media**

None - does not burn.

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical****Special exposure hazards in a fire**

Not applicable

**Special protective equipment and precautions for fire fighters****Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

<b>6. Accidental release measures</b>
---------------------------------------

**6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment. Avoid creating and breathing dust. Avoid contact with skin, eyes and clothing.

**6.2. Environmental precautions**

None known.

**6.3. Methods and material for containment and cleaning up**

Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

<b>7. Handling and storage</b>
--------------------------------

**7.1. Precautions for safe handling****Handling Precautions**

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Store in a cool well ventilated area. Store locked up. Store in a cool, dry location. Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use.

**Other Guidelines**

No information available

<b>8. Exposure Controls/Personal Protection</b>
---

**Control parameters - exposure standards, biological monitoring****Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Crystalline silica, cristobalite	14464-46-1	TWA: 0.1 mg/m <sup>3</sup>	TWA: 0.025 mg/m <sup>3</sup>

**Appropriate engineering controls****Engineering Controls**

Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits.

**Personal protective equipment (PPE)**

<b>Personal Protective Equipment</b>	If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.
<b>Respiratory Protection</b>	Wear a NIOSH certified, European Standard EN 149 (FFP2/FFP3), AS/NZS 1715, or equivalent respirator when using this product.
<b>Hand Protection</b>	Normal work gloves.
<b>Skin Protection</b>	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
<b>Eye Protection</b>	Wear safety glasses or goggles to protect against exposure.
<b>Other Precautions</b>	None known.
<b>Environmental Exposure Controls</b>	No information available

<b>9. Physical and Chemical Properties</b>
--

**9.1. Information on basic physical and chemical properties**

<b>Physical State:</b>	Solid	<b>Color</b>	Gray to tan
<b>Odor:</b>	Odorless	<b>Odor Threshold:</b>	No information available

<u>Property</u>	<u>Values</u>
Remarks/ - Method	
<b>pH:</b>	No data available
<b>Freezing Point / Range</b>	No data available
<b>Melting Point / Range</b>	No data available
<b>Pour Point / Range</b>	No data available
<b>Boiling Point / Range</b>	No data available
<b>Flash Point</b>	No data available
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	3.1
<b>Water Solubility</b>	Insoluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

**9.2. Other information**

<b>VOC Content (%)</b>	No data available
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<b>10. Stability and Reactivity</b>
-------------------------------------

**10.1. Reactivity**

Not expected to be reactive.

**10.2. Chemical stability**

Stable

**10.3. Possibility of hazardous reactions**

Will Not Occur

**10.4. Conditions to avoid**

None anticipated

**10.5. Incompatible materials**

Hydrofluoric acid.

**10.6. Hazardous decomposition products**

Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).

## 11. Toxicological Information

### Information on routes of exposure

**Principle Route of Exposure** Eye or skin contact, inhalation.

### Symptoms related to exposure

#### **Most Important Symptoms/Effects**

Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

### Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Crystalline silica, cristobalite	14464-46-1	> 15000 mg/kg (human) (similar substance)	No information available	No data available

### Immediate, delayed and chronic health effects from exposure

#### **Inhalation**

Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).

Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).

#### **Eye Contact**

May cause mechanical irritation to eye.

#### **Skin Contact**

None known.

#### **Ingestion**

None known.

#### **Chronic Effects/Carcinogenicity**

**Silicosis:** Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

**Cancer Status:** The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2). There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

### Exposure Levels

No data available

### Interactive effects

Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.

**Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Crystalline silica, cristobalite	14464-46-1	Non-irritating to the skin

Substances	CAS Number	Serious eye damage/irritation
Crystalline silica, cristobalite	14464-46-1	Mechanical irritation of the eyes is possible.

Substances	CAS Number	Skin Sensitization
Crystalline silica, cristobalite	14464-46-1	No information available

Substances	CAS Number	Respiratory Sensitization
Crystalline silica, cristobalite	14464-46-1	No information available

Substances	CAS Number	Mutagenic Effects
Crystalline silica, cristobalite	14464-46-1	Not regarded as mutagenic.

Substances	CAS Number	Carcinogenic Effects
Crystalline silica, cristobalite	14464-46-1	Contains crystalline silica which may cause silicosis, a delayed and progressive lung disease. The IARC and NTP have determined there is sufficient evidence in humans of the carcinogenicity of crystalline silica with repeated respiratory exposure. Based on available scientific evidence, this substance is a threshold carcinogen with a mode of action involving indirect genotoxicity secondary to lung injury.

Substances	CAS Number	Reproductive toxicity
Crystalline silica, cristobalite	14464-46-1	No information available

Substances	CAS Number	STOT - single exposure
Crystalline silica, cristobalite	14464-46-1	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	STOT - repeated exposure
Crystalline silica, cristobalite	14464-46-1	Causes damage to organs through prolonged or repeated exposure if inhaled: (Lungs)

Substances	CAS Number	Aspiration hazard
Crystalline silica, cristobalite	14464-46-1	Not applicable

## 12. Ecological Information

**Ecotoxicity****Product Ecotoxicity Data**

Product is not classified as hazardous to the environment.

**Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Crystalline silica, cristobalite	14464-46-1	No information available	LL0(96 h)=10000 mg/L (Danio rerio)	No information available	LL50(24 h)>10000 mg/L (Daphnia magna)

**12.2. Persistence and degradability**

Substances	CAS Number	Persistence and Degradability
Crystalline silica, cristobalite	14464-46-1	The methods for determining biodegradability are not applicable to inorganic substances.

**12.3. Bioaccumulative potential**

Substances	CAS Number	Bioaccumulation
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Crystalline silica, cristobalite	14464-46-1	Not bioaccumulative
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**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Crystalline silica, cristobalite	14464-46-1	No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

<b>13. Disposal Considerations</b>
------------------------------------

**Safe handling and disposal methods**

Bury in a licensed landfill according to federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

<b>14. Transport Information</b>
----------------------------------

**Transportation Information****Australia ADG**

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

**IMDG/IMO**

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

**IATA/ICAO**

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

<b>15. Regulatory Information</b>
-----------------------------------

**Safety, health and environmental regulations specific for the product****International Inventories****Australian AICS Inventory**

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

**New Zealand Inventory of**

All components are listed on the NZIoC or are subject to a relevant exemption, permit, or

**Chemicals** assessment certificate.  
**US TSCA Inventory** All components listed on inventory or are exempt.  
**Canadian Domestic Substances List (DSL)** All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

**International Agreements**

<b>Montreal Protocol - Ozone Depleting Substances:</b>	Does not apply.
<b>Stockholm Convention - Persistent Organic Pollutants:</b>	Does not apply
<b>Rotterdam Convention - Prior Informed Consent:</b>	Does not apply.
<b>Basel Convention - Hazardous Waste:</b>	Does not apply.

<b>16. Other information</b>
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**Date of preparation or review****Revision Date:** 07-Jun-2018**Revision Note**SDS sections updated:  
2**Full text of H-Statements referred to under sections 2 and 3**

H350 - May cause cancer by inhalation

H372 - Causes damage to organs through prolonged or repeated exposure if inhaled

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight  
CAS – Chemical Abstracts Service  
EC50 – Effective Concentration 50%  
LC50 – Lethal Concentration 50%  
LD50 – Lethal Dose 50%  
LL50 – Lethal Loading 50%  
mg/kg – milligram/kilogram  
mg/L – milligram/liter  
NOEC – No Observed Effect Concentration  
OEL – Occupational Exposure Limit  
PBT – Persistent Bioaccumulative and Toxic  
ppm – parts per million  
STEL – Short Term Exposure Limit  
TWA – Time-Weighted Average  
vPvB – very Persistent and very Bioaccumulative  
h - hour  
mg/m<sup>3</sup> - milligram/cubic meter  
mm - millimeter  
mmHg - millimeter mercury  
w/w - weight/weight  
d - day

**Key literature references and sources for data**[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)**Disclaimer Statement**

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This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

**End of Safety Data Sheet**

## SAFETY DATA SHEET

### CL-28M CROSSLINKER

Revision Date: 03-Apr-2015

Revision Number: 19

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** CL-28M CROSSLINKER

##### Other means of Identification

**Synonyms:** None  
**Product Code:** HM000346

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Crosslinker  
**Uses Advised Against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road  
Jandakot  
WA 6164  
Australia  
  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-Mail address:** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951

##### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Serious Eye Damage / Eye Irritation	Category 2 - H319
Carcinogenicity	Category 1A - H350
Reproductive Toxicity	Category 1B - H360
Specific Target Organ Toxicity - (Repeated Exposure)	Category 2 - H373

##### Label elements, including precautionary statements

##### **Hazard Pictograms**



<b>Signal Word</b>	Danger		
<b>Hazard Statements</b>	H319 - Causes serious eye irritation H350i - May cause cancer by inhalation H360 - May damage fertility or the unborn child H373 - May cause damage to organs through prolonged or repeated exposure if inhaled		
<b>Precautionary Statements</b>			
<b>Prevention</b>	P201 - Obtain special instructions before use P202 - Do not handle until all safety precautions have been read and understood P260 - Do not breathe dust/fume/gas/mist/vapors/spray P264 - Wash face, hands and any exposed skin thoroughly after handling P280 - Wear eye protection/face protection P281 - Use personal protective equipment as required		
<b>Response</b>	P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing P337 + P313 - If eye irritation persists: Get medical advice/attention P308 + P313 - IF exposed or concerned: Get medical advice/attention P314 - Get medical attention/advice if you feel unwell		
<b>Storage</b>	P405 - Store locked up		
<b>Disposal</b>	P501 - Dispose of contents/container in accordance with local/regional/national/international regulations		
<b>Contains Substances</b>		<b>CAS Number</b>	
Borate Salts		Proprietary	
Crystalline silica, quartz		14808-60-7	
<b>Other hazards which do not result in classification</b>	<u>None known</u>		
<b>Australia Classification</b>	<i>For the full text of the H-phrases mentioned in this Section, see Section 16</i>		
<b>Classification</b>	T - Toxic.		
<b>Risk Phrases</b>	R36 Irritating to eyes. R49 May cause cancer by inhalation. R62 Possible risk of impaired fertility. R48/20 Harmful: danger of serious damage to health by prolonged exposure through inhalation.		

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
------------	------------	---------------	--------------------------------

Borate Salts	Proprietary	30 - 60%	Eye Irrit. 2A (H319) Repr. 1 (H360)
Crystalline silica, quartz	14808-60-7	1 - 5%	Carc. 1 (H350) STOT RE 1 (H372)

#### 4. First aid measures

##### Description of necessary first aid measures

<b>Inhalation</b>	If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
<b>Eyes</b>	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
<b>Skin</b>	Wash with soap and water. Get medical attention if irritation persists.
<b>Ingestion</b>	Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

##### Symptoms caused by exposure

Causes eye irritation Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease. Potential reproductive hazard. May cause birth defects. Prolonged or repeated exposure may cause damage to organs.

##### Medical Attention and Special Treatment

**Notes to Physician** Treat symptomatically

#### 5. Fire Fighting Measures

##### Suitable extinguishing equipment

##### **Suitable Extinguishing Media**

All standard fire fighting media

##### **Extinguishing media which must not be used for safety reasons**

None known.

##### Specific hazards arising from the chemical

##### **Special Exposure Hazards**

Decomposition in fire may produce harmful gases.

##### Special protective equipment and precautions for fire fighters

##### **Special Protective Equipment for Fire-Fighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

#### 6. Accidental release measures

##### 6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment.

##### 6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

##### 6.3. Methods and material for containment and cleaning up

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

#### 7. Handling and storage

##### 7.1. Precautions for Safe Handling

##### **Handling Precautions**

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when

wet.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Keep container closed when not in use. Product has a shelf life of 24 months.

**Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

**Control parameters - exposure standards, biological monitoring****Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Borate Salts	Proprietary	Not applicable	Not applicable
Crystalline silica, quartz	14808-60-7	TWA: 0.1 mg/m <sup>3</sup>	TWA: 0.025 mg/m <sup>3</sup>

**Appropriate engineering controls****Engineering Controls**

Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits.

**Personal protective equipment (PPE)****Respiratory Protection**

Wear a NIOSH certified, European Standard EN 149 (FFP2/FFP3), AS/NZS 1715, or equivalent respirator when using this product.

**Hand Protection**

Normal work gloves.

**Skin Protection**

Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.

**Eye Protection**

Wear safety glasses or goggles to protect against exposure.

**Other Precautions**

None known.

**Environmental Exposure Controls**

No information available

## 9. Physical and Chemical Properties

**9.1. Information on basic physical and chemical properties**

**Physical State:** Liquid

**Color:** Gray to tan

**Odor:** Odorless

**Odor Threshold:** No information available

PropertyValues

Remarks/ - Method

**pH:**

No data available

**Freezing Point/Range**

0 °C

**Melting Point/Range**

No data available

**Boiling Point/Range**

100 °C / 212 °F

**Flash Point**

No data available

**Evaporation rate**

No data available

**Vapor Pressure**

No data available

**Vapor Density**

No data available

**Specific Gravity**

1.27

**Water Solubility**

Insoluble in water

**Solubility in other solvents**

No data available

**Partition coefficient: n-octanol/water**

No data available

**Autoignition Temperature**

No data available

**Decomposition Temperature**

No data available

**Viscosity**

No data available

**Explosive Properties**

No information available

**Oxidizing Properties**

No information available

**9.2. Other information**

VOC Content (%)

No data available

## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

### 10.2. Chemical Stability

Stable

### 10.3. Possibility of Hazardous Reactions

Will Not Occur

### 10.4. Conditions to Avoid

None anticipated

### 10.5. Incompatible Materials

Hydrofluoric acid.

### 10.6. Hazardous Decomposition Products

Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).

## 11. Toxicological Information

### Information on routes of exposure

**Principle Route of Exposure** Eye or skin contact, inhalation.

### Symptoms related to exposure

#### Most Important Symptoms/Effects

Causes eye irritation Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease. Potential reproductive hazard. May cause birth defects. Prolonged or repeated exposure may cause damage to organs.

### Numerical measures of toxicity

#### Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Borate Salts	Proprietary	3493-6080 mg/kg (Rat) (similar substance) 3450 mg/kg (Male Rat) (similar substance)	> 2000 mg/kg (Rabbit) (similar substance)	> 2 mg/L (Rat) 4h (similar substance) > 2.12 mg/L (Rat) 4h (similar substance) > 2.04 mg/L (Rat) 4h (similar substance)
Crystalline silica, quartz	14808-60-7	>15,000 mg/kg (Human)	No data available	No data available

### Immediate, delayed and chronic health effects from exposure

#### Inhalation

Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).

Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).

May cause respiratory irritation.

Causes eye irritation.

#### Eye Contact

#### Skin Contact

#### Ingestion

May cause mild skin irritation.

May cause abdominal pain, vomiting, nausea, and diarrhea.

#### Chronic Effects/Carcinogenicity

**Silicosis:** Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.



Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

Prolonged or repeated exposure may cause reproductive system damage.

#### Exposure Levels

No data available

#### Interactive effects

Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.

#### Data limitations

No data available

Substances	CAS Number	Skin corrosion/irritation
Borate Salts		Non-irritating to the skin (Rabbit) (similar substances)
Crystalline silica, quartz	14808-60-7	Non-irritating to the skin

Substances	CAS Number	Eye damage/irritation
Borate Salts		Causes moderate eye irritation. (Rabbit) (similar substances)
Crystalline silica, quartz	14808-60-7	Mechanical irritation of the eyes is possible.

Substances	CAS Number	Skin Sensitization
Borate Salts		Did not cause sensitization on laboratory animals (guinea pig) (similar substances)
Crystalline silica, quartz	14808-60-7	No information available.

Substances	CAS Number	Respiratory Sensitization
Borate Salts		No information available
Crystalline silica, quartz	14808-60-7	No information available

Substances	CAS Number	Mutagenic Effects
Borate Salts		In vitro tests did not show mutagenic effects (similar substances)
Crystalline silica, quartz	14808-60-7	Not regarded as mutagenic.

Substances	CAS Number	Carcinogenic Effects
Borate Salts		Did not show carcinogenic effects in animal experiments (similar substances)
Crystalline silica, quartz	14808-60-7	Contains crystalline silica which may cause silicosis, a delayed and progressive lung disease. The IARC and NTP have determined there is sufficient evidence in humans of the carcinogenicity of crystalline silica with repeated respiratory exposure. Based on available scientific evidence, this substance is a threshold carcinogen with a mode of action involving indirect genotoxicity secondary to lung injury.

Substances	CAS Number	Reproductive toxicity
Borate Salts		Experiments have shown reproductive toxicity effects on laboratory animals (similar substances)
Crystalline silica, quartz	14808-60-7	No information available

Substances	CAS Number	STOT - single exposure
Borate Salts		None under normal use conditions
Crystalline silica, quartz	14808-60-7	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	STOT - repeated exposure
Borate Salts		None under normal use conditions
Crystalline silica, quartz	14808-60-7	Causes damage to organs through prolonged or repeated exposure if inhaled: (Lungs)

Substances	CAS Number	Aspiration hazard
Borate Salts		Not applicable
Crystalline silica, quartz	14808-60-7	Not applicable

## 12. Ecological Information

### Ecotoxicity

#### Product Ecotoxicity Data

No data available

#### Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Borate Salts	Proprietary	EC50 (72h) 1398.64 mg/L (Skeletonema costatum)	LC50 (96h) > 320 mg/L (Scophthalmus maximus) LC50 (96h) > 1100 mg/L (Oncorhynchus mykiss) LC50 (96h) > 1021 mg/L (Lepomis macrochirus) LD50 (28d) 65 mg/L (Oncorhynchus mykiss)	No information available	EC50 (48h) 7341.67 mg/L (Acartia tonsa) EC50 (48h) 133 mg/L (Daphnia magna)
Crystalline silica, quartz	14808-60-7	No information available	LL0 (96h) 10,000 mg/L (Danio rerio) (similar substance)	No information available	LL50 (24h) > 10,000 mg/L (Daphnia magna) (similar substance)

### 12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Borate Salts	Proprietary	The methods for determining biodegradability are not applicable to inorganic substances.
Crystalline silica, quartz	14808-60-7	No information available

### 12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Borate Salts	Proprietary	0.175
Crystalline silica, quartz	14808-60-7	No information available

### 12.4. Mobility in soil

Substances	CAS Number	Mobility
Borate Salts	Proprietary	No information available
Crystalline silica, quartz	14808-60-7	No information available

### 12.6. Other adverse effects

#### Endocrine Disruptor Information

This product does not contain any known or suspected endocrine disruptors

## 13. Disposal Considerations

### Safe handling and disposal methods

Disposal should be made in accordance with federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

**14. Transport Information****Transportation Information**

**UN Number:** Not restricted  
**UN Proper Shipping Name:** Not restricted  
**Transport Hazard Class(es):** Not applicable  
**Packing Group:** Not applicable  
**Environmental Hazards:** Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

**15. Regulatory Information****Safety, health and environmental regulations specific for the product****International Inventories**

**Australian AICS Inventory** All components listed on inventory or are exempt.  
**New Zealand Inventory of Chemicals** Product contains one or more components not listed on inventory.  
**EINECS Inventory** This product, and all its components, complies with EINECS  
**US TSCA Inventory** All components listed on inventory or are exempt.  
**Canadian DSL Inventory** All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

**16. Other information****Date of preparation or review**

**Revision Date:** 03-Apr-2015

**Revision Note** Revision Note  
SDS sections updated: 2

**Full text of R-phrases referred to under Sections 2 and 3**

R36 - Irritating to eyes  
R49 May cause cancer by inhalation.  
R48/20 Harmful: danger of serious damage to health by prolonged exposure through inhalation.  
R62 Possible risk of impaired fertility.

**Full text of H-Statements referred to under sections 2 and 3**

H319 - Causes serious eye irritation  
H350i - May cause cancer by inhalation  
H360 - May damage fertility or the unborn child  
H372 - Causes damage to organs through prolonged or repeated exposure if inhaled  
H373 - May cause damage to organs through prolonged or repeated exposure if inhaled

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight CAS – Chemical Abstracts Service EC50 – Effective Concentration 50% LC50 – Lethal Concentration 50% LD50 – Lethal Dose 50% LL50 – Lethal Loading 50% mg/kg – milligram/kilogram mg/L – milligram/liter NOEC – No Observed Effect Concentration OEL – Occupational Exposure Limit PBT – Persistent Bioaccumulative and Toxic ppm – parts per million STEL – Short Term Exposure Limit TWA – Time-Weighted Average vPvB – very Persistent and very Bioaccumulative h - hour mg/m<sup>3</sup> - milligram/cubic meter mm - millimeter mmHg - millimeter mercury w/w - weight/weight d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

NZ CCID

OSHA

ECHA C&L

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**End of Safety Data Sheet**

## SAFETY DATA SHEET

### Clayfix II Plus

Revision Date: 26-Oct-2017

Revision Number: 2

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** Clayfix II Plus

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM006534

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Clay Control  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road, Jandakot, WA 6164  
Australia  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-mail Address** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951  
Global Incident Response Access Code: 334305  
Contract Number: 14012

##### Australian Poisons Information Centre

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Acute Oral Toxicity	Category 3 - H301
Acute toxicity - Dermal	Category 3 - H311
Skin Corrosion/Irritation	Category 2 - H315
Acute Aquatic Toxicity	Category 2 - H401
Chronic Aquatic Toxicity	Category 1 - H410

##### Label elements, including precautionary statements

##### **Hazard Pictograms**

**Signal Word**

DANGER

**Hazard Statements:**

H301 - Toxic if swallowed  
 H311 - Toxic in contact with skin  
 H315 - Causes skin irritation  
 H401 - Toxic to aquatic life  
 H410 - Very toxic to aquatic life with long lasting effects

**Precautionary Statements****Prevention**

P264 - Wash face, hands and any exposed skin thoroughly after handling  
 P270 - Do not eat, drink or smoke when using this product  
 P273 - Avoid release to the environment

**Response**

P280 - Wear protective gloves/eye protection/face protection  
 P301 + P310 - IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician  
 P330 - Rinse mouth  
 P302 + P352 - IF ON SKIN: Wash with plenty of water.  
 P312 - Call a POISON CENTER/doctor/physician if you feel unwell  
 P361 - Take off immediately all contaminated clothing.

**Storage**

P391 - Collect spillage

**Disposal**

P405 - Store locked up  
 P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Contains****Substances**

Tetramethyl ammonium chloride

**CAS Number**

75-57-0

**Other hazards which do not result in classification**

None known

For the full text of the H-phrases mentioned in this Section, see Section 16

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Tetramethyl ammonium chloride	75-57-0	60 - 100%	Acute Tox. 2 (H300) Acute Tox. 3 (H311) Skin Irrit. 2 (H315) Aquatic Acute 2 (H401) Aquatic Chronic 1 (H410)

### 4. First aid measures

**Description of necessary first aid measures****Inhalation**

If inhaled, move victim to fresh air and seek medical attention.

**Eyes**

Immediately flush eyes with large amounts of water for at least 15 minutes. Get immediate medical attention.

**Skin**

In case of contact, immediately flush skin with plenty of soap and water for at least

**Ingestion** 15 minutes. Get medical attention.  
Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

**Symptoms caused by exposure**

Causes skin irritation. Toxic if swallowed. Toxic in contact with skin.

**Medical Attention and Special Treatment**

**Notes to Physician** Treat symptomatically

## 5. Fire Fighting Measures

**Suitable extinguishing equipment**

**Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical**

**Special exposure hazards in a fire**

Decomposition in fire may produce harmful gases. Use water spray to cool fire exposed surfaces.

**Special protective equipment and precautions for fire fighters**

**Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## 6. Accidental release measures

**6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment.

**6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas.

**6.3. Methods and material for containment and cleaning up**

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

## 7. Handling and storage

**7.1. Precautions for safe handling**

**Handling Precautions**

Wash hands after use. Launder contaminated clothing before reuse. Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Do NOT consume food, drink, or tobacco in contaminated areas.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities**

**Storage Information**

Store away from oxidizers. Store in a cool well ventilated area. Keep container closed when not in use. Store locked up. Product has a shelf life of 24 months.

**Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

**Control parameters - exposure standards, biological monitoring**

**Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA

Tetramethyl ammonium chloride	75-57-0	Not applicable	Not applicable
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**Appropriate engineering controls**

**Engineering Controls** Use in a well ventilated area.

**Personal protective equipment (PPE)**

<b>Personal Protective Equipment</b>	If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.
<b>Respiratory Protection</b>	If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Organic vapor/acid gas respirator with a dust/mist filter.
<b>Hand Protection</b>	Impervious rubber gloves.
<b>Skin Protection</b>	Rubber apron.
<b>Eye Protection</b>	Chemical goggles; also wear a face shield if splashing hazard exists.
<b>Other Precautions</b>	None known.
<b>Environmental Exposure Controls</b>	No information available

## 9. Physical and Chemical Properties

**9.1. Information on basic physical and chemical properties**

<b>Physical State:</b> Liquid	<b>Color</b> Colorless
<b>Odor:</b> Mild amine	<b>Odor Threshold:</b> No information available

Property

Remarks/ - Method

Values

<b>pH:</b>	4- 9
<b>Freezing Point / Range</b>	No data available
<b>Melting Point / Range</b>	100 °C / 212 °F
<b>Boiling Point / Range</b>	> 93 °C / > 200 °F PMCC
<b>Flash Point</b>	No data available
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	1.035
<b>Water Solubility</b>	Soluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

**9.2. Other information**

<b>VOC Content (%)</b>	No data available
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## 10. Stability and Reactivity

**10.1. Reactivity**

Not expected to be reactive.

**10.2. Chemical stability**

Stable

**10.3. Possibility of hazardous reactions**

Will Not Occur

**10.4. Conditions to avoid**

None anticipated



**10.5. Incompatible materials**

Strong oxidizers.

**10.6. Hazardous decomposition products**

Chlorine. Hydrogen chloride. Oxides of nitrogen. Carbon monoxide and carbon dioxide.

<b>11. Toxicological Information</b>
--------------------------------------

**Information on routes of exposure****Principle Route of Exposure** Eye or skin contact, inhalation. Ingestion.**Symptoms related to exposure****Most Important Symptoms/Effects**

Causes skin irritation. Toxic if swallowed. Toxic in contact with skin.

**Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Tetramethyl ammonium chloride	75-57-0	47 mg/kg (Rat)	200 mg/kg - 500 mg/kg (rat)	No data available

**Immediate, delayed and chronic health effects from exposure**

<b>Inhalation</b>	May cause respiratory irritation.
<b>Eye Contact</b>	Non-irritating to rabbit's eye
<b>Skin Contact</b>	Toxic in contact with skin. Causes skin irritation.
<b>Ingestion</b>	Toxic if swallowed.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

**Exposure Levels**

No data available

**Interactive effects**

Eye ailments. Skin disorders.

**Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Tetramethyl ammonium chloride	75-57-0	Causes moderate skin irritation.

Substances	CAS Number	Serious eye damage/irritation
Tetramethyl ammonium chloride	75-57-0	Non-irritating to rabbit's eye

Substances	CAS Number	Skin Sensitization
Tetramethyl ammonium chloride	75-57-0	Did not cause sensitization on laboratory animals (mouse)

Substances	CAS Number	Respiratory Sensitization
Tetramethyl ammonium chloride	75-57-0	No information available

Substances	CAS Number	Mutagenic Effects
Tetramethyl ammonium chloride	75-57-0	In vitro tests did not show mutagenic effects. (similar substances)

Substances	CAS Number	Carcinogenic Effects
Tetramethyl ammonium chloride	75-57-0	No information available

Substances	CAS Number	Reproductive toxicity
Tetramethyl ammonium chloride	75-57-0	Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments. (similar substances)
Substances	CAS Number	STOT - single exposure
Tetramethyl ammonium chloride	75-57-0	No significant toxicity observed in animal studies at concentration requiring classification.
Substances	CAS Number	STOT - repeated exposure
Tetramethyl ammonium chloride	75-57-0	No data of sufficient quality are available.
Substances	CAS Number	Aspiration hazard
Tetramethyl ammonium chloride	75-57-0	Not applicable

## 12. Ecological Information

### Ecotoxicity

#### Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Tetramethyl ammonium chloride	75-57-0	No information available	LC50 (96h) 462 mg/L (Pimephales promelas)	No information available	LC50 (48h) 1.86 mg/L (Daphnia magna) NOEL (11d) 0.03 mg/L (Daphnia magna)

### 12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Tetramethyl ammonium chloride	75-57-0	No information available

### 12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Tetramethyl ammonium chloride	75-57-0	No information available

### 12.4. Mobility in soil

Substances	CAS Number	Mobility
Tetramethyl ammonium chloride	75-57-0	No information available

### 12.6. Other adverse effects

#### Endocrine Disruptor Information

This product does not contain any known or suspected endocrine disruptors

## 13. Disposal Considerations

### Safe handling and disposal methods

Disposal should be made in accordance with federal, state, and local regulations.

### Disposal of any contaminated packaging

Follow all applicable national or local regulations. Contaminated packaging may be disposed of by: rendering packaging incapable of containing any substance, or treating packaging to remove residual contents, or treating packaging to make sure the residual contents are no longer hazardous, or by disposing of packaging into commercial waste collection.

### Environmental regulations

Not applicable

## 14. Transport Information

### Transportation Information

#### Australia ADG

**UN Number** UN2810  
**UN proper shipping name:** Toxic Liquid, Organic, N.O.S. (Contains Tetramethylammonium Chloride)  
**Transport Hazard Class(es):** 6.1  
**Packing Group:** III  
**Environmental Hazards:** Marine Pollutant

#### IMDG/IMO

**UN Number** UN2810  
**UN proper shipping name:** Toxic Liquid, Organic, N.O.S. (Contains Tetramethylammonium Chloride)  
**Transport Hazard Class(es):** 6.1  
**Packing Group:** III  
**Environmental Hazards:** Marine Pollutant  
**EMS:** EmS F-A, S-A

#### IATA/ICAO

**UN Number** UN2810  
**UN proper shipping name:** Toxic Liquid, Organic, N.O.S. (Contains Tetramethylammonium Chloride)  
**Transport Hazard Class(es):** 6.1  
**Packing Group:** III  
**Environmental Hazards:** Marine Pollutant

#### Special precautions during transport

None

#### HazChem Code

2X

## 15. Regulatory Information

### Safety, health and environmental regulations specific for the product

#### International Inventories

##### **Australian AICS Inventory**

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

##### **New Zealand Inventory of Chemicals**

All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

##### **EINECS (European Inventory of Existing Chemical Substances)**

This product, and all its components, complies with EINECS

##### **US TSCA Inventory**

All components listed on inventory or are exempt.

##### **Canadian Domestic Substances List (DSL)**

All components listed on inventory or are exempt.

#### Poisons Schedule number

None Allocated

#### International Agreements

**Montreal Protocol - Ozone Depleting Substances:**

Does not apply

**Stockholm Convention - Persistent Organic Pollutants:**

Does not apply

**Rotterdam Convention - Prior Informed Consent:**

Does not apply

**Basel Convention - Hazardous Waste:**

Does not apply

## 16. Other information

### Date of preparation or review

Revision Date:

26-Oct-2017

**Revision Note****Full text of H-Statements referred to under sections 2 and 3**

H300 - Fatal if swallowed  
H301 - Toxic if swallowed  
H311 - Toxic in contact with skin  
H315 - Causes skin irritation  
H401 - Toxic to aquatic life  
H410 - Very toxic to aquatic life with long lasting effects

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight  
CAS – Chemical Abstracts Service  
EC50 – Effective Concentration 50%  
LC50 – Lethal Concentration 50%  
LD50 – Lethal Dose 50%  
LL50 – Lethal Loading 50%  
mg/kg – milligram/kilogram  
mg/L – milligram/liter  
NOEC – No Observed Effect Concentration  
OEL – Occupational Exposure Limit  
PBT – Persistent Bioaccumulative and Toxic  
ppm – parts per million  
STEL – Short Term Exposure Limit  
TWA – Time-Weighted Average  
vPvB – very Persistent and very Bioaccumulative  
h - hour  
mg/m<sup>3</sup> - milligram/cubic meter  
mm - millimeter  
mmHg - millimeter mercury  
w/w - weight/weight  
d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)  
NZ CCID

**Disclaimer Statement**

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**End of Safety Data Sheet**

## SAFETY DATA SHEET

### CLSAU352

Revision Date: 04-Mar-2015

Revision Number: 8

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** CLSAU352

##### Other means of Identification

**Synonyms:** None  
**Product Code:** HM007421

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Surfactant  
**Uses Advised Against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road  
Jandakot  
WA 6164  
Australia

ACN Number: 009 000 775  
Telephone Number: 61 (08) 9455 8300  
Fax Number: 61 (08) 9455 5300

**E-Mail address:** fdunexchem@halliburton.com

##### Emergency phone number

61 (08) 9455 8300

##### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Skin Corrosion / irritation	Category 2 - H315
Serious Eye Damage / Eye Irritation	Category 1 - H318

##### Label elements, including precautionary statements

##### **Hazard Pictograms**

**Signal Word**

Danger

**Hazard Statements**

H315 - Causes skin irritation

H318 - Causes serious eye damage

**Precautionary Statements****Prevention**

P264 - Wash face, hands and any exposed skin thoroughly after handling

P280 - Wear protective gloves/eye protection/face protection

**Response**

P302 + P352 - IF ON SKIN: Wash with plenty of soap and water

P332 + P313 - If skin irritation occurs: Get medical advice/attention

P362 - Take off contaminated clothing and wash before reuse

P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes.

Remove contact lenses, if present and easy to do. Continue rinsing

P310 - Immediately call a POISON CENTER or doctor/physician

**Storage**

None

**Disposal**

None

**Contains****Substances**

Sodium lauryl sulfate

**CAS Number**

151-21-3

**Other hazards which do not result in classification**

None known

**Australia Classification***For the full text of the R/H-phrases mentioned in this Section, see Section 16***Classification**

Xi - Irritant.

**Risk Phrases**

R41 Risk of serious damage to eyes.

R38 Irritating to skin.

<b>3. Composition/information on Ingredients</b>			
<b>Substances</b>	<b>CAS Number</b>	<b>PERCENT (w/w)</b>	<b>GHS Classification - Australia</b>

Sodium lauryl sulfate	151-21-3	10 - 30%	Acute Tox. 4 (H302) Acute Tox. 4 (H312) Skin Irrit. 2 (H315) Eye Irrit. 1 (H318) STOT SE 3 (H335) Aquatic Acute 2 (H401) Aquatic Chronic 3 (H412)
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#### 4. First aid measures

##### Description of necessary first aid measures

<b>Inhalation</b>	If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
<b>Eyes</b>	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
<b>Skin</b>	Wash with soap and water. Get medical attention if irritation persists.
<b>Ingestion</b>	If swallowed, give at least 3-4 glasses of water, but do not induce vomiting. Do not give anything by mouth to an unconscious or convulsing person. Get medical attention.

##### Symptoms caused by exposure

May cause severe eye irritation. May cause skin irritation.

##### Medical Attention and Special Treatment

**Notes to Physician** Treat symptomatically

#### 5. Fire Fighting Measures

##### Suitable extinguishing equipment

##### Suitable Extinguishing Media

Water fog, carbon dioxide, foam, dry chemical.

##### Extinguishing media which must not be used for safety reasons

None known.

##### Specific hazards arising from the chemical

##### Special Exposure Hazards

Decomposition in fire may produce toxic gases.

##### Special protective equipment and precautions for fire fighters

##### Special Protective Equipment for Fire-Fighters

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

#### 6. Accidental release measures

##### 6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment.

##### 6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

##### 6.3. Methods and material for containment and cleaning up

Do NOT spread spilled product with water. Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

#### 7. Handling and storage

**7.1. Precautions for Safe Handling****Handling Precautions**

Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse. Avoid breathing mist. Avoid contact with eyes, skin, or clothing.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Store away from oxidizers. Keep from freezing. Keep container closed when not in use. Product has a shelf life of 24 months.

**Other Guidelines**

No information available

<b>8. Exposure Controls/Personal Protection</b>
---

**Control parameters - exposure standards, biological monitoring****Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Sodium lauryl sulfate	151-21-3	Not applicable	Not applicable

**Appropriate engineering controls****Engineering Controls**

Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.

**Personal protective equipment (PPE)****Respiratory Protection**

If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.

Dust/mist respirator. (N95, P2/P3)

**Hand Protection**

Chemical-resistant protective gloves (EN 374) Suitable materials for longer, direct contact (recommended: protection index 6, corresponding to > 480 minutes permeation time as per EN 374): Nitrile gloves. (>= 0.35 mm thickness)

This information is based on literature references and on information provided by glove manufacturers, or is derived by analogy with similar substances. Please note that in practice the working life of chemical-resistant protective gloves may be considerably shorter than the permeation time determined in accordance with EN 374 as a result of the many influencing factors (e.g. temperature). If signs of wear and tear are noticed then the gloves should be replaced. Manufacturer's directions for use should be observed because of great diversity of types.

**Skin Protection**

Wear impervious protective clothing, including boots, gloves, lab coat, apron, rain jacket, pants or coverall, as appropriate, to prevent skin contact.

**Eye Protection**

Chemical goggles; also wear a face shield if splashing hazard exists.

**Other Precautions**

Eyewash fountains and safety showers must be easily accessible.

**Environmental Exposure Controls**

No information available

<b>9. Physical and Chemical Properties</b>
--

**9.1. Information on basic physical and chemical properties**

**Physical State:** Liquid

**Color:** Off white

**Odor:** Odorless

**Odor Threshold:** No information available

Property

Values

Remarks/ - Method

**pH:**

No data available

**Freezing Point/Range**

No data available

**Melting Point/Range**

No data available

**Boiling Point/Range**

100 °C / 212 °F

**Flash Point**

No data available



Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	0.98
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

**9.2. Other information**

VOC Content (%) No data available

## 10. Stability and Reactivity

**10.1. Reactivity**

Not applicable

**10.2. Chemical Stability**

Stable

**10.3. Possibility of Hazardous Reactions**

Will Not Occur

**10.4. Conditions to Avoid**

None anticipated

**10.5. Incompatible Materials**

Strong oxidizers.

**10.6. Hazardous Decomposition Products**

Oxides of sulfur. Sodium oxides. Carbon monoxide and carbon dioxide.

## 11. Toxicological Information

**Information on routes of exposure**

**Principle Route of Exposure** Eye or skin contact, inhalation.

**Symptoms related to exposure****Most Important Symptoms/Effects**

May cause severe eye irritation. May cause skin irritation.

**Numerical measures of toxicity****Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Sodium lauryl sulfate	151-21-3	1288 mg/kg (Rat) 1200 mg/kg (Rat)	> 2000 mg/kg (Rabbit) (similar substance)	3900 mg/m <sup>3</sup> ( Rat ) 1 h

**Immediate, delayed and chronic health effects from exposure****Inhalation**

May cause respiratory irritation. May cause allergic respiratory reaction.

**Eye Contact**

May cause severe eye irritation.

**Skin Contact**

May cause an allergic skin reaction. Prolonged or repeated contact may cause skin irritation.

**Ingestion**

Irritation of the mouth, throat, and stomach.

**Exposure Levels**

No data available

**Interactive effects**

Eye ailments. Skin disorders. Respiratory disorders.

**Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Sodium lauryl sulfate	151-21-3	Irritating to skin. (rabbit)

Substances	CAS Number	Eye damage/irritation
Sodium lauryl sulfate	151-21-3	Causes severe eye irritation. (rabbit)

Substances	CAS Number	Skin Sensitization
Sodium lauryl sulfate	151-21-3	Did not cause sensitization on laboratory animals (guinea pig) (similar substances)

Substances	CAS Number	Respiratory Sensitization
Sodium lauryl sulfate	151-21-3	No information available

Substances	CAS Number	Mutagenic Effects
Sodium lauryl sulfate	151-21-3	In vitro tests did not show mutagenic effects In vivo tests did not show mutagenic effects. (similar substances)

Substances	CAS Number	Carcinogenic Effects
Sodium lauryl sulfate	151-21-3	Did not show carcinogenic effects in animal experiments (similar substances)

Substances	CAS Number	Reproductive toxicity
Sodium lauryl sulfate	151-21-3	No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)

Substances	CAS Number	STOT - single exposure
Sodium lauryl sulfate	151-21-3	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	STOT - repeated exposure
Sodium lauryl sulfate	151-21-3	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	Aspiration hazard
Sodium lauryl sulfate	151-21-3	Not applicable

## 12. Ecological Information

**Ecotoxicity****Product Ecotoxicity Data**

No data available

**Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Sodium lauryl sulfate	151-21-3	EC50(72h): > 120 mg/L (growth rate) (Desmodesmus subspicatus)	LC50(96h): 29 mg/L (Pimephales promelas) LC50(96h): 4.5 mg/L (Lepomis macrochirus) NOEC(28d): < 3.8 mg/L (Pimephales promelas)	EC50(3h): 135 mg/L (activated sludge)	LC50(48h): 5.55 mg/L (Ceriodaphnia dubia) NOEC(7d): 0.88 mg/L (Ceriodaphnia dubia)

**12.2. Persistence and degradability**

Substances	CAS Number	Persistence and Degradability
Sodium lauryl sulfate	151-21-3	Readily biodegradable (95% @ 28d)

**12.3. Bioaccumulative potential**

Substances	CAS Number	Log Pow
Sodium lauryl sulfate	151-21-3	<= -2.03

**12.4. Mobility in soil**

No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

**13. Disposal Considerations****Safe handling and disposal methods**

Disposal should be made in accordance with federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

**14. Transport Information****Transportation Information**

<b>UN Number:</b>	Not restricted
<b>UN Proper Shipping Name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

**15. Regulatory Information****Safety, health and environmental regulations specific for the product****International Inventories**

<b>Australian AICS Inventory</b>	All components listed on inventory or are exempt.
<b>New Zealand Inventory of Chemicals</b>	All components listed on inventory or are exempt.
<b>EINECS Inventory</b>	This product, and all its components, complies with EINECS
<b>US TSCA Inventory</b>	All components listed on inventory or are exempt.
<b>Canadian DSL Inventory</b>	All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

**16. Other information****Date of preparation or review**

**Revision Date:** 04-Mar-2015

**Revision Note**

SDS sections updated SECTION: 2

**Full text of R-phrases referred to under Sections 2 and 3**

R22 Harmful if swallowed.

R38 Irritating to skin.

R41 Risk of serious damage to eyes.

R52/53 Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

**Full text of H-Statements referred to under sections 2 and 3**

H302 - Harmful if swallowed

H315 - Causes skin irritation

H318 - Causes serious eye damage

H412 - Harmful to aquatic life with long lasting effects

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

Not applicable

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

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**End of Safety Data Sheet**

## SAFETY DATA SHEET

### D-AIR 3000L

Revision Date: 17-Feb-2015

Revision Number: 16

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of NOHSC, Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** D-AIR 3000L

##### Other means of Identification

**Synonyms:** None  
**Product Code:** HM003191

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Defoamer  
**Uses Advised Against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road  
Jandakot  
WA 6164  
Australia

ACN Number: 009 000 775  
Telephone Number: 61 (08) 9455 8300  
Fax Number: 61 (08) 9455 5300

**E-Mail address:** fdunexchem@halliburton.com

##### Emergency phone number

61 (08) 9455 8300

##### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of NOHSC, Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Not classified

##### Label elements, including precautionary statements

##### **Hazard Pictograms**

**Signal Word**

Not Hazardous

**Hazard Statements**

Not Classified

**Precautionary Statements****Prevention** None**Response** None**Storage** None**Disposal** None**Contains****Substances**

Alkenes

**CAS Number**

Proprietary

**Other hazards which do not result in classification**

None known

**Australia Classification***For the full text of the R/H-phrases mentioned in this Section, see Section 16***Classification**

Not Classified

**Risk Phrases**

None

**3. Composition/information on Ingredients**

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Alkenes	Proprietary	60 - 100%	

**4. First aid measures****Description of necessary first aid measures****Inhalation**

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

**Eyes**

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

**Skin**

Wash with soap and water. Get medical attention if irritation persists.

**Ingestion**

Get medical attention! If vomiting occurs, keep head lower than hips to prevent aspiration.

**Symptoms caused by exposure**

May cause lung damage if swallowed.

**Medical Attention and Special Treatment****Notes to Physician**

Treat symptomatically

**5. Fire Fighting Measures****Suitable extinguishing equipment**

**Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical****Special Exposure Hazards**

Decomposition in fire may produce toxic gases.

**Special protective equipment and precautions for fire fighters****Special Protective Equipment for Fire-Fighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

<b>6. Accidental release measures</b>
---------------------------------------

**6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment.

**6.2. Environmental precautions**

None known.

**6.3. Methods and material for containment and cleaning up**

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

<b>7. Handling and storage</b>
--------------------------------

**7.1. Precautions for Safe Handling****Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid breathing vapors.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Store away from oxidizers. Keep container closed when not in use. Product has a shelf life of 24 months.

**Other Guidelines**

No information available

<b>8. Exposure Controls/Personal Protection</b>
---

**Control parameters - exposure standards, biological monitoring****Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Alkenes	Proprietary	Not applicable	Not applicable

**Appropriate engineering controls****Engineering Controls**

Use in a well ventilated area.

**Personal protective equipment (PPE)****Respiratory Protection**

Not normally necessary.

**Hand Protection**

None known.

**Skin Protection**

Normal work coveralls.

**Eye Protection**

Wear safety glasses or goggles to protect against exposure.

**Other Precautions**

None known.

**Environmental Exposure Controls**

No information available

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

**Physical State:** Liquid      **Color:** Opaque  
**Odor:** Hydrocarbon      **Odor Threshold:** No information available

<u>Property</u>	<u>Values</u>
Remarks/ - Method	
<b>pH:</b>	5.5-7.9
<b>Freezing Point/Range</b>	No data available
<b>Melting Point/Range</b>	No data available
<b>Boiling Point/Range</b>	No data available
<b>Flash Point</b>	> 121 °C PMCC
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	0.92
<b>Water Solubility</b>	Insoluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

### 9.2. Other information

**VOC Content (%)** No data available

## 10. Stability and Reactivity

### 10.1. Reactivity

Not applicable

### 10.2. Chemical Stability

Stable

### 10.3. Possibility of Hazardous Reactions

Will Not Occur

### 10.4. Conditions to Avoid

None anticipated

### 10.5. Incompatible Materials

Strong oxidizers.

### 10.6. Hazardous Decomposition Products

Carbon monoxide and carbon dioxide.

## 11. Toxicological Information

### Information on routes of exposure

**Principle Route of Exposure** Eye or skin contact, inhalation.

### Symptoms related to exposure

#### Most Important Symptoms/Effects

May cause lung damage if swallowed.

### Numerical measures of toxicity

### Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Alkenes	Proprietary	> 5000 mg/kg (Rat) (similar substance)	> 2000 mg/kg (Rat) (similar substance)	> 2.1 mg/L (Rat)



**Immediate, delayed and chronic health effects from exposure**

<b>Inhalation</b>	May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.
<b>Eye Contact</b>	May cause mild eye irritation.
<b>Skin Contact</b>	May cause mild skin irritation.
<b>Ingestion</b>	May cause abdominal pain, vomiting, nausea, and diarrhea. Aspiration into the lungs may cause chemical pneumonitis including coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 1% are chronic health hazards.

**Exposure Levels**

No data available

**Interactive effects**

None known.

**Data limitations**

No data available

## 12. Ecological Information

**Ecotoxicity****Product Ecotoxicity Data**

No data available

**Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Alkenes	Proprietary	EC50(72h): > 1000 mg/L (Selenastrum capicomutum) (similar substance)	LL50(96h): > 1000 mg/L (Oncorhynchus mykiss) (similar substance) LL50(96h): > 10000 mg/L (Scophthalmus maximus) (similar substance)	No information available	EC50(48h): > 1000 mg/L (Daphnia magna) (similar substance)

**12.2. Persistence and degradability**

Substances	CAS Number	Persistence and Degradability
Alkenes	Proprietary	Readily biodegradable (77 - 81% @ 28d)

**12.3. Bioaccumulative potential**

Substances	CAS Number	Log Pow
Alkenes	Proprietary	> 7

**12.4. Mobility in soil**

No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

**13. Disposal Considerations****Safe handling and disposal methods**

Disposal should be made in accordance with federal, state, and local regulations. Incineration recommended in approved incinerator according to federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

**14. Transport Information****Transportation Information**

<b>UN Number:</b>	Not restricted
<b>UN Proper Shipping Name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

**15. Regulatory Information****Safety, health and environmental regulations specific for the product****International Inventories**

<b>Australian AICS Inventory</b>	All components listed on inventory or are exempt.
<b>New Zealand Inventory of Chemicals</b>	All components listed on inventory or are exempt.
<b>EINECS Inventory</b>	This product, and all its components, complies with EINECS
<b>US TSCA Inventory</b>	All components listed on inventory or are exempt.
<b>Canadian DSL Inventory</b>	All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

**16. Other information****Date of preparation or review**

Revision Date: 17-Feb-2015

**Revision Note**

Update to Format SECTION: 2

**Full text of R-phrases referred to under Sections 2 and 3**

None

**Full text of H-Statements referred to under sections 2 and 3**

None

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

Not applicable

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

NZ CCID

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**End of Safety Data Sheet**

## SAFETY DATA SHEET

### DCA-11001

Revision Date: 23-Jan-2017

Revision Number: 19

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** DCA-11001

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM007644

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Additive  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Multi-Chem Mintech  
1 Ward Road  
East Rockingham  
WA 6168  
Australia  
  
Telephone Number: 61 (08) 9419 5300  
Fax Number: 61 (08) 9439 1055  
Emergency Telephone Number: + 61 1 800 686 951  
fdunexchem@halliburton.com

##### E-mail Address

##### Emergency phone number

+ 61 1 800 686 951  
Global Incident Response Access Code: 334305  
Contract Number: 14012

##### Australian Poisons Information Centre

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Skin Corrosion/Irritation	Category 2 - H315
Serious Eye Damage/Irritation	Category 1 - H318
Specific Target Organ Toxicity - (Repeated Exposure)	Category 2 - H373
Acute Aquatic Toxicity	Category 3 - H402

##### Label elements, including precautionary statements

**Hazard Pictograms****Signal Word**

DANGER

**Hazard Statements:**

H315 - Causes skin irritation  
 H318 - Causes serious eye damage  
 H373 - May cause damage to organs through prolonged or repeated exposure  
 H402 - Harmful to aquatic life

**Precautionary Statements****Prevention**

P260 - Do not breathe dust/fume/gas/mist/vapors/spray  
 P264 - Wash face, hands and any exposed skin thoroughly after handling  
 P273 - Avoid release to the environment

**Response**

P280 - Wear protective gloves/eye protection/face protection  
 P302 + P352 - IF ON SKIN: Wash with plenty of soap and water  
 P332 + P313 - If skin irritation occurs: Get medical advice/attention  
 P362 + P364 - Take off contaminated clothing and wash before reuse  
 P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
 P310 - Immediately call a POISON CENTER or doctor/physician  
 P314 - Get medical attention/advice if you feel unwell

**Storage**

None

**Disposal**

P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Contains****Substances**

Diethanolamine

**CAS Number**

111-42-2

**Other hazards which do not result in classification**

This mixture contains no substance considered to be persistent, bioaccumulating nor toxic (PBT).  
 This mixture contains no substance considered to be very persistent nor very bioaccumulating (vPvB).

*For the full text of the H-phrases mentioned in this Section, see Section 16*

<b>3. Composition/information on Ingredients</b>
--

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Diethanolamine	111-42-2	10 - 30%	Acute Tox. 4 (H302) Skin Irrit. 2 (H315) Eye Corr. 1 (H318) STOT RE 2 (H373) Aquatic Acute 2 (H401) Aquatic Chronic 3 (H412)

<b>4. First aid measures</b>
------------------------------

**Description of necessary first aid measures**

<b>Inhalation</b>	If inhaled, move victim to fresh air and seek medical attention.
<b>Eyes</b>	In case of contact, immediately flush eyes with plenty of water for at least 30 minutes. Remove contact lenses after the first 5 minutes and continue washing. Seek immediate medical attention/advice. Suitable emergency eye wash facility should be immediately available
<b>Skin</b>	Remove contaminated clothing and launder before reuse. In case of contact, immediately flush skin with plenty of soap and water for at least 30 minutes and remove contaminated clothing, shoes and leather goods immediately. Get medical attention immediately.
<b>Ingestion</b>	Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

**Symptoms caused by exposure**

Causes severe eye irritation which may damage tissue. Causes skin irritation. Prolonged or repeated exposure may cause damage to organs.

**Medical Attention and Special Treatment**

**Notes to Physician** Treat symptomatically

## 5. Fire Fighting Measures

**Suitable extinguishing equipment****Suitable Extinguishing Media**

Carbon dioxide, dry chemical, foam.

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical****Special exposure hazards in a fire**

Decomposition in fire may produce harmful gases.

**Special protective equipment and precautions for fire fighters****Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## 6. Accidental release measures

**6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment. Avoid contact with skin, eyes and clothing. Avoid breathing vapors. Ensure adequate ventilation. Evacuate all persons from the area.

**6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas. Consult local authorities.

**6.3. Methods and material for containment and cleaning up**

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

## 7. Handling and storage

**7.1. Precautions for safe handling****Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse. Ensure adequate ventilation. Use appropriate protective equipment.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Store away from oxidizers. Store in a cool well ventilated area. Keep container closed when not in use. Product has a shelf life of

12 months.

**Other Guidelines**

No information available

<b>8. Exposure Controls/Personal Protection</b>
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**Control parameters - exposure standards, biological monitoring****Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Diethanolamine	111-42-2	TWA: 3 ppm TWA: 13 mg/m <sup>3</sup>	TWA: 1 mg/m <sup>3</sup>

**Appropriate engineering controls****Engineering Controls**

Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.

**Personal protective equipment (PPE)****Personal Protective Equipment**

If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

**Respiratory Protection**

Wear a NIOSH certified, European Standard EN 149 (FFP2/FFP3), AS/NZS 1715, or equivalent respirator when using this product.

**Hand Protection**

Chemical-resistant protective gloves (EN 374) Suitable materials for longer, direct contact (recommended: protection index 6, corresponding to > 480 minutes permeation time as per EN 374): Butyl rubber gloves. (>= 0.7 mm thickness)  
This information is based on literature references and on information provided by glove manufacturers, or is derived by analogy with similar substances. Please note that in practice the working life of chemical-resistant protective gloves may be considerably shorter than the permeation time determined in accordance with EN 374 as a result of the many influencing factors (e.g. temperature). If signs of wear and tear are noticed then the gloves should be replaced. Manufacturer's directions for use should be observed because of great diversity of types.

**Skin Protection**

Rubber apron.

**Eye Protection**

Chemical goggles; also wear a face shield if splashing hazard exists.

**Other Precautions**

Eyewash fountains and safety showers must be easily accessible.

**Environmental Exposure Controls**

Do not allow material to contaminate ground water system

<b>9. Physical and Chemical Properties</b>
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**9.1. Information on basic physical and chemical properties****Physical State:** Liquid**Color:** Water white**Odor:** Characteristic**Odor Threshold:** No information availablePropertyValuesRemarks/ - Method**pH:**

10.5

**Freezing Point / Range**

16 °C

**Melting Point / Range**

No data available

**Boiling Point / Range**

250 °C / 482 °F

**Flash Point**

194 °C / 382 °F PMCC

**Upper flammability limit**

8.5

**Lower flammability limit**

1.3

**Evaporation rate**

No data available

**Vapor Pressure**

0.01 mmHg

**Vapor Density**

No data available

**Specific Gravity**

1.11

**Water Solubility**

Soluble in water

**Solubility in other solvents**

No data available

**Partition coefficient: n-octanol/water**

No data available

<b>Autoignition Temperature</b>	315 °C / 600 °F
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

**9.2. Other information**

**VOC Content (%)** No data available

## 10. Stability and Reactivity

**10.1. Reactivity**

Not expected to be reactive.

**10.2. Chemical stability**

Stable

**10.3. Possibility of hazardous reactions**

Will Not Occur

**10.4. Conditions to avoid**

None anticipated

**10.5. Incompatible materials**

Strong oxidizers. Violent, explosive reaction with sulfur trioxide, decaborane, silver perchlorate, triethenyl aluminum, and hydrogen in presence of nickel catalyst at temperatures above 200 C.

**10.6. Hazardous decomposition products**

Oxides of nitrogen. Carbon monoxide and carbon dioxide.

## 11. Toxicological Information

**Information on routes of exposure**

**Principle Route of Exposure** Eye or skin contact, inhalation.

**Symptoms related to exposure****Most Important Symptoms/Effects**

Causes severe eye irritation which may damage tissue. Causes skin irritation. Prolonged or repeated exposure may cause damage to organs.

**Numerical measures of toxicity****Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Diethanolamine	111-42-2	620 µL/kg (Rat) 1600 mg/kg (Rat)	7640 µL/kg (Rabbit) 13,000 mg/kg (Rabbit)	3.35 mg/L (Rat)

**Immediate, delayed and chronic health effects from exposure****Inhalation**

May cause respiratory irritation.

**Eye Contact**

Causes severe eye irritation which may damage tissue.

**Skin Contact**

Causes skin irritation.

**Ingestion**

Irritation of the mouth, throat, and stomach.

**Chronic Effects/Carcinogenicity**

Repeated overexposure may cause liver and kidney effects. Amines may form nitrosamines, a suspect carcinogen, if product is mixed with nitrates, nitrites, nitrogen oxides or other nitrosamines.

**Exposure Levels**

No data available

**Interactive effects**

Skin disorders.

**Data limitations**

No data available



<b>Substances</b>	<b>CAS Number</b>	<b>Skin corrosion/irritation</b>
Diethanolamine	111-42-2	Causes moderate skin irritation. (Rabbit)
<b>Substances</b>	<b>CAS Number</b>	<b>Serious eye damage/irritation</b>
Diethanolamine	111-42-2	Causes severe eye irritation (Rabbit)
<b>Substances</b>	<b>CAS Number</b>	<b>Skin Sensitization</b>
Diethanolamine	111-42-2	Did not cause sensitization on laboratory animals (guinea pig)
<b>Substances</b>	<b>CAS Number</b>	<b>Respiratory Sensitization</b>
Diethanolamine	111-42-2	No information available
<b>Substances</b>	<b>CAS Number</b>	<b>Mutagenic Effects</b>
Diethanolamine	111-42-2	In vivo tests did not show mutagenic effects.
<b>Substances</b>	<b>CAS Number</b>	<b>Carcinogenic Effects</b>
Diethanolamine	111-42-2	No data of sufficient quality are available.
<b>Substances</b>	<b>CAS Number</b>	<b>Reproductive toxicity</b>
Diethanolamine	111-42-2	Animal testing did not show any effects on fertility. (similar substances) Did not show teratogenic effects in animal experiments.
<b>Substances</b>	<b>CAS Number</b>	<b>STOT - single exposure</b>
Diethanolamine	111-42-2	No information available
<b>Substances</b>	<b>CAS Number</b>	<b>STOT - repeated exposure</b>
Diethanolamine	111-42-2	Causes damage to organs through prolonged or repeated exposure if swallowed: (Liver) (Blood) (Kidney)
<b>Substances</b>	<b>CAS Number</b>	<b>Aspiration hazard</b>
Diethanolamine	111-42-2	Not applicable

## 12. Ecological Information

### Ecotoxicity

#### Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Diethanolamine	111-42-2	EC50 7.8 mg/L (Desmodesmus subspicatus) EC50 (96h) 2.2 mg/L (growth rate) (Selenastrum capricornutum)	LC50 4460-4980 mg/L (Pimephales promelas) LC50 (96h) 1460 mg/L (Pimephales promelas)	EC20 >1000 mg/L (respiration rate) (activated sludge) EC90 (30min) > 1000 mg/L (Activated sludge)	EC50 (48h) 30.1 mg/L (Ceriodaphnia dubia) EC50 (48h) 55 mg/L (Daphnia magna) NOEC (21d) 0.78 mg/L (Daphnia magna) (Reproduction)

### 12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Diethanolamine	111-42-2	Readily biodegradable (88 - 97% @ 28d)

### 12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Diethanolamine	111-42-2	-1.71

### 12.4. Mobility in soil

Substances	CAS Number	Mobility
Diethanolamine	111-42-2	No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

<b>13. Disposal Considerations</b>
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**Safe handling and disposal methods**

Disposal should be made in accordance with federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

<b>14. Transport Information</b>
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**Transportation Information****Australia ADG**

<b>UN Number</b>	Not restricted
<b>UN proper shipping name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**IMDG/IMO**

<b>UN Number</b>	Not restricted
<b>UN proper shipping name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**IATA/ICAO**

<b>UN Number</b>	Not restricted
<b>UN proper shipping name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

<b>15. Regulatory Information</b>
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**Safety, health and environmental regulations specific for the product****International Inventories**

<b>Australian AICS Inventory</b>	All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.
<b>New Zealand Inventory of Chemicals</b>	All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.
<b>EINECS (European Inventory of Existing Chemical Substances)</b>	This product, and all its components, complies with EINECS
<b>US TSCA Inventory</b>	All components listed on inventory or are exempt.
<b>Canadian Domestic Substances List (DSL)</b>	All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

**International Agreements**

<b>Montreal Protocol - Ozone Depleting Substances:</b>	Does not apply
<b>Stockholm Convention - Persistent Organic Pollutants:</b>	Does not apply
<b>Rotterdam Convention - Prior Informed Consent:</b>	Does not apply
<b>Basel Convention - Hazardous Waste:</b>	Does not apply

**16. Other information****Date of preparation or review****Revision Date:** 23-Jan-2017**Revision Note****Full text of H-Statements referred to under sections 2 and 3**

H302 - Harmful if swallowed  
 H315 - Causes skin irritation  
 H318 - Causes serious eye damage  
 H373 - May cause damage to organs through prolonged or repeated exposure if swallowed  
 H401 - Toxic to aquatic life  
 H402 - Harmful to aquatic life  
 H412 - Harmful to aquatic life with long lasting effects

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight  
 CAS – Chemical Abstracts Service  
 EC50 – Effective Concentration 50%  
 LC50 – Lethal Concentration 50%  
 LD50 – Lethal Dose 50%  
 LL50 – Lethal Loading 50%  
 mg/kg – milligram/kilogram  
 mg/L – milligram/liter  
 NOEC – No Observed Effect Concentration  
 OEL – Occupational Exposure Limit  
 PBT – Persistent Bioaccumulative and Toxic  
 ppm – parts per million  
 STEL – Short Term Exposure Limit  
 TWA – Time-Weighted Average  
 vPvB – very Persistent and very Bioaccumulative  
 h - hour  
 mg/m<sup>3</sup> - milligram/cubic meter  
 mm - millimeter  
 mmHg - millimeter mercury  
 w/w - weight/weight  
 d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

**Disclaimer Statement**

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all

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conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

**End of Safety Data Sheet**

## SAFETY DATA SHEET

### DCA-13002

Revision Date: 21-Sep-2017

Revision Number: 22

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature**      Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

**1.1. Product Identifier**

**Product Name**      DCA-13002

**Other means of Identification**

**Synonyms**      None  
**Hazardous Material Number:**      HM007647

**Recommended use of the chemical and restrictions on use**

**Recommended Use**      Breaker  
**Uses advised against**      No information available

**Supplier's name, address and phone number**

**Manufacturer/Supplier**      Halliburton Australia Pty. Ltd.  
 15 Marriott Road, Jandakot, WA 6164  
 Australia  
 ACN Number: 009 000 775  
 Telephone Number: + 61 1 800 686 951  
 Fax Number: 61 (08) 9455 5300  
**E-mail Address**      fdunexchem@halliburton.com

**Emergency phone number**

+ 61 1 800 686 951  
 Global Incident Response Access Code: 334305  
 Contract Number: 14012

**Australian Poisons Information Centre**

24 Hour Service:      - 13 11 26  
 Police or Fire Brigade: - 000 (exchange):      - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature**      Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

**Classification of the hazardous chemical**

Acute Oral Toxicity	Category 4 - H302
Skin Corrosion/Irritation	Category 2 - H315
Serious Eye Damage/Irritation	Category 2 - H319
Respiratory Sensitization	Category 1 - H334
Skin Sensitization	Category 1 - H317
Specific Target Organ Toxicity - (Single Exposure)	Category 3 - H335
Oxidizing solids.	Category 3 - H272

**Label elements, including precautionary statements**

**Hazard Pictograms****Signal Word**

DANGER

**Hazard Statements:**

H272 - May intensify fire; oxidizer  
 H302 - Harmful if swallowed  
 H315 - Causes skin irritation  
 H317 - May cause an allergic skin reaction  
 H319 - Causes serious eye irritation  
 H334 - May cause allergy or asthma symptoms or breathing difficulties if inhaled  
 H335 - May cause respiratory irritation

**Precautionary Statements****Prevention**

P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.  
 P221 - Take any precaution to avoid mixing with combustibles  
 P261 - Avoid breathing dust/fume/gas/mist/vapors/spray  
 P264 - Wash face, hands and any exposed skin thoroughly after handling  
 P270 - Do not eat, drink or smoke when using this product  
 P271 - Use only outdoors or in a well-ventilated area  
 P272 - Contaminated work clothing should not be allowed out of the workplace  
 P280 - Wear protective gloves/protective clothing/eye protection/face protection  
 P285 - In case of inadequate ventilation wear respiratory protection

**Response**

P301 + P312 - IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell  
 P330 - Rinse mouth  
 P302 + P352 - IF ON SKIN: Wash with plenty of water.  
 P332 + P313 - If skin irritation occurs: Get medical advice/attention  
 P333 + P313 - If skin irritation or rash occurs: Get medical advice/attention  
 P362 + P364 - Take off contaminated clothing and wash before reuse  
 P304 + P341 - IF INHALED: If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing  
 P342 + P311 - If experiencing respiratory symptoms: Call a POISON CENTER or doctor/physician  
 P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
 P337 + P313 - If eye irritation persists: Get medical advice/attention  
 P370 + P378 - In case of fire: Use water spray for extinction  
 P403 + P233 - Store in a well-ventilated place. Keep container tightly closed  
 P405 - Store locked up  
 P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Storage****Disposal****Contains****Substances**

Sodium persulfate

**CAS Number**

7775-27-1

**Other hazards which do not result in classification**

This substance is not considered to be persistent, bioaccumulating nor toxic (PBT).  
This substance is not considered to be very persistent nor very bioaccumulating (vPvB).

For the full text of the H-phrases mentioned in this Section, see Section 16

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Sodium persulfate	7775-27-1	60 - 100%	Acute Tox. 4 (H302) Skin Irrit. 2 (H315) Eye Irrit. 2 (H319) Resp. Sens. 1 (H334) Skin Sens. 1 (H317) STOT SE 3 (H335) Ox. Sol. 3 (H272)

### 4. First aid measures

**Description of necessary first aid measures**

<b>Inhalation</b>	If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
<b>Eyes</b>	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
<b>Skin</b>	Wash off immediately with soap and plenty of water for at least 15 minutes while removing all contaminated clothing and shoes.
<b>Ingestion</b>	Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

**Symptoms caused by exposure**

Causes eye irritation. Causes skin irritation. May cause allergic skin reaction. May cause allergic respiratory reaction. May cause respiratory irritation. Harmful if swallowed.

**Medical Attention and Special Treatment**

**Notes to Physician** Treat symptomatically

### 5. Fire Fighting Measures

**Suitable extinguishing equipment****Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical****Special exposure hazards in a fire**

Oxidizer. May ignite combustibles. Decomposition in fire may produce harmful gases.

**Special protective equipment and precautions for fire fighters****Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

### 6. Accidental release measures

**6.1. Personal precautions, protective equipment and emergency procedures**

Remove sources of ignition. Use appropriate protective equipment. Avoid creating and breathing dust. Avoid contact with skin, eyes and clothing. Ensure adequate ventilation. Evacuate all persons from the area.

### **6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas. Consult local authorities.

### **6.3. Methods and material for containment and cleaning up**

Scoop up and remove.

## 7. Handling and storage

### **7.1. Precautions for safe handling**

#### **Handling Precautions**

Remove sources of ignition. Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust. Avoid dust accumulations. Ensure adequate ventilation. Wash hands after use. Launder contaminated clothing before reuse. Use appropriate protective equipment.

#### **Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

### **7.2. Conditions for safe storage, including any incompatibilities**

#### **Storage Information**

Store away from combustibles. Store in a cool well ventilated area. Keep container closed when not in use. Product has a shelf life of 12 months.

#### **Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

### **Control parameters - exposure standards, biological monitoring**

#### **Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Sodium persulfate	7775-27-1	0.01 mg/m <sup>3</sup>	TWA: 0.1 mg/m <sup>3</sup>

### **Appropriate engineering controls**

#### **Engineering Controls**

Use in a well ventilated area. Localized ventilation should be used to control dust levels.

### **Personal protective equipment (PPE)**

#### **Personal Protective Equipment**

If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

#### **Respiratory Protection**

If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.  
Dust/mist respirator. (N95, P2/P3)

#### **Hand Protection**

Chemical-resistant protective gloves (EN 374) Suitable materials for longer, direct contact (recommended: protection index 6, corresponding to > 480 minutes permeation time as per EN 374): Butyl rubber gloves. (>= 0.7 mm thickness)

This information is based on literature references and on information provided by glove manufacturers, or is derived by analogy with similar substances. Please note that in practice the working life of chemical-resistant protective gloves may be considerably shorter than the permeation time determined in accordance with EN 374 as a result of the many influencing factors (e.g. temperature). If signs of wear and tear are noticed then the gloves should be replaced. Manufacturer's directions for use should be observed because of great diversity of types.

#### **Skin Protection**

Rubber apron.

#### **Eye Protection**

Dust proof goggles.

#### **Other Precautions**

None known.

#### **Environmental Exposure Controls**

Do not allow material to contaminate ground water system



## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

**Physical State:** Solid      **Color:** White  
**Odor:** Odorless      **Odor Threshold:** No information available

<u>Property</u>	<u>Values</u>
<u>Remarks/ - Method</u>	
<b>pH:</b>	6
<b>Freezing Point / Range</b>	No data available
<b>Melting Point / Range</b>	No data available
<b>Boiling Point / Range</b>	No data available
<b>Flash Point</b>	No data available
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	2.47
<b>Water Solubility</b>	Soluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

### 9.2. Other information

**Molecular Weight** 238.1 g/mol  
**VOC Content (%)** No data available

## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

### 10.2. Chemical stability

Stable

### 10.3. Possibility of hazardous reactions

Will Not Occur

### 10.4. Conditions to avoid

Avoid contact with readily oxidizable materials.

### 10.5. Incompatible materials

Avoid halogens. Contact with acids. Strong alkalis. Combustible materials.

### 10.6. Hazardous decomposition products

Oxides of sulfur. Oxygen. Sulfuric acid.

## 11. Toxicological Information

### Information on routes of exposure

**Principle Route of Exposure** Eye or skin contact, inhalation.

### Symptoms related to exposure

#### Most Important Symptoms/Effects

Causes eye irritation. Causes skin irritation. May cause allergic skin reaction. May cause allergic respiratory reaction. May cause respiratory irritation. Harmful if swallowed.

### Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation

Sodium persulfate	7775-27-1	895 mg/kg (Rat) 1200 mg/kg 930 mg/kg 1000 mg/kg 920 mg/kg	> 10000 mg/kg (Rat)	19.0 mg/L (Rat) 4h > 5.1 mg/L (Rat) 4h
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**Immediate, delayed and chronic health effects from exposure**

<b>Inhalation</b>	May cause respiratory irritation. May cause allergy or asthma symptoms or breathing difficulties if inhaled
<b>Eye Contact</b>	Causes eye irritation.
<b>Skin Contact</b>	Causes skin irritation. May cause an allergic skin reaction.
<b>Ingestion</b>	Harmful if swallowed. Irritation of the mouth, throat, and stomach.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

**Exposure Levels**

No data available

**Interactive effects**

Lung disorders.

**Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Sodium persulfate	7775-27-1	Causes skin irritation. (Rabbit)

Substances	CAS Number	Serious eye damage/irritation
Sodium persulfate	7775-27-1	Causes severe eye irritation (Rabbit)

Substances	CAS Number	Skin Sensitization
Sodium persulfate	7775-27-1	Skin sensitizer in guinea pig.

Substances	CAS Number	Respiratory Sensitization
Sodium persulfate	7775-27-1	May cause sensitization by inhalation

Substances	CAS Number	Mutagenic Effects
Sodium persulfate	7775-27-1	In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects.

Substances	CAS Number	Carcinogenic Effects
Sodium persulfate	7775-27-1	Did not show carcinogenic effects in animal experiments (similar substances)

Substances	CAS Number	Reproductive toxicity
Sodium persulfate	7775-27-1	Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments. (similar substances)

Substances	CAS Number	STOT - single exposure
Sodium persulfate	7775-27-1	May cause respiratory irritation.

Substances	CAS Number	STOT - repeated exposure
Sodium persulfate	7775-27-1	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	Aspiration hazard
Sodium persulfate	7775-27-1	Not applicable

## 12. Ecological Information

**Ecotoxicity****Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Sodium persulfate	7775-27-1	EC50 (72h) 116 mg/L (biomass) (Pseudokirchnerella subcapitata)	LC50 (96h) 163 mg/L (Oncorhynchus mykiss)	EC10 (18h) 36 mg/L (Pseudomonas putida)	EC50 (48h) 133 mg/L (Daphnia magna)

**12.2. Persistence and degradability**

Substances	CAS Number	Persistence and Degradability
Sodium persulfate	7775-27-1	The methods for determining biodegradability are not applicable to inorganic substances.

**12.3. Bioaccumulative potential**

Substances	CAS Number	Log Pow
Sodium persulfate	7775-27-1	No information available

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Sodium persulfate	7775-27-1	No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

## 13. Disposal Considerations

**Safe handling and disposal methods**

Disposal should be made in accordance with federal, state, and local regulations.

**Disposal of any contaminated packaging**

This bag may contain residue of a hazardous material. Some authorities may regulate such containers as hazardous waste. Dispose of container according to national or local regulations.

**Environmental regulations**

Not applicable

## 14. Transport Information

**Transportation Information****Australia ADG**

**UN Number** UN1505  
**UN proper shipping name:** Sodium Persulfate  
**Transport Hazard Class(es):** 5.1  
**Packing Group:** III  
**Environmental Hazards:** Not applicable

**IMDG/IMO**

**UN Number** UN1505  
**UN proper shipping name:** Sodium Persulfate  
**Transport Hazard Class(es):** 5.1  
**Packing Group:** III  
**Environmental Hazards:** Not applicable  
**EMS:** EmS F-A, S-Q

**IATA/ICAO**

**UN Number** UN1505  
**UN proper shipping name:** Sodium Persulfate  
**Transport Hazard Class(es):** 5.1

**Packing Group:** III  
**Environmental Hazards:** Not applicable

**Special precautions during transport**

None

**HazChem Code**

1Z

**15. Regulatory Information****Safety, health and environmental regulations specific for the product****International Inventories****Australian AICS Inventory**

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

**New Zealand Inventory of Chemicals**

All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

**EINECS (European Inventory of Existing Chemical Substances)**

This product, and all its components, complies with EINECS

**US TSCA Inventory**

All components listed on inventory or are exempt.

**Canadian Domestic Substances List (DSL)**

All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

**International Agreements****Montreal Protocol - Ozone Depleting Substances:**

Does not apply

**Stockholm Convention - Persistent Organic Pollutants:**

Does not apply

**Rotterdam Convention - Prior Informed Consent:**

Does not apply

**Basel Convention - Hazardous Waste:**

Does not apply

**16. Other information****Date of preparation or review****Revision Date:** 21-Sep-2017**Revision Note**

SDS sections updated:

2

**Full text of H-Statements referred to under sections 2 and 3**

H272 - May intensify fire; oxidizer

H302 - Harmful if swallowed

H315 - Causes skin irritation

H317 - May cause an allergic skin reaction

H319 - Causes serious eye irritation

H334 - May cause allergy or asthma symptoms or breathing difficulties if inhaled

H335 - May cause respiratory irritation

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight

CAS – Chemical Abstracts Service  
EC50 – Effective Concentration 50%  
LC50 – Lethal Concentration 50%  
LD50 – Lethal Dose 50%  
LL50 – Lethal Loading 50%  
mg/kg – milligram/kilogram  
mg/L – milligram/liter  
NOEC – No Observed Effect Concentration  
OEL – Occupational Exposure Limit  
PBT – Persistent Bioaccumulative and Toxic  
ppm – parts per million  
STEL – Short Term Exposure Limit  
TWA – Time-Weighted Average  
vPvB – very Persistent and very Bioaccumulative  
h - hour  
mg/m<sup>3</sup> - milligram/cubic meter  
mm - millimeter  
mmHg - millimeter mercury  
w/w - weight/weight  
d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)  
OSHA  
ECHA C&L

**Disclaimer Statement**

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

**End of Safety Data Sheet**

## SAFETY DATA SHEET

### DCA-13003

Revision Date: 05-Jul-2016

Revision Number: 13

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** DCA-13003

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM007648

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Breaker  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road  
Jandakot  
WA 6164  
Australia  
  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
E-mail Address: fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951

##### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Acute toxicity - Dermal	Category 4 - H312
Acute inhalation toxicity - vapor	Category 4 - H332
Skin Corrosion/Irritation	Category 1 - H314
Serious Eye Damage/Irritation	Category 1 - H318
Acute Aquatic Toxicity	Category 2 - H401

##### Label elements, including precautionary statements

**Hazard pictograms****Signal Word**

Danger

**Hazard Statements:**

H312 - Harmful in contact with skin  
 H314 - Causes severe skin burns and eye damage  
 H318 - Causes serious eye damage  
 H332 - Harmful if inhaled  
 H401 - Toxic to aquatic life

**Precautionary Statements****Prevention**

P260 - Do not breathe dust/fume/gas/mist/vapors/spray  
 P271 - Use only outdoors or in a well-ventilated area  
 P273 - Avoid release to the environment

**Response**

P280 - Wear protective gloves/protective clothing/eye protection/face protection  
 P301 + P330 + P331 - IF SWALLOWED: rinse mouth. Do NOT induce vomiting  
 P303 + P361 + P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower  
 P304 + P340 - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing  
 P310 - Immediately call a POISON CENTER or doctor/physician  
 P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
 P405 - Store locked up  
 P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Storage****Disposal****Contains****Substances**

Chlorous acid, sodium salt  
 Sodium chloride

**CAS Number**

7758-19-2  
 7647-14-5

**Other hazards which do not result in classification**

This mixture contains no substance considered to be persistent, bioaccumulating nor toxic (PBT).  
 This mixture contains no substance considered to be very persistent nor very bioaccumulating (vPvB).

*For the full text of the H-phrases mentioned in this Section, see Section 16*

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Chlorous acid, sodium salt	7758-19-2	5 - 10%	Acute Tox. 3 (H301) Acute Tox. 2 (H310) Acute Tox. 2 (H330) Skin Corr. 1B (H314) Eye Corr. 1 (H318) STOT SE 3 (H335) STOT RE 2 (H373) Aquatic Acute 1 (H400) Aquatic Chronic 3 (H412) Ox. Sol. 2 (H272)

Sodium chloride	7647-14-5	10 - 30%	Not Classified
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#### 4. First aid measures

##### Description of necessary first aid measures

<b>Inhalation</b>	If inhaled, move victim to fresh air and seek medical attention.
<b>Eyes</b>	In case of contact, immediately flush eyes with plenty of water for at least 30 minutes. Remove contact lenses after the first 5 minutes and continue washing. Seek immediate medical attention/advice. Suitable emergency eye wash facility should be immediately available
<b>Skin</b>	In case of contact, immediately flush skin with plenty of soap and water for at least 30 minutes and remove contaminated clothing, shoes and leather goods immediately. Get medical attention immediately.
<b>Ingestion</b>	Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

##### Symptoms caused by exposure

Causes severe eye irritation which may damage tissue. Causes severe skin irritation with tissue destruction. Harmful in contact with skin. Harmful if inhaled.

##### Medical Attention and Special Treatment

**Notes to Physician** Treat symptomatically

#### 5. Fire Fighting Measures

##### Suitable extinguishing equipment

##### **Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

##### **Extinguishing media which must not be used for safety reasons**

None known.

##### Specific hazards arising from the chemical

##### **Special exposure hazards in a fire**

Product is not expected to burn unless all the water is boiled away. Use water spray to cool fire exposed surfaces. Decomposition in fire may produce harmful gases. If allowed to dry, this product is an oxidizer.

##### Special protective equipment and precautions for fire fighters

##### **Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

#### 6. Accidental release measures

##### 6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment. Wear self-contained breathing apparatus in enclosed areas. Avoid contact with skin, eyes and clothing. Avoid breathing vapors. Ensure adequate ventilation. Evacuate all persons from the area.

##### 6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

##### 6.3. Methods and material for containment and cleaning up

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

#### 7. Handling and storage

##### 7.1. Precautions for safe handling

##### **Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Ensure adequate ventilation. Wash hands after use. Launder



contaminated clothing before reuse. Use appropriate protective equipment.

#### Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice.

#### 7.2. Conditions for safe storage, including any incompatibilities

##### Storage Information

Store away from acids. Store away from reducing agents. Store away from direct sunlight. Keep from excessive heat. Product has a shelf life of 24 months.

##### Other Guidelines

No information available

## 8. Exposure Controls/Personal Protection

#### Control parameters - exposure standards, biological monitoring

##### Exposure Limits

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Chlorous acid, sodium salt	7758-19-2	Not applicable	Not applicable
Sodium chloride	7647-14-5	Not applicable	Not applicable

#### Appropriate engineering controls

##### Engineering Controls

Use in a well ventilated area.

#### Personal protective equipment (PPE)

##### Personal Protective Equipment

If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

##### Respiratory Protection

If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.

Organic vapor/acid gas/chlorine respirator.

##### Hand Protection

Chemical-resistant protective gloves (EN 374) Suitable materials for longer, direct contact (recommended: protection index 6, corresponding to > 480 minutes permeation time as per EN 374); Butyl rubber gloves. (>= 0.7 mm thickness)

This information is based on literature references and on information provided by glove manufacturers, or is derived by analogy with similar substances. Please note that in practice the working life of chemical-resistant protective gloves may be considerably shorter than the permeation time determined in accordance with EN 374 as a result of the many influencing factors (e.g. temperature). If signs of wear and tear are noticed then the gloves should be replaced. Manufacturer's directions for use should be observed because of great diversity of types.

##### Skin Protection

Full protective chemical resistant clothing.

##### Eye Protection

Chemical goggles; also wear a face shield if splashing hazard exists.

##### Other Precautions

Eyewash fountains and safety showers must be easily accessible.

##### Environmental Exposure Controls

Do not allow material to contaminate ground water system

## 9. Physical and Chemical Properties

#### 9.1. Information on basic physical and chemical properties

**Physical State:** Liquid

**Color:** Clear tan

**Odor:** Mild chlorine

**Odor Threshold:** No information available

##### Property

##### Values

Remarks/ - Method

**pH:**

11.5-12.5

**Freezing Point / Range**

3-4 °C

**Melting Point / Range**

No data available

**Boiling Point / Range**

106 - 108 °C

**Flash Point**

No data available

Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	1.17 - 1.23
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

**9.2. Other information**

VOC Content (%) No data available

## 10. Stability and Reactivity

**10.1. Reactivity**

Not expected to be reactive.

**10.2. Chemical stability**

Stable

**10.3. Possibility of hazardous reactions****10.4. Conditions to avoid**

Keep away from heat, sparks and flame. Avoid contact with organic materials. Avoid friction.

**10.5. Incompatible materials**

Prolonged contact with aluminum. Contact with metals. Organic matter. Contact with ammonia. All flammables, especially petroleum products, asphalt & other volatile flammables. Ammonium compounds. Strong acids.

**10.6. Hazardous decomposition products**

Chlorine.

## 11. Toxicological Information

**Information on routes of exposure**

Principle Route of Exposure Eye or skin contact, inhalation.

**Symptoms related to exposure****Most Important Symptoms/Effects**

Causes severe eye irritation which may damage tissue. Causes severe skin irritation with tissue destruction. Harmful in contact with skin. Harmful if inhaled.

**Numerical measures of toxicity****Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Chlorous acid, sodium salt	7758-19-2	165 mg/kg (Rat) 390 - 500 mg/kg (Rat) 212 - 284 mg/kg (Rat)	315 mg/kg (Rat) 134 mg/kg (Rabbit)	0.29 mg/L (Rat) 4h 230 mg/m <sup>3</sup> (Rat) 4h
Sodium chloride	7647-14-5	3000 mg/kg-bw (rat)	No data available	No data available

**Immediate, delayed and chronic health effects from exposure****Inhalation**

Harmful if inhaled. Causes severe respiratory irritation.

**Eye Contact**

Causes severe eye irritation which may damage tissue.

**Skin Contact**

Harmful in contact with skin. Causes severe burns.

**Ingestion**

Causes burns of the mouth, throat and stomach. May cause abdominal pain, vomiting, nausea, and diarrhea.

**Chronic Effects/Carcinogenicity** Prolonged or repeated exposure may cause adverse effects on the blood.

**Exposure Levels**

No data available

### Interactive effects

Blood disorders.

### Data limitations

No data available

Substances	CAS Number	Skin corrosion/irritation
Chlorous acid, sodium salt	7758-19-2	Corrosive to skin (Rabbit)
Sodium chloride	7647-14-5	Non-irritating to the skin (Rabbit) Not a dermal irritant

Substances	CAS Number	Serious eye damage/irritation
Chlorous acid, sodium salt	7758-19-2	Corrosive to eyes (Rabbit)
Sodium chloride	7647-14-5	May cause mild eye irritation. (Rabbit)

Substances	CAS Number	Skin Sensitization
Chlorous acid, sodium salt	7758-19-2	Did not cause sensitization on laboratory animals (guinea pig)
Sodium chloride	7647-14-5	No information available Not confirmed to cause skin or respiratory sensitization.

Substances	CAS Number	Respiratory Sensitization
Chlorous acid, sodium salt	7758-19-2	No information available
Sodium chloride	7647-14-5	No information available

Substances	CAS Number	Mutagenic Effects
Chlorous acid, sodium salt	7758-19-2	Not regarded as mutagenic.
Sodium chloride	7647-14-5	No information available

Substances	CAS Number	Carcinogenic Effects
Chlorous acid, sodium salt	7758-19-2	Did not show carcinogenic effects in animal experiments
Sodium chloride	7647-14-5	Did not show carcinogenic effects in animal experiments

Substances	CAS Number	Reproductive toxicity
Chlorous acid, sodium salt	7758-19-2	Animal testing did not show any effects on fertility. (fetotoxic and teratogenic effects).
Sodium chloride	7647-14-5	Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments.

Substances	CAS Number	STOT - single exposure
Chlorous acid, sodium salt	7758-19-2	May cause respiratory irritation.
Sodium chloride	7647-14-5	No information available

Substances	CAS Number	STOT - repeated exposure
Chlorous acid, sodium salt	7758-19-2	Causes damage to organs through prolonged or repeated exposure if swallowed: (spleen) (Blood)
Sodium chloride	7647-14-5	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	Aspiration hazard
Chlorous acid, sodium salt	7758-19-2	Not applicable
Sodium chloride	7647-14-5	Not applicable

## 12. Ecological Information

### Ecotoxicity

#### **Product Ecotoxicity Data**

No data available

#### **Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Chlorous acid, sodium salt	7758-19-2	EC50 (72h) 9.09 mg/L (Skeletonea costatum) EC50 (72h) 0.2 mg/L (Pseudokirchnerella)	LC50 (96h) 210 mg/L (Scophthalmus maximus) TLM96 290 mg/L (Oncorhynchus mykiss)	EC50 (3h) > 75 mg/L (activated sludge)	LC50 (48h) 50.67 mg/L (Acartia tonsa) TLM96 0.29 mg/L (Daphnia magna)

		subcapitata)	TLM96 208 mg/L (Lepomis macrochirus)		NOEC (22d) 25 ug/L (Daphnia magna)
Sodium chloride	7647-14-5	EC50 (120h) 2430 mg/L (Nitzschia sp.)	TLM96 > 1000 mg/L (Oncorhynchus mykiss) LC50 (96h) 5840 mg/L (Lepomis macrochirus) NOEC (33d) 252 mg/L (Pimephales promelas)	NOEC 5000 – 8000 mg/L (activated sludge) NOEC 292-584 mg/L (Escherichia coli)	TLM96 > 1,000,000 ppm (Mysidopsis bahia) LC50 (48h) 874-4136 mg/L (Daphnia magna) NOEC (21d) 314 mg/L (Daphnia pulex)

**12.2. Persistence and degradability**

Substances	CAS Number	Persistence and Degradability
Chlorous acid, sodium salt	7758-19-2	The methods for determining biodegradability are not applicable to inorganic substances.
Sodium chloride	7647-14-5	No information available

**12.3. Bioaccumulative potential**

Substances	CAS Number	Log Pow
Chlorous acid, sodium salt	7758-19-2	No information available
Sodium chloride	7647-14-5	No information available

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Chlorous acid, sodium salt	7758-19-2	No information available
Sodium chloride	7647-14-5	No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

**13. Disposal Considerations****Safe handling and disposal methods**

Disposal should be made in accordance with federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

**14. Transport Information****Transportation Information****Australia ADG**

UN Number: UN1908  
 UN proper shipping name: Chlorite Solution (14% Available Chlorine)  
 Transport Hazard Class(es): 8  
 Packing Group: III  
 Environmental Hazards: Not applicable

**IMDG/IMO**

UN Number: UN1908  
 UN proper shipping name: Chlorite Solution (14% Available Chlorine)  
 Transport Hazard Class(es): 8  
 Packing Group: III  
 Environmental Hazards: Not applicable  
 EMS: EmS F-A, S-B

**IATA/CAO**

**UN Number** UN1908  
**UN proper shipping name:** Chlorite Solution (14% Available Chlorine)  
**Transport Hazard Class(es):** 8  
**Packing Group:** III  
**Environmental Hazards:** Not applicable

**Special precautions during transport**

None

**HazChem Code**

2X

**15. Regulatory Information****Safety, health and environmental regulations specific for the product****International Inventories**

**Australian AICS Inventory** All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

**New Zealand Inventory of Chemicals** All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

**EINECS (European Inventory of Existing Chemical Substances)** This product, and all its components, complies with EINECS

**US TSCA Inventory** All components listed on inventory or are exempt.

**Canadian Domestic Substances List (DSL)** All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

**International Agreements**

<b>Montreal Protocol - Ozone Depleting Substances:</b>	Does not apply
<b>Stolkhom Convention - Persistent Organic Pollutants:</b>	Does not apply
<b>Rotterdam Convention - Prior Informed Consent:</b>	Does not apply
<b>Basel Convention - Hazardous Waste:</b>	Does not apply

**16. Other information****Date of preparation or review**

**Revision Date:** 05-Jul-2016

**Revision Note**

SDS sections updated: 2

**Full text of H-Statements referred to under sections 2 and 3**

H272 - May intensify fire; oxidizer  
H301 - Toxic if swallowed  
H310 - Fatal in contact with skin  
H312 - Harmful in contact with skin  
H314 - Causes severe skin burns and eye damage  
H318 - Causes serious eye damage  
H320 - Causes eye irritation  
H330 - Fatal if inhaled  
H332 - Harmful if inhaled  
H335 - May cause respiratory irritation  
H373 - May cause damage to organs through prolonged or repeated exposure if inhaled  
H400 - Very toxic to aquatic life  
H412 - Harmful to aquatic life with long lasting effects

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight  
CAS – Chemical Abstracts Service  
EC50 – Effective Concentration 50%  
LC50 – Lethal Concentration 50%  
LD50 – Lethal Dose 50%  
LL50 – Lethal Loading 50%  
mg/kg – milligram/kilogram  
mg/L – milligram/liter  
NOEC – No Observed Effect Concentration  
OEL – Occupational Exposure Limit  
PBT – Persistent Bioaccumulative and Toxic  
ppm – parts per million  
STEL – Short Term Exposure Limit  
TWA – Time-Weighted Average  
vPvB – very Persistent and very Bioaccumulative  
h - hour  
mg/m<sup>3</sup> - milligram/cubic meter  
mm - millimeter  
mmHg - millimeter mercury  
w/w - weight/weight  
d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)  
OSHA  
ECHA C&L

**Disclaimer Statement**

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**End of Safety Data Sheet**

## SAFETY DATA SHEET

### DCA-14003

Revision Date: 27-Sep-2016

Revision Number: 11

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** DCA-14003

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM007651

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Buffer  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road, Jandakot, WA 6164  
Australia  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-mail Address** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951

##### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Not classified

##### Label elements, including precautionary statements

##### **Hazard pictograms**

**Signal Word** Not Hazardous

**Hazard Statements:** Not Classified

**Precautionary Statements**

<b>Prevention</b>	None
<b>Response</b>	None
<b>Storage</b>	None
<b>Disposal</b>	None

**Contains Substances**

Contains no hazardous substances in concentrations above cut-off values according to the competent authority

**CAS Number**

NA

**Other hazards which do not result in classification**

This substance is not considered to be persistent, bioaccumulating nor toxic (PBT).  
This substance is not considered to be very persistent nor very bioaccumulating (vPvB).

*For the full text of the H-phrases mentioned in this Section, see Section 16*

<b>3. Composition/information on Ingredients</b>
--

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	60 - 100%	Not Applicable

<b>4. First aid measures</b>
------------------------------

**Description of necessary first aid measures**

<b>Inhalation</b>	If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
<b>Eyes</b>	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
<b>Skin</b>	Wash with soap and water. Get medical attention if irritation persists.
<b>Ingestion</b>	Under normal conditions, first aid procedures are not required.

**Symptoms caused by exposure**

No significant hazards expected.

**Medical Attention and Special Treatment**

**Notes to Physician** Treat symptomatically

<b>5. Fire Fighting Measures</b>
----------------------------------

**Suitable extinguishing equipment****Suitable Extinguishing Media**

All standard fire fighting media

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical****Special exposure hazards in a fire**

None anticipated

**Special protective equipment and precautions for fire fighters****Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.



## 6. Accidental release measures

### 6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment. Avoid creating and breathing dust. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing.

### 6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

### 6.3. Methods and material for containment and cleaning up

Scoop up and remove.

## 7. Handling and storage

### 7.1. Precautions for safe handling

#### **Handling Precautions**

Avoid creating or inhaling dust. Ensure adequate ventilation. Avoid contact with eyes, skin, or clothing. Wash hands after use. Launder contaminated clothing before reuse. Use appropriate protective equipment.

#### **Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

### 7.2. Conditions for safe storage, including any incompatibilities

#### **Storage Information**

Store away from acids. Store in a dry location.

#### **Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

### Control parameters - exposure standards, biological monitoring

#### **Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	Not applicable	Not applicable

### Appropriate engineering controls

#### **Engineering Controls**

A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation.

### Personal protective equipment (PPE)

#### **Personal Protective Equipment**

If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

#### **Respiratory Protection**

Not normally needed. But if significant exposures are possible then the following respirator is recommended:

Dust/mist respirator. (N95, P2/P3)

#### **Hand Protection**

Normal work gloves.

#### **Skin Protection**

Normal work coveralls.

#### **Eye Protection**

Wear safety glasses or goggles to protect against exposure.

#### **Other Precautions**

None known.

#### **Environmental Exposure Controls**

Do not allow material to contaminate ground water system

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

**Physical State:** Solid

**Color:** White

**Odor:** Odorless

**Odor Threshold:** No information available

<u>Property</u>	<u>Values</u>
<u>Remarks/ - Method</u>	
<b>pH:</b>	8
<b>Freezing Point / Range</b>	No data available
<b>Melting Point / Range</b>	No data available
<b>Boiling Point / Range</b>	No data available
<b>Flash Point</b>	No data available
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	1.87
<b>Water Solubility</b>	Soluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available
<b>9.2. Other information</b>	
<b>VOC Content (%)</b>	No data available

## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

### 10.2. Chemical stability

Stable

### 10.3. Possibility of hazardous reactions

Will Not Occur

### 10.4. Conditions to avoid

None anticipated

### 10.5. Incompatible materials

Strong acids.

### 10.6. Hazardous decomposition products

Carbon monoxide and carbon dioxide.

## 11. Toxicological Information

### Information on routes of exposure

**Principle Route of Exposure** Eye or skin contact, inhalation.

### Symptoms related to exposure

#### **Most Important Symptoms/Effects**

No significant hazards expected.

### Numerical measures of toxicity

### Toxicology data for the components

<b>Substances</b>	<b>CAS Number</b>	<b>LD50 Oral</b>	<b>LD50 Dermal</b>	<b>LC50 Inhalation</b>
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No data available	No data available	No data available

### Immediate, delayed and chronic health effects from exposure

**Inhalation** May cause mild respiratory irritation.

**Eye Contact** May cause mechanical irritation to eye.  
**Skin Contact** None known.  
**Ingestion** None known.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

**Exposure Levels**

No data available

**Interactive effects**

None known.

**Data limitations**

No data available

## 12. Ecological Information

**Ecotoxicity****Product Ecotoxicity Data**

No data available

**Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available	No information available	No information available	No information available

**12.2. Persistence and degradability**

Substances	CAS Number	Persistence and Degradability
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.3. Bioaccumulative potential**

Substances	CAS Number	Log Pow
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

<b>13. Disposal Considerations</b>
------------------------------------

**Safe handling and disposal methods**

Bury in a licensed landfill according to federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

<b>14. Transport Information</b>
----------------------------------

**Transportation Information****Australia ADG**

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

**IMDG/IMO**

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

**IATA/ICAO**

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

<b>15. Regulatory Information</b>
-----------------------------------

**Safety, health and environmental regulations specific for the product****International Inventories****Australian AICS Inventory**

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

**New Zealand Inventory of Chemicals**

All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

**EINECS (European Inventory of Existing Chemical Substances)**

This product, and all its components, complies with EINECS

**US TSCA Inventory**

All components listed on inventory or are exempt.

**Canadian Domestic Substances List (DSL)**

All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

**International Agreements****Montreal Protocol - Ozone Depleting Substances:**

Does not apply

**Stockholm Convention - Persistent Organic Pollutants:**

Does not apply

**Rotterdam Convention - Prior Informed Consent:**

Does not apply

**Basel Convention - Hazardous Waste:**

Does not apply

**16. Other information****Date of preparation or review****Revision Date:** 27-Sep-2016**Revision Note**

SDS sections updated: 2

**Full text of H-Statements referred to under sections 2 and 3**

None

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight

CAS – Chemical Abstracts Service

EC50 – Effective Concentration 50%

LC50 – Lethal Concentration 50%

LD50 – Lethal Dose 50%

LL50 – Lethal Loading 50%

mg/kg – milligram/kilogram

mg/L – milligram/liter

NOEC – No Observed Effect Concentration

OEL – Occupational Exposure Limit

PBT – Persistent Bioaccumulative and Toxic

ppm – parts per million

STEL – Short Term Exposure Limit

TWA – Time-Weighted Average

vPvB – very Persistent and very Bioaccumulative

h - hour

mg/m<sup>3</sup> - milligram/cubic meter

mm - millimeter

mmHg - millimeter mercury

w/w - weight/weight

d - day

**Key literature references and sources for data**[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)**Disclaimer Statement**

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**End of Safety Data Sheet**

## SAFETY DATA SHEET

### DCA-14004

Revision Date: 30-May-2017

Revision Number: 6

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** DCA-14004

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM007652

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Additive  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road, Jandakot, WA 6164  
Australia  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-mail Address** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951  
Global Incident Response Access Code: 334305  
Contract Number: 14012

##### Australian Poisons Information Centre

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Serious Eye Damage/Irritation	Category 2 - H319
-------------------------------	-------------------

##### Label elements, including precautionary statements

##### Hazard Pictograms



<b>Signal Word</b>	WARNING
<b>Hazard Statements:</b>	H319 - Causes serious eye irritation
<b>Precautionary Statements</b>	
<b>Prevention</b>	P264 - Wash face, hands and any exposed skin thoroughly after handling P280 - Wear eye protection/face protection
<b>Response</b>	P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing P337 + P313 - If eye irritation persists: Get medical advice/attention
<b>Storage</b>	None
<b>Disposal</b>	None
<b>Contains Substances</b>	<b>CAS Number</b>
Sodium carbonate	497-19-8

**Other hazards which do not result in classification**

This substance is not considered to be persistent, bioaccumulating nor toxic (PBT).  
This substance is not considered to be very persistent nor very bioaccumulating (vPvB).

*For the full text of the H-phrases mentioned in this Section, see Section 16*

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Sodium carbonate	497-19-8	60 - 100%	Eye Irrit. 2 (H319)

### 4. First aid measures

**Description of necessary first aid measures**

<b>Inhalation</b>	If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
<b>Eyes</b>	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
<b>Skin</b>	Wash with soap and water. Get medical attention if irritation persists.
<b>Ingestion</b>	Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

**Symptoms caused by exposure**

Causes eye irritation.

**Medical Attention and Special Treatment**

**Notes to Physician** Treat symptomatically

### 5. Fire Fighting Measures

**Suitable extinguishing equipment****Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical****Special exposure hazards in a fire**

Decomposition in fire may produce harmful gases.

**Special protective equipment and precautions for fire fighters****Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## 6. Accidental release measures

**6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment. Avoid creating and breathing dust. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing.

**6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas.

**6.3. Methods and material for containment and cleaning up**

Scoop up and remove.

## 7. Handling and storage

**7.1. Precautions for safe handling****Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust. Ensure adequate ventilation. Wash hands after use. Launder contaminated clothing before reuse.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Store away from acids. Store in a cool, dry location. Product has a shelf life of 24 months.

**Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

**Control parameters - exposure standards, biological monitoring****Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Sodium carbonate	497-19-8	Not applicable	Not applicable

**Appropriate engineering controls****Engineering Controls**

Use in a well ventilated area. Localized ventilation should be used to control dust levels.

**Personal protective equipment (PPE)****Personal Protective Equipment**

If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

**Respiratory Protection**

Dust/mist respirator. (N95, P2/P3)

**Hand Protection**

Normal work gloves.

**Skin Protection**

Normal work coveralls.

**Eye Protection**

Dust proof goggles.



**Other Precautions** None known.  
**Environmental Exposure Controls** Do not allow material to contaminate ground water system

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

**Physical State:** Powder      **Color** White  
**Odor:** Odorless      **Odor Threshold:** No information available

<u>Property</u>	<u>Values</u>
<u>Remarks/ - Method</u>	
<b>pH:</b>	11.4
<b>Freezing Point / Range</b>	No data available
<b>Melting Point / Range</b>	No data available
<b>Boiling Point / Range</b>	No data available
<b>Flash Point</b>	No data available
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	2.5
<b>Water Solubility</b>	Insoluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

### 9.2. Other information

**Molecular Weight** 105.99 g/mol  
**VOC Content (%)** No data available

## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

### 10.2. Chemical stability

Stable

### 10.3. Possibility of hazardous reactions

Will Not Occur

### 10.4. Conditions to avoid

None anticipated

### 10.5. Incompatible materials

Strong acids.

### 10.6. Hazardous decomposition products

Carbon monoxide and carbon dioxide.

## 11. Toxicological Information

### Information on routes of exposure

**Principle Route of Exposure** Eye or skin contact, inhalation.

### Symptoms related to exposure

#### **Most Important Symptoms/Effects**

Causes eye irritation.

### Numerical measures of toxicity

### Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Sodium carbonate	497-19-8	4090 mg/kg (Rat) 2800 mg/kg (Rat)	2210 mg/kg (Mouse) > 2000 mg/kg (Rabbit)	2.3 mg/L (Rat) 2h

**Immediate, delayed and chronic health effects from exposure**

<b>Inhalation</b>	May cause mild respiratory irritation.
<b>Eye Contact</b>	Causes eye irritation.
<b>Skin Contact</b>	Not irritating to skin in rabbits.
<b>Ingestion</b>	Irritation of the mouth, throat, and stomach.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

**Exposure Levels**

No data available

**Interactive effects**

None known.

**Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Sodium carbonate	497-19-8	Non-irritating to the skin

Substances	CAS Number	Serious eye damage/irritation
Sodium carbonate	497-19-8	Irritating to eyes

Substances	CAS Number	Skin Sensitization
Sodium carbonate	497-19-8	Not classified

Substances	CAS Number	Respiratory Sensitization
Sodium carbonate	497-19-8	No information available

Substances	CAS Number	Mutagenic Effects
Sodium carbonate	497-19-8	In vivo tests did not show mutagenic effects.

Substances	CAS Number	Carcinogenic Effects
Sodium carbonate	497-19-8	No information available

Substances	CAS Number	Reproductive toxicity
Sodium carbonate	497-19-8	Did not show teratogenic effects in animal experiments.

Substances	CAS Number	STOT - single exposure
Sodium carbonate	497-19-8	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	STOT - repeated exposure
Sodium carbonate	497-19-8	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	Aspiration hazard
Sodium carbonate	497-19-8	Not applicable

## 12. Ecological Information

**Ecotoxicity****Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Sodium carbonate	497-19-8	EC50 242 mg/L (Nitzschia)	TLM24 385 mg/L (Lepomis macrochirus)	No information available	EC50 265 mg/L (Daphnia magna)

			LC50 310-1220 mg/L (Pimephales promelas) LC50 (96h) 300 mg/L (Lepomis macrochirus)		EC50 (48h) 200 – 227 mg/L (Ceriodaphnia sp.)
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**12.2. Persistence and degradability**

Substances	CAS Number	Persistence and Degradability
Sodium carbonate	497-19-8	The methods for determining biodegradability are not applicable to inorganic substances.

**12.3. Bioaccumulative potential**

Substances	CAS Number	Log Pow
Sodium carbonate	497-19-8	No information available

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Sodium carbonate	497-19-8	No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

<b>13. Disposal Considerations</b>
------------------------------------

**Safe handling and disposal methods**

Bury in a licensed landfill according to federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations. Contaminated packaging may be disposed of by: rendering packaging incapable of containing any substance, or treating packaging to remove residual contents, or treating packaging to make sure the residual contents are no longer hazardous, or by disposing of packaging into commercial waste collection.

**Environmental regulations**

Not applicable

<b>14. Transport Information</b>
----------------------------------

**Transportation Information****Australia ADG**

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

**IMDG/IMO**

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

**IATA/CAO**

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

**15. Regulatory Information****Safety, health and environmental regulations specific for the product****International Inventories****Australian AICS Inventory**

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

**New Zealand Inventory of Chemicals**

All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

**EINECS (European Inventory of Existing Chemical Substances)**

This product, and all its components, complies with EINECS

**US TSCA Inventory**

All components listed on inventory or are exempt.

**Canadian Domestic Substances List (DSL)**

All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

**International Agreements****Montreal Protocol - Ozone Depleting Substances:**

Does not apply

**Stockholm Convention - Persistent Organic Pollutants:**

Does not apply

**Rotterdam Convention - Prior Informed Consent:**

Does not apply

**Basel Convention - Hazardous Waste:**

Does not apply

**16. Other information****Date of preparation or review****Revision Date:**

30-May-2017

**Revision Note**

SDS sections updated:

2

**Full text of H-Statements referred to under sections 2 and 3**

H319 - Causes serious eye irritation

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight

CAS – Chemical Abstracts Service

EC50 – Effective Concentration 50%

LC50 – Lethal Concentration 50%

LD50 – Lethal Dose 50%

LL50 – Lethal Loading 50%

mg/kg – milligram/kilogram

mg/L – milligram/liter

NOEC – No Observed Effect Concentration

OEL – Occupational Exposure Limit  
PBT – Persistent Bioaccumulative and Toxic  
ppm – parts per million  
STEL – Short Term Exposure Limit  
TWA – Time-Weighted Average  
vPvB – very Persistent and very Bioaccumulative  
h - hour  
mg/m<sup>3</sup> - milligram/cubic meter  
mm - millimeter  
mmHg - millimeter mercury  
w/w - weight/weight  
d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)  
NZ CCID

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**End of Safety Data Sheet**

## SAFETY DATA SHEET

### DCA-16001

Revision Date: 05-Jul-2017

Revision Number: 11

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** DCA-16001

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM007655

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Clay Stabilization Agent  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road, Jandakot, WA 6164  
Australia  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-mail Address** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951  
Global Incident Response Access Code: 334305  
Contract Number: 14012

##### Australian Poisons Information Centre

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Not classified

##### Label elements, including precautionary statements

##### **Hazard Pictograms**

**Signal Word** Not Hazardous

**Hazard Statements:** Not Classified

**Precautionary Statements**

<b>Prevention</b>	None
<b>Response</b>	None
<b>Storage</b>	None
<b>Disposal</b>	None

**Contains****Substances****CAS Number**

Contains no hazardous substances in concentrations above cut-off values according to the competent authority

NA

**Other hazards which do not result in classification**

This mixture contains no substance considered to be persistent, bioaccumulating nor toxic (PBT).

This mixture contains no substance considered to be very persistent nor very bioaccumulating (vPvB).

For the full text of the H-phrases mentioned in this Section, see Section 16

<b>3. Composition/information on Ingredients</b>
--

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	60 - 100%	Not classified

<b>4. First aid measures</b>
------------------------------

**Description of necessary first aid measures****Inhalation**

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

**Eyes**

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

**Skin**

Wash with soap and water. Get medical attention if irritation persists.

**Ingestion**

Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

**Symptoms caused by exposure**

No significant hazards expected.

**Medical Attention and Special Treatment****Notes to Physician**

Treat symptomatically

<b>5. Fire Fighting Measures</b>
----------------------------------

**Suitable extinguishing equipment****Suitable Extinguishing Media**

All standard fire fighting media

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical****Special exposure hazards in a fire**

Not applicable

**Special protective equipment and precautions for fire fighters****Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## 6. Accidental release measures

### 6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment. Avoid contact with skin, eyes and clothing. Avoid breathing vapors. Ensure adequate ventilation.

### 6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

### 6.3. Methods and material for containment and cleaning up

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

## 7. Handling and storage

### 7.1. Precautions for safe handling

#### **Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Ensure adequate ventilation. Wash hands after use. Launder contaminated clothing before reuse. Use appropriate protective equipment.

#### **Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

### 7.2. Conditions for safe storage, including any incompatibilities

#### **Storage Information**

Store in a cool, dry location. Keep container closed when not in use. Product has a shelf life of 24 months.

#### **Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

### Control parameters - exposure standards, biological monitoring

#### **Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	Not applicable	Not applicable

### Appropriate engineering controls

**Engineering Controls** Use in a well ventilated area.

### Personal protective equipment (PPE)

**Personal Protective Equipment** If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

**Respiratory Protection** Not normally necessary.

**Hand Protection**

Rubber gloves.

**Skin Protection**

Normal work coveralls.

**Eye Protection**

Wear safety glasses or goggles to protect against exposure.

**Other Precautions**

None known.

**Environmental Exposure Controls**

Do not allow material to contaminate ground water system

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties



**Physical State:** Liquid  
**Odor:** Mild amine  
**Color:** White  
**Odor Threshold:** No information available

<u>Property</u>	<u>Values</u>
<u>Remarks/ - Method</u>	
<b>pH:</b>	7-9
<b>Freezing Point / Range</b>	No data available
<b>Melting Point / Range</b>	No data available
<b>Boiling Point / Range</b>	No data available
<b>Flash Point</b>	No data available
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	1.07 - 1.091
<b>Water Solubility</b>	Soluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

**9.2. Other information**

**VOC Content (%)** No data available

## 10. Stability and Reactivity

**10.1. Reactivity**

Not expected to be reactive.

**10.2. Chemical stability**

Stable

**10.3. Possibility of hazardous reactions**

Will Not Occur

**10.4. Conditions to avoid**

Avoid contact with metals such as aluminum, tin, lead, brass, bronze, copper, and zinc.

**10.5. Incompatible materials**

Strong oxidizers.

**10.6. Hazardous decomposition products**

Oxides of nitrogen. Hydrogen chloride. Carbon monoxide and carbon dioxide.

## 11. Toxicological Information

**Information on routes of exposure****Symptoms related to exposure****Most Important Symptoms/Effects**

No significant hazards expected.

**Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No data available	No data available	No data available

**Immediate, delayed and chronic health effects from exposure**

**Inhalation** None known.

**Eye Contact** None known.  
**Skin Contact** None known.  
**Ingestion** None known.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

**Exposure Levels**

No data available

**Interactive effects**

None known.

**Data limitations**

No data available

## 12. Ecological Information

**Ecotoxicity**

**Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available	No information available	No information available	No information available

**12.2. Persistence and degradability**

Expected to be readily biodegradable

Substances	CAS Number	Persistence and Degradability
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.3. Bioaccumulative potential**

Does not bioaccumulate.

Substances	CAS Number	Log Pow
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.6. Other adverse effects**

**Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

### 13. Disposal Considerations

**Safe handling and disposal methods**

Disposal should be made in accordance with federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

### 14. Transport Information

**Transportation Information**

**Australia ADG**

<b>UN Number</b>	Not restricted
<b>UN proper shipping name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**IMDG/IMO**

<b>UN Number</b>	Not restricted
<b>UN proper shipping name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**IATA/ICAO**

<b>UN Number</b>	Not restricted
<b>UN proper shipping name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

### 15. Regulatory Information

**Safety, health and environmental regulations specific for the product**

**International Inventories**

**Australian AICS Inventory**

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

**New Zealand Inventory of Chemicals**

All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

**EINECS (European Inventory of Existing Chemical Substances)**

This product, and all its components, complies with EINECS

**US TSCA Inventory**

All components listed on inventory or are exempt.

**Canadian Domestic Substances List (DSL)**

All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

**International Agreements**

<b>Montreal Protocol - Ozone Depleting Substances:</b>	Does not apply
<b>Stockholm Convention - Persistent Organic Pollutants:</b>	Does not apply
<b>Rotterdam Convention - Prior Informed Consent:</b>	Does not apply
<b>Basel Convention - Hazardous Waste:</b>	Does not apply

**16. Other information****Date of preparation or review**

**Revision Date:** 05-Jul-2017

**Revision Note**

SDS sections updated:

2

**Full text of H-Statements referred to under sections 2 and 3**

None

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight

CAS – Chemical Abstracts Service

EC50 – Effective Concentration 50%

LC50 – Lethal Concentration 50%

LD50 – Lethal Dose 50%

LL50 – Lethal Loading 50%

mg/kg – milligram/kilogram

mg/L – milligram/liter

NOEC – No Observed Effect Concentration

OEL – Occupational Exposure Limit

PBT – Persistent Bioaccumulative and Toxic

ppm – parts per million

STEL – Short Term Exposure Limit

TWA – Time-Weighted Average

vPvB – very Persistent and very Bioaccumulative

h - hour

mg/m<sup>3</sup> - milligram/cubic meter

mm - millimeter

mmHg - millimeter mercury

w/w - weight/weight

d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

**Disclaimer Statement**

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

**End of Safety Data Sheet**

## SAFETY DATA SHEET

### DCA-17001

Revision Date: 09-Nov-2017

Revision Number: 16

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** DCA-17001

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM007659

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Corrosion Inhibitor  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road, Jandakot, WA 6164  
Australia  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-mail Address** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951  
Global Incident Response Access Code: 334305  
Contract Number: 14012

##### Australian Poisons Information Centre

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Acute Oral Toxicity	Category 4 - H302
Skin Corrosion/Irritation	Category 2 - H315
Serious Eye Damage/Irritation	Category 1 - H318
Skin Sensitization	Category 1 - H317
Reproductive Toxicity	Category 1B - H360
Specific Target Organ Toxicity - (Single Exposure)	Category 1 - H370
Specific Target Organ Toxicity - (Repeated Exposure)	Category 2 - H373
Acute Aquatic Toxicity	Category 2 - H401
Flammable liquids.	Category 3 - H226

**Label elements, including precautionary statements****Hazard Pictograms****Signal Word**

DANGER

**Hazard Statements:**

H226 - Flammable liquid and vapor  
 H302 - Harmful if swallowed  
 H315 - Causes skin irritation  
 H317 - May cause an allergic skin reaction  
 H318 - Causes serious eye damage  
 H360 - May damage fertility or the unborn child  
 H370 - Causes damage to organs  
 H373 - May cause damage to organs through prolonged or repeated exposure  
 H401 - Toxic to aquatic life

**Precautionary Statements****Prevention**

P201 - Obtain special instructions before use  
 P202 - Do not handle until all safety precautions have been read and understood  
 P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.  
 P233 - Keep container tightly closed  
 P240 - Ground and bond container and receiving equipment.  
 P241 - Use explosion-proof electrical/ventilating/lighting/equipment  
 P242 - Use only non-sparking tools  
 P243 - Take action to prevent static discharges.  
 P260 - Do not breathe dust/fume/gas/mist/vapors/spray  
 P264 - Wash face, hands and any exposed skin thoroughly after handling  
 P270 - Do not eat, drink or smoke when using this product  
 P272 - Contaminated work clothing should not be allowed out of the workplace  
 P273 - Avoid release to the environment  
 P280 - Wear protective gloves/protective clothing/eye protection/face protection  
 P281 - Use personal protective equipment as required

**Response**

P301 + P312 - IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell  
 P330 - Rinse mouth  
 P302 + P352 - IF ON SKIN: Wash with plenty of water.  
 P333 + P313 - If skin irritation or rash occurs: Get medical advice/attention  
 P362 + P364 - Take off contaminated clothing and wash before reuse  
 P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
 P310 - Immediately call a POISON CENTER or doctor/physician  
 P307 + P311 - IF exposed: Call a POISON CENTER or doctor/physician  
 P314 - Get medical attention/advice if you feel unwell

**Storage**

P370 + P378 - In case of fire: Use water spray for extinction  
 P403 + P235 - Store in a well-ventilated place. Keep cool  
 P405 - Store locked up

**Disposal** P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Contains****Substances**

	<b>CAS Number</b>
Diethylene glycol	111-46-6
Cinnamaldehyde	104-55-2
Amine oxides, cocoalkyldimethyl	61788-90-7
Methanol	67-56-1
Benzaldehyde	100-52-7
Alcohols, C12-16, ethoxylated	68551-12-2
Sodium iodide	7681-82-5

**Other hazards which do not result in classification**

This mixture contains no substance considered to be persistent, bioaccumulating nor toxic (PBT).

This mixture contains no substance considered to be very persistent nor very bioaccumulating (vPvB).

For the full text of the H-phrases mentioned in this Section, see Section 16

### 3. Composition/information on Ingredients

<b>Substances</b>	<b>CAS Number</b>	<b>PERCENT (w/w)</b>	<b>GHS Classification - Australia</b>
Diethylene glycol	111-46-6	30 - 60%	Acute Tox. 4 (H302) STOT RE 2 (H373)
Cinnamaldehyde	104-55-2	30 - 60%	Acute Tox. 4 (H312) Skin Irrit. 2 (H315) Skin Sens. 1 (H317) Aquatic Acute 2 (H401)
Amine oxides, cocoalkyldimethyl	61788-90-7	10 - 30%	Acute Tox. 4 (H302) Skin Irrit. 2 (H315) Eye Corr. 1 (H318) Aquatic Acute 1 (H400)
Methanol	67-56-1	10 - 30%	Acute Tox. 3 (H301) Acute Tox. 3 (H311) Acute Tox. 3 (H331) Repr. 1B (H360) STOT SE 1 (H370) Flam. Liq. 2 (H225)
Benzaldehyde	100-52-7	5 - 10%	Acute Tox. 4 (H302) Acute Tox. 4 (H332) Aquatic Acute 2 (H401) Flam. Liq. 4 (H227)
Alcohols, C12-16, ethoxylated	68551-12-2	1 - 5%	Acute Tox. 4 (H302) Skin Irrit. 2 (H315) Eye Corr. 1 (H318) Aquatic Acute 1 (H400) Aquatic Chronic 3 (H412)
Sodium iodide	7681-82-5	1 - 5%	Skin Irrit. 2 (H315) Eye Irrit. 2 (H319) STOT SE 3 (H335) STOT RE 1 (H372)

### 4. First aid measures

**Description of necessary first aid measures****Inhalation**

If inhaled, move victim to fresh air and seek medical attention.

**Eyes**

In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

**Skin**

In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.

**Ingestion** Get immediate medical attention. Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

**Symptoms caused by exposure**

Causes severe eye irritation which may damage tissue. Causes skin irritation. May cause allergic skin reaction. Harmful if swallowed. May cause damage to internal organs. May cause damage to organs through prolonged or repeated exposure. Potential reproductive hazard. May cause birth defects.

**Medical Attention and Special Treatment**

**Notes to Physician** Treat symptomatically

## 5. Fire Fighting Measures

**Suitable extinguishing equipment**

**Suitable Extinguishing Media**

Carbon dioxide, dry chemical, foam.

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical**

**Special exposure hazards in a fire**

May be ignited by heat, sparks or flames Use water spray to cool fire exposed surfaces. Closed containers may explode in fire. Decomposition in fire may produce harmful gases. Runoff to sewer may cause fire or explosion hazard.

**Special protective equipment and precautions for fire fighters**

**Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## 6. Accidental release measures

**6.1. Personal precautions, protective equipment and emergency procedures**

Remove sources of ignition. Use appropriate protective equipment. Wear self-contained breathing apparatus in enclosed areas. Avoid breathing vapors. Avoid contact with skin, eyes and clothing. Ensure adequate ventilation.

**6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas.

**6.3. Methods and material for containment and cleaning up**

Isolate spill and stop leak where safe. Remove ignition sources and work with non-sparking tools. Contain spill with sand or other inert materials. Scoop up and remove.

## 7. Handling and storage

**7.1. Precautions for safe handling**

**Handling Precautions**

Remove sources of ignition. Ensure adequate ventilation. Avoid breathing vapors. Avoid contact with eyes, skin, or clothing. Wash hands after use. Launder contaminated clothing before reuse. Ground and bond containers when transferring from one container to another. Use appropriate protective equipment.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities**

**Storage Information**

Store away from oxidizers. Keep from heat, sparks, and open flames. Store in a well ventilated area. Store locked up. Keep container closed when not in use. Product has a shelf life of 60 months.

**Other Guidelines**

No information available



## 8. Exposure Controls/Personal Protection

### Control parameters - exposure standards, biological monitoring

#### Exposure Limits

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Diethylene glycol	111-46-6	TWA: 23 ppm TWA: 100 mg/m <sup>3</sup>	Not applicable
Cinnamaldehyde	104-55-2	Not applicable	Not applicable
Amine oxides, cocoalkyldimethyl	61788-90-7	Not applicable	Not applicable
Methanol	67-56-1	TWA: 200 ppm TWA: 262 mg/m <sup>3</sup> STEL: 250 ppm STEL: 328 mg/m <sup>3</sup>	TWA: 200 ppm STEL: 250 ppm
Benzaldehyde	100-52-7	Not applicable	Not applicable
Alcohols, C12-16, ethoxylated	68551-12-2	Not applicable	Not applicable
Sodium iodide	7681-82-5	Not applicable	TWA: 0.01 ppm

#### Appropriate engineering controls

##### Engineering Controls

Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.

#### Personal protective equipment (PPE)

##### Personal Protective Equipment

If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

##### Respiratory Protection

If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Positive pressure self-contained breathing apparatus if methanol is released.

##### Hand Protection

Chemical-resistant protective gloves (EN 374) Suitable materials for longer, direct contact (recommended: protection index 6, corresponding to > 480 minutes permeation time as per EN 374): Butyl rubber gloves. (>= 0.7 mm thickness)  
This information is based on literature references and on information provided by glove manufacturers, or is derived by analogy with similar substances. Please note that in practice the working life of chemical-resistant protective gloves may be considerably shorter than the permeation time determined in accordance with EN 374 as a result of the many influencing factors (e.g. temperature). If signs of wear and tear are noticed then the gloves should be replaced. Manufacturer's directions for use should be observed because of great diversity of types.

##### Skin Protection

Rubber apron.

##### Eye Protection

Chemical goggles; also wear a face shield if splashing hazard exists.

##### Other Precautions

Eyewash fountains and safety showers must be easily accessible.

##### Environmental Exposure Controls

Do not allow material to contaminate ground water system

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

**Physical State:** Liquid

**Color:** Yellow-orange

**Odor:** Cinnamon

**Odor Threshold:** No information available

Property

Values

Remarks/ - Method

**pH:**

6.85 (10%)

**Freezing Point / Range**

-21 °C

**Melting Point / Range**

No data available

**Boiling Point / Range**

No data available

**Flash Point**

28.9 °C / 84 °F PMCC

**Evaporation rate**

No data available

<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	1.015
<b>Water Solubility</b>	Soluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

**9.2. Other information**

**VOC Content (%)** No data available

## 10. Stability and Reactivity

**10.1. Reactivity**

Not expected to be reactive.

**10.2. Chemical stability**

Stable

**10.3. Possibility of hazardous reactions**

Will Not Occur

**10.4. Conditions to avoid**

Keep away from heat, sparks and flame.

**10.5. Incompatible materials**

Strong oxidizers.

**10.6. Hazardous decomposition products**

Ammonia. Oxides of nitrogen. Hydrocarbons. Carbon monoxide and carbon dioxide.

## 11. Toxicological Information

**Information on routes of exposure**

**Principle Route of Exposure** Eye or skin contact, inhalation.

**Symptoms related to exposure****Most Important Symptoms/Effects**

Causes severe eye irritation which may damage tissue. Causes skin irritation. May cause allergic skin reaction. Harmful if swallowed. May cause damage to internal organs. May cause damage to organs through prolonged or repeated exposure. Potential reproductive hazard. May cause birth defects.

**Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Diethylene glycol	111-46-6	12565 - 19600 mg/kg (Rat)	11890 - 13300 mg/kg (Rabbit)	> 4.6 mg/L (Rat) 4h
Cinnamaldehyde	104-55-2	2220 mg/kg (rat)	620 mg/kg (rabbit)	No data available
Amine oxides, cocoalkyldimethyl	61788-90-7	846 - 3873 mg/kg (Rat) 1000-1250 mg/kg (Rat)	4290 mg/kg (Rabbit)	No data available
Methanol	67-56-1	300 mg/kg-bw (human) < 790 to 13,000 mg/kg (rat)	1000 mg/kg-bw (human) 17,100 mg/kg (rabbit)	10 mg/L (human, 4h, vapor)
Benzaldehyde	100-52-7	1430 mg/kg (rat)	No information available	>1 <5 mg/L air (Rat, 4h, mist)
Alcohols, C12-16, ethoxylated	68551-12-2	1600 mg/kg	No data available	No data available
Sodium iodide	7681-82-5	4340 mg/kg (Rat) 3118 mg/kg (Rats) (Similar substance)	No data available	LCLo: 50000 mg/m <sup>3</sup> (Mouse) 2h

**Immediate, delayed and chronic health effects from exposure****Product Information**

Based on the collective toxicity of product ingredients, the mixture should be considered to cause the following:

<b>Inhalation</b>	May cause respiratory irritation. May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.
<b>Eye Contact</b>	Causes severe eye irritation which may damage tissue.
<b>Skin Contact</b>	Causes skin irritation. May cause an allergic skin reaction.
<b>Ingestion</b>	Harmful if swallowed. May cause central nervous system depression including headache, dizziness, drowsiness, muscular weakness, incoordination, slowed reaction time, fatigue blurred vision, slurred speech, giddiness, tremors and convulsions. May cause liver and kidney damage.

**Chronic Effects/Carcinogenicity** Prolonged or repeated exposure may cause reproductive system damage.  
Prolonged or repeated exposure may cause embryo and fetus toxicity.

**Exposure Levels**

No data available

**Interactive effects**

Skin disorders. Eye ailments.

**Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Diethylene glycol	111-46-6	Non-irritating to the skin (Rabbit)
Cinnamaldehyde	104-55-2	Causes severe irritation and or burns (human)
Amine oxides, cocoalkyldimethyl	61788-90-7	Skin, rabbit: Causes moderate skin irritation.
Methanol	67-56-1	Non-irritating to the skin (Rabbit)
Benzaldehyde	100-52-7	Non-irritating to the skin (Rabbit)
Alcohols, C12-16, ethoxylated	68551-12-2	Causes skin irritation.
Sodium iodide	7681-82-5	Moderate dermal irritant (Rabbit)

Substances	CAS Number	Serious eye damage/irritation
Diethylene glycol	111-46-6	Non-irritating to the eye (Rabbit)
Cinnamaldehyde	104-55-2	Mild eye irritant. (human) (8 % solution)
Amine oxides, cocoalkyldimethyl	61788-90-7	Corrosive to eyes
Methanol	67-56-1	Non-irritating to the eye (Rabbit)
Benzaldehyde	100-52-7	Non-irritating to the eye (Rabbit)
Alcohols, C12-16, ethoxylated	68551-12-2	Causes severe eye irritation which may damage tissue.
Sodium iodide	7681-82-5	Moderately irritating to the eyes (Rabbit)

Substances	CAS Number	Skin Sensitization
Diethylene glycol	111-46-6	Did not cause sensitization on laboratory animals (guinea pig)
Cinnamaldehyde	104-55-2	Skin sensitizer in guinea pig.
Amine oxides, cocoalkyldimethyl	61788-90-7	No information available
Methanol	67-56-1	Did not cause sensitization on laboratory animals (guinea pig)
Benzaldehyde	100-52-7	Not sensitizing in Guinea Pigs (Guinea Pig Maximisation Test and Open Epicutaneous Test, Sensitizing in Draize Test and Freund's Complete Adjuvant Test)
Alcohols, C12-16, ethoxylated	68551-12-2	Did not cause sensitization on laboratory animals
Sodium iodide	7681-82-5	Patch test on human volunteers did not demonstrate sensitization properties

Substances	CAS Number	Respiratory Sensitization
Diethylene glycol	111-46-6	No information available
Cinnamaldehyde	104-55-2	No information available
Amine oxides, cocoalkyldimethyl	61788-90-7	No information available
Methanol	67-56-1	No information available
Benzaldehyde	100-52-7	No information available
Alcohols, C12-16, ethoxylated	68551-12-2	No information available

Sodium iodide	7681-82-5	No information available
<b>Substances</b>	<b>CAS Number</b>	<b>Mutagenic Effects</b>
Diethylene glycol	111-46-6	In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects.
Cinnamaldehyde	104-55-2	In vitro tests did not show mutagenic effects.
Amine oxides, cocoalkyldimethyl	61788-90-7	In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects. (similar substances)
Methanol	67-56-1	The weight of evidence from available in vitro and in vivo studies indicates that this substance is not expected to be mutagenic.
Benzaldehyde	100-52-7	Not mutagenic in AMES Test. Negative in the chromosomal aberration assay In vitro tests have shown mutagenic effects In vivo tests did not show mutagenic effects.
Alcohols, C12-16, ethoxylated	68551-12-2	Not regarded as mutagenic.
Sodium iodide	7681-82-5	In vitro tests did not show mutagenic effects. (similar substances)

<b>Substances</b>	<b>CAS Number</b>	<b>Carcinogenic Effects</b>
Diethylene glycol	111-46-6	Did not show carcinogenic effects in animal experiments (Rat)
Cinnamaldehyde	104-55-2	No information available
Amine oxides, cocoalkyldimethyl	61788-90-7	No information available
Methanol	67-56-1	No data of sufficient quality are available.
Benzaldehyde	100-52-7	Did not show carcinogenic effects in animal experiments (Rat) There was some evidence of carcinogenic activity in the forestomachs of mice.
Alcohols, C12-16, ethoxylated	68551-12-2	Not regarded as carcinogenic.
Sodium iodide	7681-82-5	No information available

<b>Substances</b>	<b>CAS Number</b>	<b>Reproductive toxicity</b>
Diethylene glycol	111-46-6	Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments.
Cinnamaldehyde	104-55-2	Did not show teratogenic effects in animal experiments.
Amine oxides, cocoalkyldimethyl	61788-90-7	Did not show teratogenic effects in animal experiments. When tested at maternally toxic doses, no adverse effects on teratogenicity or development were observed.
Methanol	67-56-1	Experiments have shown reproductive toxicity effects on laboratory animals
Benzaldehyde	100-52-7	Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments. (similar substances)
Alcohols, C12-16, ethoxylated	68551-12-2	Not regarded as a reproductive and developmental toxicant.
Sodium iodide	7681-82-5	Animal testing did not show any effects on fertility.

<b>Substances</b>	<b>CAS Number</b>	<b>STOT - single exposure</b>
Diethylene glycol	111-46-6	No significant toxicity observed in animal studies at concentration requiring classification.
Cinnamaldehyde	104-55-2	No information available
Amine oxides, cocoalkyldimethyl	61788-90-7	May cause respiratory irritation.
Methanol	67-56-1	May cause disorder and damage to the Central Nervous System (CNS)
Benzaldehyde	100-52-7	May cause respiratory irritation.
Alcohols, C12-16, ethoxylated	68551-12-2	No significant toxicity observed in animal studies at concentration requiring classification.
Sodium iodide	7681-82-5	No information available

<b>Substances</b>	<b>CAS Number</b>	<b>STOT - repeated exposure</b>
Diethylene glycol	111-46-6	Causes damage to organs through prolonged or repeated exposure: Kidney
Cinnamaldehyde	104-55-2	No significant toxicity observed in animal studies at concentration requiring classification.
Amine oxides, cocoalkyldimethyl	61788-90-7	No data of sufficient quality are available.
Methanol	67-56-1	No data of sufficient quality are available.
Benzaldehyde	100-52-7	No significant toxicity observed in animal studies at concentration requiring classification.
Alcohols, C12-16, ethoxylated	68551-12-2	No significant toxicity observed in animal studies at concentration requiring classification.
Sodium iodide	7681-82-5	Causes damage to organs through prolonged or repeated exposure: (Thyroid)

<b>Substances</b>	<b>CAS Number</b>	<b>Aspiration hazard</b>
Diethylene glycol	111-46-6	No information available
Cinnamaldehyde	104-55-2	Not applicable
Amine oxides, cocoalkyldimethyl	61788-90-7	No information available

Methanol	67-56-1	Not applicable
Benzaldehyde	100-52-7	Not applicable
Alcohols, C12-16, ethoxylated	68551-12-2	Not applicable
Sodium iodide	7681-82-5	Not applicable

## 12. Ecological Information

### Ecotoxicity

#### Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Diethylene glycol	111-46-6	TGK (8d) 2700 mg/L (Scenedesmus quadricauda)	LC50 75200 mg/L (Pimephales promelas)	EC20 (30m) > 1995 mg/L (domestic activated sludge)	EC50 84000 mg/L (Daphnia magna) EC50 >10000 mg/L (Daphnia magna)
Cinnamaldehyde	104-55-2	EC50 (72 h) 2.1 mg/L (Skeletonema costatum)	LC50 (96 h) 2.38 mg/L (Scophthalmus maximus)	IC50 (48h) 131.2 mg/L (Tetrahymena pyriformis)	LC50 (48 h) 1.4 mg/L (Acartia tonsa)
Amine oxides, cocoalkyldimethyl	61788-90-7	ErC50 (72h) 0.29 mg/L (Selenastrum capricornutum) ErC50 (72h) 0.0235 mg/L (Scenedesmus subspicatus) (similar substance)	LC50 (96h) 1.0–3.4 mg/L (Brachydanio rerio) LC50 (96h) 13.0 (Salmo gairdneri) LC50 (96h) 0.1-1 mg/L (Brachydanio rerio)	EC50 (3h) 240 mg/L (Pseudomonas putida) EC50 (3h) 13 mg/L (Activated sludge)	EC50 (48h) 2.9 mg/L (Daphnia magna) EC50 (48h) 0.083 mg/L (Daphnia magna) (similar substance)
Methanol	67-56-1	EC50 (96 h) =22000 mg/L (Pseudokirchnerella subcapitata) NOEC (8 d) =8000 mg/L (Scenedesmus quadricauda)	LC50 (96 h) =15400 mg/L (Lepomis macrochirus) EC50 (200 h) =14536 mg/L (Oryzias latipes)	IC50 (3h) > 1000 mg/L (activated sludge)	EC50 (96 h) =18260 mg/L (Daphnia magna) NOEC (21 d) =208 mg/L (Daphnia magna)
Benzaldehyde	100-52-7	NOEC (8d) 20 mg/L (Microcystis aeruginosa) NOEC (8d) 132 mg/L	LC50 (96 h) 1.07 mg/L (Lepomis macrochirus)	IC50 (3 h) 740 mg/L (Activated sludge)	EC50 (24 h) 50 mg/L (Daphnia magna)
Alcohols, C12-16, ethoxylated	68551-12-2	EC50 0.7 mg/L (Selenastrum capricornutum)	No information available	No information available	0.39 mg/L (Daphnia Magna)
Sodium iodide	7681-82-5	7 d Tox threshold: 2370 mg/L (Scenedesmus quadricauda, biomass) EC50(72h): 2588.7 mg/L (Skeletonema costatum)	LC50(96h): 3780 mg/L (Oncorhynchus mykiss) LC50(96h): > 100 mg/L (Scophthalmus maximus)	No information available	EC50(48h): 1.27 mg/L (Daphnia magna) EC50(48h): 575 mg/L (Acartia tonsa)

#### 12.2. Persistence and degradability

No data is available on the product itself

Substances	CAS Number	Persistence and Degradability
Diethylene glycol	111-46-6	Readily biodegradable (90-100% @ 28d)
Cinnamaldehyde	104-55-2	Predicted to be readily biodegradable.
Amine oxides, cocoalkyldimethyl	61788-90-7	Readily biodegradable (81% @ 28d)
Methanol	67-56-1	Readily biodegradable (95% @ 20d)
Benzaldehyde	100-52-7	Readily biodegradable (>=95% @ 28d)
Alcohols, C12-16, ethoxylated	68551-12-2	No information available
Sodium iodide	7681-82-5	Not applicable

#### 12.3. Bioaccumulative potential

No data is available on the product itself

Substances	CAS Number	Log Pow
Diethylene glycol	111-46-6	BCF: 100 (Leuciscus idus melanotus)
Cinnamaldehyde	104-55-2	Log Pow =1.4
Amine oxides, cocoalkyldimethyl	61788-90-7	Log Kow = 7.5
Methanol	67-56-1	Not Bioaccumulative; BCF=1
Benzaldehyde	100-52-7	Log Pow =1.1
Alcohols, C12-16, ethoxylated	68551-12-2	No information available
Sodium iodide	7681-82-5	-1.301

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Diethylene glycol	111-46-6	No information available
Cinnamaldehyde	104-55-2	No information available
Amine oxides, cocoalkyldimethyl	61788-90-7	No information available
Methanol	67-56-1	No information available
Benzaldehyde	100-52-7	No information available
Alcohols, C12-16, ethoxylated	68551-12-2	No information available
Sodium iodide	7681-82-5	No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

**13. Disposal Considerations****Safe handling and disposal methods**

Incineration recommended in approved incinerator according to federal, state, and local regulations. Substance should NOT be deposited into a sewage facility.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations. Contaminated packaging may be disposed of by: rendering packaging incapable of containing any substance, or treating packaging to remove residual contents, or treating packaging to make sure the residual contents are no longer hazardous, or by disposing of packaging into commercial waste collection.

**Environmental regulations**

Not applicable

**14. Transport Information****Transportation Information****Australia ADG**

**UN Number** UN1993  
**UN proper shipping name:** Flammable Liquid, N.O.S. (Contains Methanol)  
**Transport Hazard Class(es):** 3  
**Packing Group:** III  
**Environmental Hazards:** Not applicable

**IMDG/IMO**

**UN Number** UN1993  
**UN proper shipping name:** Flammable Liquid, N.O.S. (Contains Methanol)  
**Transport Hazard Class(es):** 3  
**Packing Group:** III  
**Environmental Hazards:** Not applicable  
**EMS:** EmS F-E, S-E

**IATA/ICAO**

**UN Number** UN1993  
**UN proper shipping name:** Flammable Liquid, N.O.S. (Contains Methanol)  
**Transport Hazard Class(es):** 3  
**Packing Group:** III  
**Environmental Hazards:** Not applicable

**Special precautions during transport**

None

**HazChem Code**

•3Y

## 15. Regulatory Information

### Safety, health and environmental regulations specific for the product

#### International Inventories

##### **Australian AICS Inventory**

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

##### **New Zealand Inventory of Chemicals**

All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

##### **EINECS (European Inventory of Existing Chemical Substances)**

This product does not comply with EINECS

##### **US TSCA Inventory**

All components listed on inventory or are exempt.

##### **Canadian Domestic Substances List (DSL)**

All components listed on inventory or are exempt.

#### Poisons Schedule number

None Allocated

#### International Agreements

**Montreal Protocol - Ozone Depleting Substances:**

Does not apply

**Stockholm Convention - Persistent Organic Pollutants:**

Does not apply

**Rotterdam Convention - Prior Informed Consent:**

Does not apply

**Basel Convention - Hazardous Waste:**

Does not apply

## 16. Other information

### Date of preparation or review

**Revision Date:** 09-Nov-2017

#### **Revision Note**

SDS sections updated:

14

#### **Full text of H-Statements referred to under sections 2 and 3**

H225 - Highly flammable liquid and vapor

H226 - Flammable liquid and vapor

H227 - Combustible liquid

H301 - Toxic if swallowed

H302 - Harmful if swallowed

H311 - Toxic in contact with skin

H312 - Harmful in contact with skin

H315 - Causes skin irritation

H317 - May cause an allergic skin reaction

H318 - Causes serious eye damage

H319 - Causes serious eye irritation

H331 - Toxic if inhaled

H332 - Harmful if inhaled

H335 - May cause respiratory irritation

H370 - Causes damage to organs

H372 - Causes damage to organs through prolonged or repeated exposure

H373 - May cause damage to organs through prolonged or repeated exposure

H400 - Very toxic to aquatic life

H401 - Toxic to aquatic life

H412 - Harmful to aquatic life with long lasting effects

#### **Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight  
CAS – Chemical Abstracts Service  
EC50 – Effective Concentration 50%  
LC50 – Lethal Concentration 50%  
LD50 – Lethal Dose 50%  
LL50 – Lethal Loading 50%  
mg/kg – milligram/kilogram  
mg/L – milligram/liter  
NOEC – No Observed Effect Concentration  
OEL – Occupational Exposure Limit  
PBT – Persistent Bioaccumulative and Toxic  
ppm – parts per million  
STEL – Short Term Exposure Limit  
TWA – Time-Weighted Average  
vPvB – very Persistent and very Bioaccumulative  
h - hour  
mg/m<sup>3</sup> - milligram/cubic meter  
mm - millimeter  
mmHg - millimeter mercury  
w/w - weight/weight  
d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)  
NZ CCID

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**End of Safety Data Sheet**



## SAFETY DATA SHEET

### DCA-19001

Revision Date: 05-Jul-2016

Revision Number: 20

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** DCA-19001

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM007662

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Crosslinker  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road  
Jandakot  
WA 6164  
Australia  
  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
E-mail Address fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951

##### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Serious Eye Damage/Irritation	Category 2 - H319
Reproductive Toxicity	Category 2 - H361

##### Label elements, including precautionary statements

**Hazard pictograms**

**Signal Word**

Danger

**Hazard Statements:**

H319 - Causes serious eye irritation  
 H361 - Suspected of damaging fertility or the unborn child

**Precautionary Statements****Prevention**

P201 - Obtain special instructions before use  
 P202 - Do not handle until all safety precautions have been read and understood  
 P264 - Wash face, hands and any exposed skin thoroughly after handling  
 P280 - Wear eye protection/face protection  
 P281 - Use personal protective equipment as required

**Response**

P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
 P337 + P313 - If eye irritation persists: Get medical advice/attention  
 P308 + P313 - IF exposed or concerned: Get medical advice/attention

**Storage**

P405 - Store locked up

**Disposal**

P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Contains****Substances**

Disodium octaborate tetrahydrate

**CAS Number**

12008-41-2

**Other hazards which do not result in classification**

This substance is not considered to be persistent, bioaccumulating nor toxic (PBT).  
 This substance is not considered to be very persistent nor very bioaccumulating (vPvB).

*For the full text of the H-phrases mentioned in this Section, see Section 16*

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Disodium octaborate tetrahydrate	12008-41-2	60 - 100%	Eye Irrit. 2A (H319) Repr. 2 (H361)

### 4. First aid measures

**Description of necessary first aid measures****Inhalation**

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

**Eyes**

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

**Skin**

Wash with soap and water. Get medical attention if irritation persists.

**Ingestion**

Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

**Symptoms caused by exposure**

Causes eye irritation Potential reproductive hazard. May cause birth defects.

**Medical Attention and Special Treatment**

**Notes to Physician** Treat symptomatically

## 5. Fire Fighting Measures

**Suitable extinguishing equipment****Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical****Special exposure hazards in a fire**

None anticipated

**Special protective equipment and precautions for fire fighters****Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## 6. Accidental release measures

**6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment. Avoid creating and breathing dust. Avoid contact with skin, eyes and clothing. Ensure adequate ventilation. Evacuate all persons from the area.

**6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas.

**6.3. Methods and material for containment and cleaning up**

Scoop up and remove.

## 7. Handling and storage

**7.1. Precautions for safe handling****Handling Precautions**

Avoid creating or inhaling dust. Ensure adequate ventilation. Avoid contact with eyes, skin, or clothing. Use appropriate protective equipment.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Store in a cool, dry location. Product has a shelf life of 60 months.

**Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

**Control parameters - exposure standards, biological monitoring****Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Disodium octaborate tetrahydrate	12008-41-2	Not applicable	2 mg/m <sup>3</sup>

**Appropriate engineering controls****Engineering Controls**

Use in a well ventilated area.

**Personal protective equipment (PPE)**

<b>Personal Protective Equipment</b>	If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.
<b>Respiratory Protection</b>	If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Dust/mist respirator. (N95, P2/P3)
<b>Hand Protection</b>	Impervious rubber gloves.
<b>Skin Protection</b>	Normal work coveralls.
<b>Eye Protection</b>	Dust proof goggles.
<b>Other Precautions</b>	None known.
<b>Environmental Exposure Controls</b>	Do not allow material to contaminate ground water system

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

<b>Physical State:</b>	Solid	<b>Color</b>	White
<b>Odor:</b>	Odorless	<b>Odor Threshold:</b>	No information available

Property	Values
Remarks/ - Method	
<b>pH:</b>	7.3
<b>Freezing Point / Range</b>	No data available
<b>Melting Point / Range</b>	> 1000 °C
<b>Boiling Point / Range</b>	No data available
<b>Flash Point</b>	No data available
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	9.9E-17 pa @ 25°C
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	1.7
<b>Water Solubility</b>	Soluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

### 9.2. Other information

<b>VOC Content (%)</b>	No data available
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## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

### 10.2. Chemical stability

Stable

### 10.3. Possibility of hazardous reactions

Will Not Occur

### 10.4. Conditions to avoid

None anticipated

### 10.5. Incompatible materials

None known.

### 10.6. Hazardous decomposition products

None known.

## 11. Toxicological Information

**Information on routes of exposure**

**Principle Route of Exposure** Eye or skin contact, inhalation.

**Symptoms related to exposure****Most Important Symptoms/Effects**

Causes eye irritation Potential reproductive hazard. May cause birth defects.

**Numerical measures of toxicity****Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Disodium octaborate tetrahydrate	12008-41-2	2550 mg/kg-bw (rat) (similar substance)	>2000 mg/kg-bw (rat) (similar substance)	>2 mg/L (dust, rat, 4 h) (similar substance)

**Immediate, delayed and chronic health effects from exposure**

**Inhalation** May cause respiratory irritation.  
**Eye Contact** Causes eye irritation.  
**Skin Contact** May cause mild skin irritation.  
**Ingestion** May cause abdominal pain, vomiting, nausea, and diarrhea.

**Chronic Effects/Carcinogenicity** Prolonged or repeated exposure may cause reproductive system damage.  
Prolonged or repeated exposure may cause embryo and fetus toxicity.

**Exposure Levels**

No data available

**Interactive effects**

None known.

**Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Disodium octaborate tetrahydrate	12008-41-2	Not irritating to skin in rabbits. (similar substances)

Substances	CAS Number	Serious eye damage/irritation
Disodium octaborate tetrahydrate	12008-41-2	Eye, rabbit: Causes moderate eye irritation

Substances	CAS Number	Skin Sensitization
Disodium octaborate tetrahydrate	12008-41-2	Did not cause sensitization on laboratory animals (guinea pig)

Substances	CAS Number	Respiratory Sensitization
Disodium octaborate tetrahydrate	12008-41-2	No information available

Substances	CAS Number	Mutagenic Effects
Disodium octaborate tetrahydrate	12008-41-2	In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects. (similar substances)

Substances	CAS Number	Carcinogenic Effects
Disodium octaborate tetrahydrate	12008-41-2	Did not show carcinogenic effects in animal experiments (similar substances)

Substances	CAS Number	Reproductive toxicity
Disodium octaborate tetrahydrate	12008-41-2	May impair fertility May cause birth defects (similar substances)

Substances	CAS Number	STOT - single exposure
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Disodium octaborate tetrahydrate	12008-41-2	No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)
<b>Substances</b>	<b>CAS Number</b>	<b>STOT - repeated exposure</b>
Disodium octaborate tetrahydrate	12008-41-2	No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)
<b>Substances</b>	<b>CAS Number</b>	<b>Aspiration hazard</b>
Disodium octaborate tetrahydrate	12008-41-2	Not applicable

## 12. Ecological Information

### Ecotoxicity

#### **Product Ecotoxicity Data**

No data available

#### **Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Disodium octaborate tetrahydrate	12008-41-2	EC10 (3 d) 96.5 mg/L (Pseudokirchneriella subcapitata)	LC50 (96 h) 314.6 mg/L (Pimephales promelas) NOEC (34 d) 25.2 mg/L (Danio rerio)	EC50 (3 h) >39371 mg/L (activated sludge)	NOEC (21 d) 42.5 mg/L (Daphnia magna)

### 12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Disodium octaborate tetrahydrate	12008-41-2	The methods for determining biodegradability are not applicable to inorganic substances.

### 12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Disodium octaborate tetrahydrate	12008-41-2	No information available

### 12.4. Mobility in soil

Substances	CAS Number	Mobility
Disodium octaborate tetrahydrate	12008-41-2	No information available

### 12.6. Other adverse effects

#### **Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

## 13. Disposal Considerations

### Safe handling and disposal methods

Bury in a licensed landfill according to federal, state, and local regulations.

### Disposal of any contaminated packaging

Follow all applicable national or local regulations.

### Environmental regulations

Not applicable

## 14. Transport Information

### Transportation Information

#### Australia ADG

<b>UN Number</b>	Not restricted
<b>UN proper shipping name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**IMDG/IMO**

<b>UN Number</b>	Not restricted
<b>UN proper shipping name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**IATA/ICAO**

<b>UN Number</b>	Not restricted
<b>UN proper shipping name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

**15. Regulatory Information****Safety, health and environmental regulations specific for the product****International Inventories****Australian AICS Inventory**

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

**New Zealand Inventory of Chemicals**

All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

**EINECS (European Inventory of Existing Chemical Substances)**

This product, and all its components, complies with EINECS

**US TSCA Inventory**

All components listed on inventory or are exempt.

**Canadian Domestic Substances List (DSL)**

All components listed on inventory or are exempt.

**Poisons Schedule number**

S5

**International Agreements****Montreal Protocol - Ozone Depleting Substances:**

Does not apply

**Stolkhom Convention - Persistent Organic Pollutants:**

Does not apply

**Rotterdam Convention - Prior Informed Consent:**

Does not apply

**Basel Convention - Hazardous Waste:**

Does not apply

**16. Other information****Date of preparation or review****Revision Date:** 05-Jul-2016**Revision Note**

SDS sections updated: 2

**Full text of H-Statements referred to under sections 2 and 3**

H319 - Causes serious eye irritation

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H361 - Suspected of damaging fertility or the unborn child

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight

CAS – Chemical Abstracts Service

EC50 – Effective Concentration 50%

LC50 – Lethal Concentration 50%

LD50 – Lethal Dose 50%

LL50 – Lethal Loading 50%

mg/kg – milligram/kilogram

mg/L – milligram/liter

NOEC – No Observed Effect Concentration

OEL – Occupational Exposure Limit

PBT – Persistent Bioaccumulative and Toxic

ppm – parts per million

STEL – Short Term Exposure Limit

TWA – Time-Weighted Average

vPvB – very Persistent and very Bioaccumulative

h - hour

mg/m<sup>3</sup> - milligram/cubic meter

mm - millimeter

mmHg - millimeter mercury

w/w - weight/weight

d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

OSHA

ECHA C&L

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**End of Safety Data Sheet**



## SAFETY DATA SHEET

### DCA-19002

Revision Date: 05-Jul-2016

Revision Number: 19

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** DCA-19002

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM007663

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Crosslinker  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road  
Jandakot  
WA 6164  
Australia  
  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-mail Address** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951

##### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Serious Eye Damage/Irritation	Category 2 - H319
Reproductive Toxicity	Category 1B - H360
Specific Target Organ Toxicity - (Repeated Exposure)	Category 1 - H372

##### Label elements, including precautionary statements

**Hazard pictograms**

**Signal Word**

Danger

**Hazard Statements:**

H319 - Causes serious eye irritation  
 H360 - May damage fertility or the unborn child  
 H372 - Causes damage to organs through prolonged or repeated exposure

**Precautionary Statements****Prevention**

P201 - Obtain special instructions before use  
 P202 - Do not handle until all safety precautions have been read and understood  
 P260 - Do not breathe dust/fume/gas/mist/vapors/spray  
 P264 - Wash face, hands and any exposed skin thoroughly after handling  
 P270 - Do not eat, drink or smoke when using this product  
 P280 - Wear eye protection/face protection  
 P281 - Use personal protective equipment as required

**Response**

P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
 P337 + P313 - If eye irritation persists: Get medical advice/attention  
 P308 + P313 - IF exposed or concerned: Get medical advice/attention  
 P314 - Get medical attention/advice if you feel unwell

**Storage**

P405 - Store locked up

**Disposal**

P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Contains****Substances**

	<b>CAS Number</b>
Ulexite	1319-33-1
Ethylene glycol	107-21-1
Crystalline silica, quartz	14808-60-7

**Other hazards which do not result in classification**

This mixture contains no substance considered to be persistent, bioaccumulating nor toxic (PBT).

This mixture contains no substance considered to be very persistent nor very bioaccumulating (vPvB).

*For the full text of the H-phrases mentioned in this Section, see Section 16*

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Ulexite	1319-33-1	30 - 60%	Eye Irrit. 2A (H319) Repr. 1 (H360)
Ethylene glycol	107-21-1	10 - 30%	Acute Tox. 4 (H302) STOT RE 1 (H372)
Crystalline silica, quartz	14808-60-7	1 - 5%	Carc. 2 (H351) STOT RE 1 (H372)

### 4. First aid measures

**Description of necessary first aid measures****Inhalation**

If inhaled, move victim to fresh air and seek medical attention.

<b>Eyes</b>	Immediately flush eyes with large amounts of water for at least 15 minutes. Get immediate medical attention.
<b>Skin</b>	Wash off immediately with soap and plenty of water for at least 15 minutes while removing all contaminated clothing and shoes.
<b>Ingestion</b>	Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

**Symptoms caused by exposure**

Causes eye irritation Potential reproductive hazard. May cause birth defects. Prolonged or repeated exposure may cause damage to organs. Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

**Medical Attention and Special Treatment**

**Notes to Physician** Treat symptomatically

## **5. Fire Fighting Measures**

**Suitable extinguishing equipment****Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical****Special exposure hazards in a fire**

Decomposition in fire may produce harmful gases.

**Special protective equipment and precautions for fire fighters****Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## **6. Accidental release measures**

**6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment. Avoid contact with skin, eyes and clothing. Avoid breathing vapors. Ensure adequate ventilation. Evacuate all persons from the area.

**6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas. Consult local authorities.

**6.3. Methods and material for containment and cleaning up**

Contain spill with sand or other inert materials. Scoop up and remove. Isolate spill and stop leak where safe.

## **7. Handling and storage**

**7.1. Precautions for safe handling****Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Avoid breathing mist. This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud if this product becomes dry. Avoid breathing or creating dust. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using dried product. Ensure adequate ventilation. Material is slippery underfoot. Use appropriate protective equipment.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Store away from oxidizers. Store in a cool well ventilated area. Keep container closed when not in use.

**Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

### Control parameters - exposure standards, biological monitoring

#### Exposure Limits

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Ulexite	1319-33-1	Not applicable	Not applicable
Ethylene glycol	107-21-1	TWA: 10 mg/m <sup>3</sup> TWA: 20 ppm TWA: 52 mg/m <sup>3</sup> STEL: 40 ppm STEL: 104 mg/m <sup>3</sup>	Ceiling: 100 mg/m <sup>3</sup> (aerosol only)
Crystalline silica, quartz	14808-60-7	TWA: 0.1 mg/m <sup>3</sup>	TWA: 0.025 mg/m <sup>3</sup>

### Appropriate engineering controls

**Engineering Controls** Use in a well ventilated area.

### Personal protective equipment (PPE)

**Personal Protective Equipment** If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

**Respiratory Protection** If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.  
Organic vapor respirator.

**Hand Protection**

Rubber gloves.

**Skin Protection**

Rubber apron.

**Eye Protection**

Chemical goggles; also wear a face shield if splashing hazard exists.

**Other Precautions**

None known.

**Environmental Exposure Controls**

Do not allow material to contaminate ground water system

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

**Physical State:** Liquid

**Color** Milky white

**Odor:** Odorless

**Odor Threshold:** No information available

Property

Values

Remarks/ - Method

**pH:**

6.5 - 7.5

**Freezing Point / Range**

-34 °C

**Melting Point / Range**

No data available

**Boiling Point / Range**

No data available

**Flash Point**

No data available

**Evaporation rate**

No data available

**Vapor Pressure**

No data available

**Vapor Density**

No data available

**Specific Gravity**

1.45

**Water Solubility**

Soluble in water

**Solubility in other solvents**

No data available

**Partition coefficient: n-octanol/water**

No data available

**Autoignition Temperature**

No data available

**Decomposition Temperature**

No data available

**Viscosity**

No data available

**Explosive Properties**

No information available

**Oxidizing Properties**

No information available

**9.2. Other information**

VOC Content (%)

No data available

**10. Stability and Reactivity****10.1. Reactivity**

Not expected to be reactive.

**10.2. Chemical stability**

Stable

**10.3. Possibility of hazardous reactions**

Will Not Occur

**10.4. Conditions to avoid**

None anticipated

**10.5. Incompatible materials**

Strong oxidizers.

**10.6. Hazardous decomposition products**

Carbon monoxide and carbon dioxide.

**11. Toxicological Information****Information on routes of exposure****Principle Route of Exposure** Eye or skin contact, inhalation.**Symptoms related to exposure****Most Important Symptoms/Effects**

Causes eye irritation Potential reproductive hazard. May cause birth defects. Prolonged or repeated exposure may cause damage to organs. Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

**Numerical measures of toxicity****Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Ulexite	1319-33-1	3493-6080 mg/kg (Rat) (similar substance) 3450 mg/kg (Male Rat) (similar substance)	> 2000 mg/kg (Rabbit) (similar substance)	> 2 mg/L (Rat) 4h (similar substance) > 2.12 mg/L (Rat) 4h (similar substance) > 2.04 mg/L (Rat) 4h (similar substance)
Ethylene glycol	107-21-1	4000 mg/kg (Rat) 7712 mg/kg (Rat) > 10000 mg/kg (Rat) 1670 mg/kg (Cat) 1400 – 1600 mg/kg (Human)	9530 µL/kg (Rabbit) > 3500 mg/kg (Mouse)	> 2.5 mg/L (Rat) 6h (saturated concentration)
Crystalline silica, quartz	14808-60-7	> 15000 mg/kg (human)	No information available	No data available

**Immediate, delayed and chronic health effects from exposure****Inhalation**

May cause respiratory irritation. In high air concentrations: May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness. Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).

Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).

**Eye Contact**

Causes eye irritation.

**Skin Contact**

May cause mild skin irritation.

**Ingestion**

May be harmful if swallowed. In large amounts: May cause abdominal pain, vomiting,

nausea, and diarrhea. May cause heart, kidney and brain disorders.

**Chronic Effects/Carcinogenicity** Prolonged or repeated exposure may cause embryo and fetus toxicity. Prolonged or repeated exposure may cause reproductive system damage. Repeated overexposure may cause liver and kidney effects. Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

See "Inhalation" subsection above with respect to silicosis, cancer status and other data with possible relevance to human health. There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

#### **Exposure Levels**

No data available

#### **Interactive effects**

Eye ailments. Skin disorders. Liver and kidney disorders. Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.

#### **Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Ulexite	1319-33-1	Non-irritating to the skin (Rabbit) (similar substances)
Ethylene glycol	107-21-1	Non-irritating to the skin (Rabbit)
Crystalline silica, quartz	14808-60-7	Non-irritating to the skin

Substances	CAS Number	Serious eye damage/irritation
Ulexite	1319-33-1	Causes moderate eye irritation (Rabbit) (similar substances)
Ethylene glycol	107-21-1	Non-irritating to the eye (Rabbit)
Crystalline silica, quartz	14808-60-7	Mechanical irritation of the eyes is possible. No information available

Substances	CAS Number	Skin Sensitization
Ulexite	1319-33-1	Did not cause sensitization on laboratory animals (guinea pig) (similar substances)
Ethylene glycol	107-21-1	Did not cause sensitization on laboratory animals (guinea pig) Patch test on human volunteers did not demonstrate sensitization properties
Crystalline silica, quartz	14808-60-7	No information available.

Substances	CAS Number	Respiratory Sensitization
Ulexite	1319-33-1	No information available
Ethylene glycol	107-21-1	No information available
Crystalline silica, quartz	14808-60-7	No information available

Substances	CAS Number	Mutagenic Effects
Ulexite	1319-33-1	In vitro tests did not show mutagenic effects (similar substances)
Ethylene glycol	107-21-1	In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects.
Crystalline silica, quartz	14808-60-7	Not regarded as mutagenic.

Substances	CAS Number	Carcinogenic Effects
Ulexite	1319-33-1	Did not show carcinogenic effects in animal experiments (similar substances)
Ethylene glycol	107-21-1	Did not show carcinogenic effects in animal experiments
Crystalline silica, quartz	14808-60-7	Contains crystalline silica which may cause silicosis, a delayed and progressive lung disease. The IARC and NTP have determined there is sufficient evidence in humans of the carcinogenicity of crystalline silica with repeated respiratory exposure. Based on available scientific evidence, this

		substance is a threshold carcinogen with a mode of action involving indirect genotoxicity secondary to lung injury.
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Substances	CAS Number	Reproductive toxicity
Ulexite	1319-33-1	Experiments have shown reproductive toxicity effects on laboratory animals (similar substances)
Ethylene glycol	107-21-1	Fetotoxic and teratogenic effects observed in experimental animals at concentrations that did not produce maternal toxicity.
Crystalline silica, quartz	14808-60-7	No information available

Substances	CAS Number	STOT - single exposure
Ulexite	1319-33-1	None under normal use conditions
Ethylene glycol	107-21-1	No significant toxicity observed in animal studies at concentration requiring classification.
Crystalline silica, quartz	14808-60-7	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	STOT - repeated exposure
Ulexite	1319-33-1	None under normal use conditions
Ethylene glycol	107-21-1	Causes damage to organs through prolonged or repeated exposure: (Kidney)
Crystalline silica, quartz	14808-60-7	Causes damage to organs through prolonged or repeated exposure if inhaled: (Lungs)

Substances	CAS Number	Aspiration hazard
Ulexite	1319-33-1	Not applicable
Ethylene glycol	107-21-1	No information available
Crystalline silica, quartz	14808-60-7	Not applicable

## 12. Ecological Information

### Ecotoxicity

#### Product Ecotoxicity Data

No data available

#### Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Ulexite	1319-33-1	EC50 (72h) 1398.64 mg/L (Skeletonema costatum)	LC50 (96h) > 320 mg/L (Scophthalmus maximus) LC50 (96h) > 1100 mg/L (Oncorhynchus mykiss) LC50 (96h) > 1021 mg/L (Lepomis macrochirus) LD50 (28d) 65 mg/L (Oncorhynchus mykiss)	No information available	EC50 (48h) 7341.67 mg/L (Acartia tonsa) EC50 (48h) 133 mg/L (Daphnia magna)
Ethylene glycol	107-21-1	EC50 6500 - 13000 mg/L (Pseudokirchneriella subcapitata) TGK (8d) > 10000 mg/L (Scenedesmus quadricauda)	LC50 41000 mg/L (Oncorhynchus mykiss) LC50 (96h) 72860 mg/L (Pimephales promelas) NOEC (7d) 15380 mg/L (mortality) (Pimephales promelas)	TTC (16h) > 10000 mg/L (Pseudomonas putida) EC20 (30 m) > 1995 mg/L (activated sludge, domestic) (similar substance)	EC50 46300 mg/L (Daphnia magna) EC50 (48h) >100 mg/L (Daphnia magna) NOEC (7d) 8590 mg/L (reproduction) (Ceriodaphnia dubia)
Crystalline silica, quartz	14808-60-7	EC50 (72 h) =440 mg/L (Selenastrum capricornutum)	LL0 (96 h) =10000 mg/L (Danio rerio)	No information available	LL50 (24 h) >10000 mg/L (Daphnia magna)

### 12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Ulexite	1319-33-1	The methods for determining biodegradability are not applicable to inorganic substances.
Ethylene glycol	107-21-1	Readily biodegradable (100% @ 10d)
Crystalline silica, quartz	14808-60-7	The methods for determining biodegradability are not applicable to inorganic substances.

### 12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow

Ulexite	1319-33-1	0.175
Ethylene glycol	107-21-1	-1.36
Crystalline silica, quartz	14808-60-7	No information available

#### 12.4. Mobility in soil

Substances	CAS Number	Mobility
Ulexite	1319-33-1	No information available
Ethylene glycol	107-21-1	No information available
Crystalline silica, quartz	14808-60-7	No information available

#### 12.6. Other adverse effects

##### **Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

### 13. Disposal Considerations

#### Safe handling and disposal methods

Disposal should be made in accordance with federal, state, and local regulations.

#### Disposal of any contaminated packaging

Follow all applicable national or local regulations.

#### Environmental regulations

Not applicable

### 14. Transport Information

#### Transportation Information

##### Australia ADG

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

##### IMDG/IMO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

##### IATA/ICAO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

#### Special precautions during transport

None

#### HazChem Code

None Allocated

### 15. Regulatory Information

#### Safety, health and environmental regulations specific for the product



**International Inventories****Australian AICS Inventory**

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

**New Zealand Inventory of Chemicals**

All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

**EINECS (European Inventory of Existing Chemical Substances)**

This product, and all its components, complies with EINECS

**US TSCA Inventory**

All components listed on inventory or are exempt.

**Canadian Domestic Substances List (DSL)**

All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

**International Agreements****Montreal Protocol - Ozone Depleting Substances:**

Does not apply

**Stokholm Convention - Persistent Organic Pollutants:**

Does not apply

**Rotterdam Convention - Prior Informed Consent:**

Does not apply

**Basel Convention - Hazardous Waste:**

Does not apply

<b>16. Other information</b>
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**Date of preparation or review**

**Revision Date:** 05-Jul-2016

**Revision Note**

SDS sections updated: 2

**Full text of H-Statements referred to under sections 2 and 3**

H302 - Harmful if swallowed

H319 - Causes serious eye irritation

H351 - Suspected of causing cancer if inhaled

H360 - May damage fertility or the unborn child

H372 - Causes damage to organs through prolonged or repeated exposure if swallowed

H372 - Causes damage to organs through prolonged or repeated exposure if inhaled

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight

CAS – Chemical Abstracts Service

EC50 – Effective Concentration 50%

LC50 – Lethal Concentration 50%

LD50 – Lethal Dose 50%

LL50 – Lethal Loading 50%

mg/kg – milligram/kilogram

mg/L – milligram/liter

NOEC – No Observed Effect Concentration

OEL – Occupational Exposure Limit

PBT – Persistent Bioaccumulative and Toxic

ppm – parts per million

STEL – Short Term Exposure Limit

TWA – Time-Weighted Average

vPvB – very Persistent and very Bioaccumulative

h - hour

mg/m<sup>3</sup> - milligram/cubic meter

mm - millimeter

mmHg - millimeter mercury  
w/w - weight/weight  
d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)  
OSHA  
ECHA C&L

**Disclaimer Statement**

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

**End of Safety Data Sheet**

## SAFETY DATA SHEET

### DCA-21003

Revision Date: 30-Sep-2015

Revision Number: 9

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** DCA-21003

##### Other means of Identification

**Synonyms:** None  
**Product Code:** HM007806

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Fluid Loss Additive

**Uses Advised Against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton/Baroid Australia Pty. Ltd.  
15 Marriott Road  
Jandakot  
WA 6164  
Australia

ACN Number: 009 000 775  
Telephone Number: 61 (08) 9455 8300  
Fax Number: 61 (08) 9455 5300

##### **Product Emergency Telephone**

Australia: + 61 1 800 686 951  
Papua New Guinea: + 61 1 800 686 951  
NewZealand: +64 800 451719

##### **Fire, Police & Ambulance - Emergency Telephone**

Australia: 000  
Papua New Guinea: 000  
New Zealand: 111

**E-Mail address:** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951

##### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous

Goods according to the criteria of ADG.

**Classification of the hazardous chemical**

Not classified

**Label elements, including precautionary statements**

**Hazard Pictograms**

**Signal Word** Not Hazardous

**Hazard Statements** Not Classified

**Precautionary Statements**

**Prevention** None

**Response** None

**Storage** None

**Disposal** None

**Contains**

**Substances**

Contains no hazardous substances in concentrations above cut-off values according to the competent authority

**CAS Number**

NA

**Other hazards which do not result in classification**

None known

**Australia Classification**

*For the full text of the H-phrases mentioned in this Section, see Section 16*

**Classification** Not Classified

**Risk Phrases** None

**3. Composition/information on Ingredients**

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	60 - 100%	Not Applicable

**4. First aid measures**

**Description of necessary first aid measures**

**Inhalation**

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

**Eyes**

Immediately flush eyes with large amounts of water for at least 15 minutes. Get immediate medical attention.

**Skin**

Wash with soap and water. Get medical attention if irritation persists.

**Ingestion**

If swallowed, induce vomiting immediately by giving two glasses of water and sticking fingers down throat; never give anything to an unconscious person. Get medical attention.

**Symptoms caused by exposure**

No significant hazards expected.

**Medical Attention and Special Treatment**

Notes to Physician Treat symptomatically

**5. Fire Fighting Measures****Suitable extinguishing equipment****Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical****Special Exposure Hazards**

Decomposition in fire may produce harmful gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

**Special protective equipment and precautions for fire fighters****Special Protective Equipment for Fire-Fighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

**6. Accidental release measures****6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment. Spills of this product are very slippery.

**6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas.

**6.3. Methods and material for containment and cleaning up**

Scoop up and remove.

**7. Handling and storage****7.1. Precautions for Safe Handling****Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust. Avoid dust accumulations.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Store between 40.5 F (4.7 C) and 120.5 F (49 C). Store away from oxidizers. Store in a cool, dry location. Product has a shelf life of 24 months.

**Other Guidelines**

No information available

**8. Exposure Controls/Personal Protection****Control parameters - exposure standards, biological monitoring****Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	Not applicable	Not applicable

**Appropriate engineering controls**

**Engineering Controls** Use in a well ventilated area.

**Personal protective equipment (PPE)**

**Respiratory Protection** If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.  
Dust/mist respirator. (N95, P2/P3)

**Hand Protection** Normal work gloves.

**Skin Protection** Normal work coveralls.

**Eye Protection** Wear safety glasses or goggles to protect against exposure.

**Other Precautions** None known.

**Environmental Exposure Controls** No information available

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

**Physical State:** Powder      **Color:** White to off white  
**Odor:** Sweet      **Odor Threshold:** No information available

<u>Property</u>	<u>Values</u>
<u>Remarks/ - Method</u>	
<b>pH:</b>	No data available
<b>Freezing Point/Range</b>	No data available
<b>Melting Point/Range</b>	No data available
<b>Boiling Point/Range</b>	No data available
<b>Flash Point</b>	No data available
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	1.24
<b>Water Solubility</b>	Insoluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	388 °C / 730 °F
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

### 9.2. Other information

**VOC Content (%)** No data available

## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

### 10.2. Chemical Stability

Stable

### 10.3. Possibility of Hazardous Reactions

Will Not Occur

### 10.4. Conditions to Avoid

Temperature over 440 F (240 C).

### 10.5. Incompatible Materials

Strong oxidizers. Strong alkalis.

### 10.6. Hazardous Decomposition Products

Toxic fumes. Aldehydes. Carbon monoxide and carbon dioxide.

## 11. Toxicological Information

**Information on routes of exposure****Principle Route of Exposure** Eye or skin contact, inhalation.**Symptoms related to exposure****Most Important Symptoms/Effects**

No significant hazards expected.

**Numerical measures of toxicity****LD50 Oral:** > 5000 mg/kg; (Rat)**LD50 Dermal:** > 2000 mg/kg; (Rabbit)**Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No data available	No data available	No data available

**Immediate, delayed and chronic health effects from exposure****Inhalation** May cause mild respiratory irritation.**Eye Contact** May cause mild eye irritation.**Skin Contact** Prolonged or repeated contact may cause slight skin irritation.**Ingestion** Irritation of the mouth, throat, and stomach. Large doses may cause nausea, vomiting and diarrhea.**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.**Exposure Levels**

No data available

**Interactive effects**

None known.

**Data limitations**

No data available

<b>12. Ecological Information</b>
-----------------------------------

**Ecotoxicity****Product Ecotoxicity Data**

No data available

**Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Contains no hazardous substances	NA	No information available	No information available	No information available	No information available

in concentrations above cut-off values according to the competent authority					
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**12.2. Persistence and degradability**

Substances	CAS Number	Persistence and Degradability
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.3. Bioaccumulative potential**

Does not bioaccumulate

Substances	CAS Number	Log Pow
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

<b>13. Disposal Considerations</b>
------------------------------------

**Safe handling and disposal methods**

Bury in a licensed landfill according to federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

<b>14. Transport Information</b>
----------------------------------

**Transportation Information**

<b>UN Number:</b>	Not restricted
<b>UN Proper Shipping Name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

<b>15. Regulatory Information</b>
-----------------------------------

**Safety, health and environmental regulations specific for the product**



**International Inventories****Australian AICS Inventory  
New Zealand Inventory of  
Chemicals**

All components listed on inventory or are exempt.  
All components listed on inventory or are exempt.

**EINECS Inventory  
US TSCA Inventory  
Canadian DSL Inventory**

This product, and all its components, complies with EINECS  
All components listed on inventory or are exempt.  
All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

**16. Other information****Date of preparation or review**

**Revision Date:** 30-Sep-2015

**Revision Note**

SDS sections updated: 2

**Full text of R-phrases referred to under Sections 2 and 3**

None

**Full text of H-Statements referred to under sections 2 and 3**

None

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight CAS – Chemical Abstracts Service EC50 – Effective Concentration 50% LC50 – Lethal Concentration 50% LD50 – Lethal Dose 50% LL50 – Lethal Loading 50% mg/kg – milligram/kilogram mg/L – milligram/liter NOEC – No Observed Effect Concentration OEL – Occupational Exposure Limit PBT – Persistent Bioaccumulative and Toxic ppm – parts per million STEL – Short Term Exposure Limit TWA – Time-Weighted Average vPvB – very Persistent and very Bioaccumulative h - hour mg/m<sup>3</sup> - milligram/cubic meter mm - millimeter mmHg - millimeter mercury w/w - weight/weight d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

**Disclaimer Statement**

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

**End of Safety Data Sheet**

## SAFETY DATA SHEET

### DCA-23001

Revision Date: 30-Sep-2015

Revision Number: 10

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** DCA-23001

##### Other means of Identification

**Synonyms:** None  
**Product Code:** HM007701

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Friction Reducer  
**Uses Advised Against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road  
Jandakot  
WA 6164  
Australia  
  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-Mail address:** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951

##### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Not classified

##### Label elements, including precautionary statements

##### **Hazard Pictograms**

**Signal Word** Not Hazardous

**Hazard Statements** Not Classified

**Precautionary Statements**

**Prevention** None

**Response** None

**Storage** None

**Disposal** None

**Contains**

**Substances**

Contains no hazardous substances in concentrations above cut-off values according to the competent authority

**CAS Number**

NA

**Other hazards which do not result in classification**

This mixture contains no substance considered to be persistent, bioaccumulating nor toxic (PBT).

This mixture contains no substance considered to be very persistent nor very bioaccumulating (vPvB).

**Australia Classification**

For the full text of the H-phrases mentioned in this Section, see Section 16

**Classification** Not Classified

**Risk Phrases** None

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	60 - 100%	Not Applicable

### 4. First aid measures

**Description of necessary first aid measures**

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

**Eyes** Immediately flush eyes with large amounts of water for at least 15 minutes. Get immediate medical attention.

**Skin** Wash with soap and water. Get medical attention if irritation persists.

**Ingestion** Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

**Symptoms caused by exposure**

No significant hazards expected.

**Medical Attention and Special Treatment**

**Notes to Physician** Treat symptomatically

### 5. Fire Fighting Measures

**Suitable extinguishing equipment**

**Suitable Extinguishing Media**

All standard fire fighting media

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical**

**Special Exposure Hazards**

Not applicable.

**Special protective equipment and precautions for fire fighters**

**Special Protective Equipment for Fire-Fighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## 6. Accidental release measures

**6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment. Avoid creating and breathing dust. Avoid contact with skin, eyes and clothing. Ensure adequate ventilation.

**6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas.

**6.3. Methods and material for containment and cleaning up**

Scoop up and remove.

## 7. Handling and storage

**7.1. Precautions for Safe Handling**

**Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust. Ensure adequate ventilation. Ground and bond containers when transferring from one container to another. Slippery when wet. Wash hands after use. Launder contaminated clothing before reuse. Use appropriate protective equipment.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities**

**Storage Information**

Store in a cool, dry location. Keep container closed when not in use. Keep from heat, sparks, and open flames. Product has a shelf life of 24 months.

**Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

**Control parameters - exposure standards, biological monitoring**

**Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	Not applicable	Not applicable

**Appropriate engineering controls**

**Engineering Controls**

Use in a well ventilated area.

**Personal protective equipment (PPE)**

**Respiratory Protection**

If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.

**Hand Protection**

Normal work gloves.

**Skin Protection**

Normal work coveralls.

<b>Eye Protection</b>	Wear safety glasses or goggles to protect against exposure.
<b>Other Precautions</b>	None known.
<b>Environmental Exposure Controls</b>	Do not allow material to contaminate ground water system

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

<b>Physical State:</b>	Powder	<b>Color:</b>	White
<b>Odor:</b>	Slight	<b>Odor Threshold:</b>	No information available

Property	Values
Remarks/ - Method	
<b>pH:</b>	9
<b>Freezing Point/Range</b>	No data available
<b>Melting Point/Range</b>	No data available
<b>Boiling Point/Range</b>	No data available
<b>Flash Point</b>	No data available
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	2
<b>Water Solubility</b>	Soluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

### 9.2. Other information

<b>VOC Content (%)</b>	No data available
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## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

### 10.2. Chemical Stability

Stable

### 10.3. Possibility of Hazardous Reactions

Will Not Occur

### 10.4. Conditions to Avoid

None anticipated

### 10.5. Incompatible Materials

Strong oxidizers.

### 10.6. Hazardous Decomposition Products

Carbon monoxide and carbon dioxide. Ammonia.

## 11. Toxicological Information

### Information on routes of exposure

**Principle Route of Exposure** Eye or skin contact, inhalation.

### Symptoms related to exposure

#### **Most Important Symptoms/Effects**

No significant hazards expected.

### Numerical measures of toxicity

### Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No data available	No data available	No data available

**Immediate, delayed and chronic health effects from exposure**

<b>Inhalation</b>	May cause mild respiratory irritation.
<b>Eye Contact</b>	May cause mild eye irritation.
<b>Skin Contact</b>	May cause mild skin irritation.
<b>Ingestion</b>	Large doses may cause nausea, vomiting and diarrhea.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

**Exposure Levels**

No data available

**Interactive effects**

Respiratory disorders. Skin disorders.

**Data limitations**

No data available

## 12. Ecological Information

**Ecotoxicity****Product Ecotoxicity Data**

No data available

**Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available	No information available	No information available	No information available

**12.2. Persistence and degradability**

Substances	CAS Number	Persistence and Degradability
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.3. Bioaccumulative potential**

Substances	CAS Number	Log Pow
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

#### **12.4. Mobility in soil**

Substances	CAS Number	Mobility
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

#### **12.6. Other adverse effects**

##### **Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

### **13. Disposal Considerations**

#### **Safe handling and disposal methods**

Bury in a licensed landfill according to federal, state, and local regulations.

#### **Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

#### **Environmental regulations**

Not applicable

### **14. Transport Information**

#### **Transportation Information**

**UN Number:** Not restricted  
**UN Proper Shipping Name:** Not restricted  
**Transport Hazard Class(es):** Not applicable  
**Packing Group:** Not applicable  
**Environmental Hazards:** Not applicable

#### **Special precautions during transport**

None

#### **HazChem Code**

None Allocated

### **15. Regulatory Information**

#### **Safety, health and environmental regulations specific for the product**

#### **International Inventories**

**Australian AICS Inventory** All components listed on inventory or are exempt.

**New Zealand Inventory of Chemicals** All components listed on inventory or are exempt.

**EINECS Inventory** This product, and all its components, complies with EINECS

**US TSCA Inventory** All components listed on inventory or are exempt.

**Canadian DSL Inventory** All components listed on inventory or are exempt.

#### **Poisons Schedule number**

None Allocated

### **16. Other information**

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**Date of preparation or review**

**Revision Date:** 30-Sep-2015

**Revision Note**

SDS sections updated: 2

**Full text of R-phrases referred to under Sections 2 and 3**

None

**Full text of H-Statements referred to under sections 2 and 3**

None

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight CAS – Chemical Abstracts Service EC50 – Effective Concentration 50% LC50 – Lethal Concentration 50% LD50 – Lethal Dose 50% LL50 – Lethal Loading 50% mg/kg – milligram/kilogram mg/L – milligram/liter NOEC – No Observed Effect Concentration OEL – Occupational Exposure Limit PBT – Persistent Bioaccumulative and Toxic ppm – parts per million STEL – Short Term Exposure Limit TWA – Time-Weighted Average vPvB – very Persistent and very Bioaccumulative h - hour mg/m<sup>3</sup> - milligram/cubic meter mm - millimeter mmHg - millimeter mercury w/w - weight/weight d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

**Disclaimer Statement**

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**End of Safety Data Sheet**



## SAFETY DATA SHEET

### DCA-24001

Revision Date: 11-Jan-2017

Revision Number: 15

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** DCA-24001

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM007732

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Stabilizer  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road, Jandakot, WA 6164  
Australia  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-mail Address** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951  
Global Incident Response Access Code: 334305  
Contract Number: 14012

##### Australian Poisons Information Centre

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Not classified

##### Label elements, including precautionary statements

##### Hazard Pictograms

**Signal Word** Not Hazardous

**Hazard Statements:** Not Classified

**Precautionary Statements**

**Prevention** None  
**Response** None  
**Storage** None  
**Disposal** None

**Contains Substances**

Contains no hazardous substances in concentrations above cut-off values according to the competent authority

**CAS Number**  
NA

**Other hazards which do not result in classification**

None known

For the full text of the H-phrases mentioned in this Section, see Section 16

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	60 - 100%	Not Applicable

### 4. First aid measures

**Description of necessary first aid measures**

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

**Eyes** In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

**Skin** Wash with soap and water. Get medical attention if irritation persists.

**Ingestion** Under normal conditions, first aid procedures are not required.

**Symptoms caused by exposure**

No significant hazards expected.

**Medical Attention and Special Treatment**

**Notes to Physician** Treat symptomatically

### 5. Fire Fighting Measures

**Suitable extinguishing equipment**

**Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical**

**Special exposure hazards in a fire**

Decomposition in fire may produce harmful gases.

**Special protective equipment and precautions for fire fighters**

**Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## 6. Accidental release measures

### 6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment.

### 6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

### 6.3. Methods and material for containment and cleaning up

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

## 7. Handling and storage

### 7.1. Precautions for safe handling

#### **Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid breathing vapors.

#### **Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

### 7.2. Conditions for safe storage, including any incompatibilities

#### **Storage Information**

Store in a cool well ventilated area. Keep container closed when not in use. Product has a shelf life of 24 months.

#### **Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

### Control parameters - exposure standards, biological monitoring

#### **Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	Not applicable	Not applicable

### Appropriate engineering controls

#### **Engineering Controls**

Use in a well ventilated area.

### Personal protective equipment (PPE)

#### **Personal Protective Equipment**

If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

#### **Respiratory Protection**

If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.

Dust/mist respirator. (N95, P2/P3)

#### **Hand Protection**

Normal work gloves.

#### **Skin Protection**

Normal work coveralls.

#### **Eye Protection**

Wear safety glasses or goggles to protect against exposure.

#### **Other Precautions**

None known.

#### **Environmental Exposure Controls**

No information available

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

**Physical State:** Liquid  
**Odor:** Mild sulfur  
**Color:** Clear to hazy  
**Odor Threshold:** No information available

<u>Property</u>	<u>Values</u>
<u>Remarks/ - Method</u>	
<b>pH:</b>	8
<b>Freezing Point / Range</b>	No data available
<b>Melting Point / Range</b>	No data available
<b>Boiling Point / Range</b>	106 °C / 224 °F
<b>Flash Point</b>	No data available
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	1.29
<b>Water Solubility</b>	Miscible with water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available
<b>9.2. Other information</b>	
<b>VOC Content (%)</b>	No data available

## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

### 10.2. Chemical stability

Stable

### 10.3. Possibility of hazardous reactions

Will Not Occur

### 10.4. Conditions to avoid

None anticipated

### 10.5. Incompatible materials

Strong oxidizers. Hydrochloric acid

### 10.6. Hazardous decomposition products

Oxides of sulfur.

## 11. Toxicological Information

### Information on routes of exposure

**Principle Route of Exposure** Eye or skin contact, inhalation.

### Symptoms related to exposure

#### **Most Important Symptoms/Effects**

No significant hazards expected.

### Numerical measures of toxicity

#### Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No data available	No data available	No data available

**Immediate, delayed and chronic health effects from exposure**

<b>Inhalation</b>	None known.
<b>Eye Contact</b>	May cause mild eye irritation.
<b>Skin Contact</b>	Not irritating to skin in rabbits.
<b>Ingestion</b>	Large doses may cause nausea, vomiting and diarrhea.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

**Exposure Levels**

No data available

**Interactive effects**

None known.

**Data limitations**

No data available

## 12. Ecological Information

**Ecotoxicity****Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available	No information available	No information available	No information available

**12.2. Persistence and degradability**

Substances	CAS Number	Persistence and Degradability
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.3. Bioaccumulative potential**

Does not bioaccumulate.

Substances	CAS Number	Log Pow
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

<b>13. Disposal Considerations</b>
------------------------------------

**Safe handling and disposal methods**

Disposal should be made in accordance with federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations. Contaminated packaging may be disposed of by: rendering packaging incapable of containing any substance, or treating packaging to remove residual contents, or treating packaging to make sure the residual contents are no longer hazardous, or by disposing of packaging into commercial waste collection.

**Environmental regulations**

Not applicable

<b>14. Transport Information</b>
----------------------------------

**Transportation Information****Australia ADG**

<b>UN Number</b>	Not restricted
<b>UN proper shipping name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**IMDG/IMO**

<b>UN Number</b>	Not restricted
<b>UN proper shipping name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**IATA/ICAO**

<b>UN Number</b>	Not restricted
<b>UN proper shipping name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

<b>15. Regulatory Information</b>
-----------------------------------

**Safety, health and environmental regulations specific for the product****International Inventories**

<b>Australian AICS Inventory</b>	All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.
<b>New Zealand Inventory of Chemicals</b>	All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.
<b>EINECS (European Inventory of Existing Chemical Substances)</b>	This product, and all its components, complies with EINECS
<b>US TSCA Inventory</b>	All components listed on inventory or are exempt.
<b>Canadian Domestic Substances List</b>	All components listed on inventory or are exempt.

**(DSL)****Poisons Schedule number**

None Allocated

**International Agreements****Montreal Protocol - Ozone Depleting Substances:**

Does not apply

**Stockholm Convention - Persistent Organic Pollutants:**

Does not apply

**Rotterdam Convention - Prior Informed Consent:**

Does not apply

**Basel Convention - Hazardous Waste:**

Does not apply

**16. Other information****Date of preparation or review****Revision Date:** 11-Jan-2017**Revision Note**

SDS sections updated: 2

**Full text of H-Statements referred to under sections 2 and 3**

None

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight

CAS – Chemical Abstracts Service

EC50 – Effective Concentration 50%

LC50 – Lethal Concentration 50%

LD50 – Lethal Dose 50%

LL50 – Lethal Loading 50%

mg/kg – milligram/kilogram

mg/L – milligram/liter

NOEC – No Observed Effect Concentration

OEL – Occupational Exposure Limit

PBT – Persistent Bioaccumulative and Toxic

ppm – parts per million

STEL – Short Term Exposure Limit

TWA – Time-Weighted Average

vPvB – very Persistent and very Bioaccumulative

h - hour

mg/m<sup>3</sup> - milligram/cubic meter

mm - millimeter

mmHg - millimeter mercury

w/w - weight/weight

d - day

**Key literature references and sources for data**[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

NZ CCID

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**End of Safety Data Sheet**



## SAFETY DATA SHEET

### DCA-25003

Revision Date: 30-Sep-2015

Revision Number: 13

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** DCA-25003

##### Other means of Identification

**Synonyms:** None  
**Product Code:** HM007670

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Gelling Agent  
**Uses Advised Against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road  
Jandakot  
WA 6164  
Australia  
  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-Mail address:** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951

##### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Not classified

##### Label elements, including precautionary statements

##### **Hazard Pictograms**

**Signal Word** Not Hazardous

**Hazard Statements** Not Classified

**Precautionary Statements**

**Prevention** None

**Response** None

**Storage** None

**Disposal** None

**Contains**

**Substances**

Contains no hazardous substances in concentrations above cut-off values according to the competent authority

**CAS Number**

NA

**Other hazards which do not result in classification**

Dust can form an explosive mixture in air

This mixture contains no substance considered to be persistent, bioaccumulating nor toxic (PBT).

This mixture contains no substance considered to be very persistent nor very bioaccumulating (vPvB).

**Australia Classification**

For the full text of the H-phrases mentioned in this Section, see Section 16

**Classification** Not Classified

**Risk Phrases** None

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	60 - 100%	Not Applicable

### 4. First aid measures

**Description of necessary first aid measures**

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

**Eyes** In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

**Skin** Wash with soap and water.

**Ingestion** Under normal conditions, first aid procedures are not required.

**Symptoms caused by exposure**

No significant hazards expected.

**Medical Attention and Special Treatment**

**Notes to Physician** Treat symptomatically

### 5. Fire Fighting Measures

**Suitable extinguishing equipment**

**Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

**Extinguishing media which must not be used for safety reasons**

None known.

### **Specific hazards arising from the chemical**

#### **Special Exposure Hazards**

Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

### **Special protective equipment and precautions for fire fighters**

#### **Special Protective Equipment for Fire-Fighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## **6. Accidental release measures**

### **6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment. Avoid creating and breathing dust. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing.

### **6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas.

### **6.3. Methods and material for containment and cleaning up**

Scoop up and remove.

## **7. Handling and storage**

### **7.1. Precautions for Safe Handling**

#### **Handling Precautions**

Avoid creating or inhaling dust. Avoid contact with eyes, skin, or clothing. Ensure adequate ventilation. Wash hands after use. Launder contaminated clothing before reuse. Use appropriate protective equipment.

#### **Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

### **7.2. Conditions for safe storage, including any incompatibilities**

#### **Storage Information**

Store away from oxidizers. Store in a cool, dry location. Product has a shelf life of 24 months.

#### **Other Guidelines**

No information available

## **8. Exposure Controls/Personal Protection**

### **Control parameters - exposure standards, biological monitoring**

#### **Exposure Limits**

<b>Substances</b>	<b>CAS Number</b>	<b>Australia NOHSC</b>	<b>ACGIH TLV-TWA</b>
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	Not applicable	Not applicable

### **Appropriate engineering controls**

#### **Engineering Controls**

Use in a well ventilated area.

### **Personal protective equipment (PPE)**

#### **Respiratory Protection**

If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.

Dust/mist respirator. (N95, P2/P3)

#### **Hand Protection**

Normal work gloves.

#### **Skin Protection**

Normal work coveralls.

#### **Eye Protection**

Wear safety glasses or goggles to protect against exposure.

**Other Precautions** None known.  
**Environmental Exposure Controls** Do not allow material to contaminate ground water system

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

**Physical State:** Solid      **Color:** White to light straw  
**Odor:** Bean      **Odor Threshold:** No information available

<u>Property</u>	<u>Values</u>
Remarks/ - Method	
<b>pH:</b>	10.1
<b>Freezing Point/Range</b>	No data available
<b>Melting Point/Range</b>	No data available
<b>Boiling Point/Range</b>	No data available
<b>Flash Point</b>	No data available
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	1.3
<b>Water Solubility</b>	Hydrolyzes
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	510 °C / 950 °F
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

### 9.2. Other information

**VOC Content (%)** No data available

## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

### 10.2. Chemical Stability

Stable

### 10.3. Possibility of Hazardous Reactions

Will Not Occur

### 10.4. Conditions to Avoid

None anticipated

### 10.5. Incompatible Materials

Strong oxidizers.

### 10.6. Hazardous Decomposition Products

Carbon monoxide and carbon dioxide.

## 11. Toxicological Information

### Information on routes of exposure

**Principle Route of Exposure** Eye or skin contact, inhalation.

### Symptoms related to exposure

#### **Most Important Symptoms/Effects**

No significant hazards expected.

### Numerical measures of toxicity

### Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No data available	No data available	No data available

**Immediate, delayed and chronic health effects from exposure**

<b>Inhalation</b>	May cause mild respiratory irritation.
<b>Eye Contact</b>	May cause mild eye irritation.
<b>Skin Contact</b>	May cause mild skin irritation.
<b>Ingestion</b>	None known.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

**Exposure Levels**

No data available

**Interactive effects**

None known.

**Data limitations**

No data available

## 12. Ecological Information

**Ecotoxicity****Product Ecotoxicity Data**

No data available

**Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available	No information available	No information available	No information available

**12.2. Persistence and degradability**

Substances	CAS Number	Persistence and Degradability
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.3. Bioaccumulative potential**

Substances	CAS Number	Log Pow
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

#### **12.4. Mobility in soil**

Substances	CAS Number	Mobility
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

#### **12.6. Other adverse effects**

##### **Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

### **13. Disposal Considerations**

#### **Safe handling and disposal methods**

Follow all applicable community, national or regional regulations regarding waste management methods.

#### **Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

#### **Environmental regulations**

Not applicable

### **14. Transport Information**

#### **Transportation Information**

**UN Number:** Not restricted  
**UN Proper Shipping Name:** Not restricted  
**Transport Hazard Class(es):** Not applicable  
**Packing Group:** Not applicable  
**Environmental Hazards:** Not applicable

#### **Special precautions during transport**

None

#### **HazChem Code**

None Allocated

### **15. Regulatory Information**

#### **Safety, health and environmental regulations specific for the product**

##### **International Inventories**

**Australian AICS Inventory** All components listed on inventory or are exempt.

**New Zealand Inventory of Chemicals** All components listed on inventory or are exempt.

**EINECS Inventory** This product, and all its components, complies with EINECS

**US TSCA Inventory** All components listed on inventory or are exempt.

**Canadian DSL Inventory** All components listed on inventory or are exempt.

#### **Poisons Schedule number**

None Allocated

### **16. Other information**

**Date of preparation or review****Revision Date:** 30-Sep-2015**Revision Note**

SDS sections updated: 2

**Full text of R-phrases referred to under Sections 2 and 3**

None

**Full text of H-Statements referred to under sections 2 and 3**

None

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight CAS – Chemical Abstracts Service EC50 – Effective Concentration 50% LC50 – Lethal Concentration 50% LD50 – Lethal Dose 50% LL50 – Lethal Loading 50% mg/kg – milligram/kilogram mg/L – milligram/liter NOEC – No Observed Effect Concentration OEL – Occupational Exposure Limit PBT – Persistent Bioaccumulative and Toxic ppm – parts per million STEL – Short Term Exposure Limit TWA – Time-Weighted Average vPvB – very Persistent and very Bioaccumulative h - hour mg/m<sup>3</sup> - milligram/cubic meter mm - millimeter mmHg - millimeter mercury w/w - weight/weight d - day

**Key literature references and sources for data**[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)**Disclaimer Statement**

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**End of Safety Data Sheet**

## SAFETY DATA SHEET

### DCA-25005

Revision Date: 30-Sep-2015

Revision Number: 10

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** DCA-25005

##### Other means of Identification

**Synonyms:** None  
**Product Code:** HM007672

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Gelling Agent  
**Uses Advised Against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road  
Jandakot  
WA 6164  
Australia  
  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-Mail address:** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951

##### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Not classified

##### Label elements, including precautionary statements

##### **Hazard Pictograms**

**Signal Word** Not Hazardous



**Hazard Statements** Not Classified

**Precautionary Statements**

**Prevention** None

**Response** None

**Storage** None

**Disposal** None

**Contains**

**Substances**

Contains no hazardous substances in concentrations above cut-off values according to the competent authority

**CAS Number**

NA

**Other hazards which do not result in classification**

This substance is not considered to be persistent, bioaccumulating nor toxic (PBT).

This substance is not considered to be very persistent nor very bioaccumulating (vPvB).

**Australia Classification**

*For the full text of the H-phrases mentioned in this Section, see Section 16*

**Classification** Not Classified

**Risk Phrases** None

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	60 - 100%	Not Applicable

### 4. First aid measures

**Description of necessary first aid measures**

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

**Eyes** In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

**Skin** Wash with soap and water. Get medical attention if irritation persists.

**Ingestion** Under normal conditions, first aid procedures are not required.

**Symptoms caused by exposure**

No significant hazards expected.

**Medical Attention and Special Treatment**

**Notes to Physician** Treat symptomatically

### 5. Fire Fighting Measures

**Suitable extinguishing equipment**

**Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical****Special Exposure Hazards**

Decomposition in fire may produce harmful gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

**Special protective equipment and precautions for fire fighters****Special Protective Equipment for Fire-Fighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

<b>6. Accidental release measures</b>
---------------------------------------

**6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment. Avoid creating and breathing dust. Avoid contact with skin, eyes and clothing. Ensure adequate ventilation.

**6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas.

**6.3. Methods and material for containment and cleaning up**

Scoop up and remove.

<b>7. Handling and storage</b>
--------------------------------

**7.1. Precautions for Safe Handling****Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust. Ensure adequate ventilation. Wash hands after use. Launder contaminated clothing before reuse. Use appropriate protective equipment.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Store away from oxidizers. Store in a cool, dry location. Product has a shelf life of 24 months.

**Other Guidelines**

No information available

<b>8. Exposure Controls/Personal Protection</b>
---

**Control parameters - exposure standards, biological monitoring****Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	Not applicable	Not applicable

**Appropriate engineering controls****Engineering Controls**

Use in a well ventilated area.

**Personal protective equipment (PPE)****Respiratory Protection**

Not normally needed. But if significant exposures are possible then the following respirator is recommended:

Dust/mist respirator. (N95, P2/P3)

**Hand Protection**

Normal work gloves.

**Skin Protection**

Normal work coveralls.

**Eye Protection**

Wear safety glasses or goggles to protect against exposure.

**Other Precautions**

None known.

**Environmental Exposure Controls**

Do not allow material to contaminate ground water system

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

<b>Physical State:</b>	Solid	<b>Color:</b>	Off white
<b>Odor:</b>	Bean	<b>Odor Threshold:</b>	No information available
<u>Property</u>		<u>Values</u>	
<u>Remarks/ - Method</u>			
<b>pH:</b>		6.5-7.5	
<b>Freezing Point/Range</b>		No data available	
<b>Melting Point/Range</b>		No data available	
<b>Boiling Point/Range</b>		No data available	
<b>Flash Point</b>		> 93 °C / > 200 °F	Cleveland Open Cup (COC)
<b>Evaporation rate</b>		No data available	
<b>Vapor Pressure</b>		No data available	
<b>Vapor Density</b>		No data available	
<b>Specific Gravity</b>		1.42 - 1.47	
<b>Water Solubility</b>		Soluble in water	
<b>Solubility in other solvents</b>		No data available	
<b>Partition coefficient: n-octanol/water</b>		No data available	
<b>Autoignition Temperature</b>		No data available	
<b>Decomposition Temperature</b>		No data available	
<b>Viscosity</b>		No data available	
<b>Explosive Properties</b>		No information available	
<b>Oxidizing Properties</b>		No information available	

### 9.2. Other information

**VOC Content (%)** No data available

## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

### 10.2. Chemical Stability

Stable

### 10.3. Possibility of Hazardous Reactions

Will Not Occur

### 10.4. Conditions to Avoid

None anticipated

### 10.5. Incompatible Materials

Strong oxidizers.

### 10.6. Hazardous Decomposition Products

Carbon monoxide and carbon dioxide.

## 11. Toxicological Information

### Information on routes of exposure

**Principle Route of Exposure** Eye or skin contact, inhalation.

### Symptoms related to exposure

#### Most Important Symptoms/Effects

No significant hazards expected.

### Numerical measures of toxicity

#### Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Contains no hazardous substances in concentrations above	NA	No data available	No data available	No data available

cut-off values according to the competent authority				
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**Immediate, delayed and chronic health effects from exposure**

<b>Inhalation</b>	May cause mild respiratory irritation.
<b>Eye Contact</b>	May cause mild eye irritation.
<b>Skin Contact</b>	None known.
<b>Ingestion</b>	None known.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

**Exposure Levels**

No data available

**Interactive effects**

None known.

**Data limitations**

No data available

## 12. Ecological Information

**Ecotoxicity****Product Ecotoxicity Data**

No data available

**Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available	No information available	No information available	No information available

**12.2. Persistence and degradability**

Substances	CAS Number	Persistence and Degradability
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.3. Bioaccumulative potential**

Substances	CAS Number	Log Pow
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

<b>13. Disposal Considerations</b>
------------------------------------

**Safe handling and disposal methods**

Bury in a licensed landfill according to federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

<b>14. Transport Information</b>
----------------------------------

**Transportation Information**

<b>UN Number:</b>	Not restricted
<b>UN Proper Shipping Name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

<b>15. Regulatory Information</b>
-----------------------------------

**Safety, health and environmental regulations specific for the product****International Inventories****Australian AICS Inventory**

All components listed on inventory or are exempt.

**New Zealand Inventory of Chemicals**

All components listed on inventory or are exempt.

**EINECS Inventory**

This product, and all its components, complies with EINECS

**US TSCA Inventory**

All components listed on inventory or are exempt.

**Canadian DSL Inventory**

All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

<b>16. Other information</b>
------------------------------

**Date of preparation or review**

Revision Date: 30-Sep-2015

Revision Note

---

SDS sections updated: 2

**Full text of R-phrases referred to under Sections 2 and 3**

None

**Full text of H-Statements referred to under sections 2 and 3**

None

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight CAS – Chemical Abstracts Service EC50 – Effective Concentration 50% LC50 – Lethal Concentration 50% LD50 – Lethal Dose 50% LL50 – Lethal Loading 50% mg/kg – milligram/kilogram mg/L – milligram/liter NOEC – No Observed Effect Concentration OEL – Occupational Exposure Limit PBT – Persistent Bioaccumulative and Toxic ppm – parts per million STEL – Short Term Exposure Limit TWA – Time-Weighted Average vPvB – very Persistent and very Bioaccumulative h - hour mg/m<sup>3</sup> - milligram/cubic meter mm - millimeter mmHg - millimeter mercury w/w - weight/weight d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

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**End of Safety Data Sheet**

## SAFETY DATA SHEET

### DCA-30001

Revision Date: 05-Jul-2016

Revision Number: 11

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** DCA-30001

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM007676

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Scale Inhibitor  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton/Baroid Australia Pty. Ltd.  
15 Marriott Road  
Jandakot  
WA 6164  
Australia

ACN Number: 009 000 775  
Telephone Number: 61 (08) 9455 8300  
Fax Number: 61 (08) 9455 5300

##### **Product Emergency Telephone**

Australia: + 61 1 800 686 951  
Papua New Guinea: + 61 1 800 686 951  
NewZealand: +64 800 451719

##### **Fire, Police & Ambulance - Emergency Telephone**

Australia: 000  
Papua New Guinea: 000  
New Zealand: 111

**E-mail Address** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951

##### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

**Classification of the hazardous chemical**

Not classified

**Label elements, including precautionary statements****Hazard pictograms****Signal Word** Not Hazardous**Hazard Statements:** Not Classified**Precautionary Statements****Prevention** None**Response** None**Storage** None**Disposal** None**Contains****Substances**

Contains no hazardous substances in concentrations above cut-off values according to the competent authority

**CAS Number**

NA

**Other hazards which do not result in classification**

This mixture contains no substance considered to be persistent, bioaccumulating nor toxic (PBT).

This mixture contains no substance considered to be very persistent nor very bioaccumulating (vPvB).

*For the full text of the H-phrases mentioned in this Section, see Section 16***3. Composition/information on Ingredients**

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	60 - 100%	Not Applicable

**4. First aid measures****Description of necessary first aid measures****Inhalation** If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.**Eyes** In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.**Skin** Wash with soap and water. Get medical attention if irritation persists.**Ingestion** Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.**Symptoms caused by exposure**

No significant hazards expected.

**Medical Attention and Special Treatment****Notes to Physician** Treat symptomatically**5. Fire Fighting Measures**



**Suitable extinguishing equipment****Suitable Extinguishing Media**

All standard fire fighting media

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical****Special exposure hazards in a fire**

Not applicable

**Special protective equipment and precautions for fire fighters****Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

**6. Accidental release measures****6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment. Avoid contact with skin, eyes and clothing. Avoid breathing vapors. Ensure adequate ventilation.

**6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas.

**6.3. Methods and material for containment and cleaning up**

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

**7. Handling and storage****7.1. Precautions for safe handling****Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid breathing mist. Avoid breathing vapors. Ensure adequate ventilation. Wash hands after use. Launder contaminated clothing before reuse. Use appropriate protective equipment.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Store away from oxidizers. Product has a shelf life of 12 months.

**Other Guidelines**

No information available

**8. Exposure Controls/Personal Protection****Control parameters - exposure standards, biological monitoring****Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	Not applicable	Not applicable

**Appropriate engineering controls****Engineering Controls**

Use in a well ventilated area.

**Personal protective equipment (PPE)****Personal Protective Equipment**

If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

**Respiratory Protection**

If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN

149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.

<b>Hand Protection</b>	Butyl rubber gloves.
<b>Skin Protection</b>	Normal work coveralls.
<b>Eye Protection</b>	Chemical goggles; also wear a face shield if splashing hazard exists.
<b>Other Precautions</b>	None known.
<b>Environmental Exposure Controls</b>	Do not allow material to contaminate ground water system

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

<b>Physical State:</b>	Liquid	<b>Color</b>	Clear to slightly hazy amber
<b>Odor:</b>	Mild	<b>Odor Threshold:</b>	No information available

<u>Property</u>	<u>Values</u>
Remarks/ - Method	
<b>pH:</b>	6.49 - 7.49
<b>Freezing Point / Range</b>	-1.1 °C
<b>Melting Point / Range</b>	No data available
<b>Boiling Point / Range</b>	100 °C
<b>Flash Point</b>	> 95 °C / PMCC
<b>Evaporation rate</b>	< 1
<b>Vapor Pressure</b>	18 mmHg
<b>Vapor Density</b>	> 1
<b>Specific Gravity</b>	1.24
<b>Water Solubility</b>	Soluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	1.2
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

### 9.2. Other information

<b>VOC Content (%)</b>	No data available
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## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

### 10.2. Chemical stability

Stable

### 10.3. Possibility of hazardous reactions

Will Not Occur

### 10.4. Conditions to avoid

None anticipated

### 10.5. Incompatible materials

Strong oxidizers.

### 10.6. Hazardous decomposition products

Carbon monoxide and carbon dioxide. Toxic monomer fumes.

## 11. Toxicological Information

### Information on routes of exposure

**Principle Route of Exposure** Eye and skin contact.

### Symptoms related to exposure

**Most Important Symptoms/Effects**

No significant hazards expected.

### Numerical measures of toxicity

#### Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No data available	No data available	No data available

#### Immediate, delayed and chronic health effects from exposure

<b>Inhalation</b>	May cause mild respiratory irritation.
<b>Eye Contact</b>	May cause mild eye irritation.
<b>Skin Contact</b>	Prolonged or repeated contact may cause slight skin irritation.
<b>Ingestion</b>	In large amounts: Irritation of the mouth, throat, and stomach.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

#### Exposure Levels

No data available

#### Interactive effects

Skin disorders. Eye ailments. Respiratory disorders.

#### Data limitations

No data available

## 12. Ecological Information

#### Ecotoxicity

##### **Product Ecotoxicity Data**

No data available

##### **Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available	No information available	No information available	No information available

#### 12.2. Persistence and degradability

Biodegradable.

Substances	CAS Number	Persistence and Degradability
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Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available
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**12.3. Bioaccumulative potential**

Does not bioaccumulate.

Substances	CAS Number	Log Pow
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

<b>13. Disposal Considerations</b>
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**Safe handling and disposal methods**

Disposal should be made in accordance with federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

<b>14. Transport Information</b>
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**Transportation Information****Australia ADG**

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

**IMDG/IMO**

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

**IATA/ICAO**

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

## 15. Regulatory Information

### Safety, health and environmental regulations specific for the product

#### International Inventories

##### **Australian AICS Inventory**

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

##### **New Zealand Inventory of Chemicals**

All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

##### **EINECS (European Inventory of Existing Chemical Substances)**

This product, and all its components, complies with EINECS

##### **US TSCA Inventory**

All components listed on inventory or are exempt.

##### **Canadian Domestic Substances List (DSL)**

All components listed on inventory or are exempt.

#### Poisons Schedule number

None Allocated

#### International Agreements

##### **Montreal Protocol - Ozone Depleting Substances:**

Does not apply

##### **Stolkhom Convention - Persistent Organic Pollutants:**

Does not apply

##### **Rotterdam Convention - Prior Informed Consent:**

Does not apply

##### **Basel Convention - Hazardous Waste:**

Does not apply

## 16. Other information

### Date of preparation or review

**Revision Date:** 05-Jul-2016

#### **Revision Note**

SDS sections updated: 2

#### **Full text of H-Statements referred to under sections 2 and 3**

None

#### **Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

#### Key abbreviations or acronyms used

bw – body weight

CAS – Chemical Abstracts Service

EC50 – Effective Concentration 50%

LC50 – Lethal Concentration 50%

LD50 – Lethal Dose 50%

LL50 – Lethal Loading 50%

mg/kg – milligram/kilogram

mg/L – milligram/liter

NOEC – No Observed Effect Concentration

OEL – Occupational Exposure Limit

PBT – Persistent Bioaccumulative and Toxic

ppm – parts per million

STEL – Short Term Exposure Limit

TWA – Time-Weighted Average

vPvB – very Persistent and very Bioaccumulative

h - hour

mg/m<sup>3</sup> - milligram/cubic meter

mm - millimeter

mmHg - millimeter mercury

w/w - weight/weight

d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

**Disclaimer Statement**

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

**End of Safety Data Sheet**

## SAFETY DATA SHEET

### DCA-32002

Revision Date: 07-Feb-2018

Revision Number: 19

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** DCA-32002

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM007683

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Surfactant  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road, Jandakot, WA 6164  
Australia  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-mail Address** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951  
Global Incident Response Access Code: 334305  
Contract Number: 14012

##### Australian Poisons Information Centre

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Acute Oral Toxicity	Category 4 - H302
Skin Corrosion/Irritation	Category 2 - H315
Serious Eye Damage/Irritation	Category 1 - H318
Acute Aquatic Toxicity	Category 2 - H401

##### Label elements, including precautionary statements

##### Hazard Pictograms

**Signal Word**

DANGER

**Hazard Statements:**

H302 - Harmful if swallowed  
 H315 - Causes skin irritation  
 H318 - Causes serious eye damage  
 H401 - Toxic to aquatic life

**Precautionary Statements****Prevention**

P264 - Wash face, hands and any exposed skin thoroughly after handling  
 P270 - Do not eat, drink or smoke when using this product  
 P273 - Avoid release to the environment

**Response**

P280 - Wear protective gloves/eye protection/face protection  
 P301 + P312 - IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell  
 P330 - Rinse mouth  
 P302 + P352 - IF ON SKIN: Wash with plenty of water.  
 P332 + P313 - If skin irritation occurs: Get medical advice/attention  
 P362 + P364 - Take off contaminated clothing and wash before reuse  
 P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
 P310 - Immediately call a POISON CENTER or doctor/physician

**Storage**

None

**Disposal**

P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Contains****Substances**

Alcohols, C6-C12, ethoxylated propoxylated  
 Alcohols, C10-C16, ethoxylated propoxylated

**CAS Number**

68937-66-6  
 69227-22-1

**Other hazards which do not result in classification**

This mixture contains no substance considered to be persistent, bioaccumulating nor toxic (PBT).  
 This mixture contains no substance considered to be very persistent nor very bioaccumulating (vPvB).

For the full text of the H-phrases mentioned in this Section, see Section 16

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Alcohols, C6-C12, ethoxylated propoxylated	68937-66-6	60 - 100%	Acute Tox. 4 (H302) Skin Irrit. 2 (H315) Eye Corr. 1 (H318) Aquatic Acute 2 (H401)
Alcohols, C10-C16, ethoxylated propoxylated	69227-22-1	10 - 30%	Acute Tox. 4 (H302) Skin Irrit. 2 (H315) Eye Corr. 1 (H318) Aquatic Acute 2 (H401)

### 4. First aid measures



**Description of necessary first aid measures**

<b>Inhalation</b>	Under normal conditions, first aid procedures are not required.
<b>Eyes</b>	Immediately flush eyes with large amounts of water for at least 15 minutes. Get immediate medical attention.
<b>Skin</b>	Wash with soap and water. Get medical attention if irritation persists.
<b>Ingestion</b>	Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

**Symptoms caused by exposure**

Causes severe eye irritation which may damage tissue. Causes skin irritation. Harmful if swallowed.

**Medical Attention and Special Treatment**

**Notes to Physician** Treat symptomatically

## 5. Fire Fighting Measures

**Suitable extinguishing equipment****Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical****Special exposure hazards in a fire**

Decomposition in fire may produce harmful gases.

**Special protective equipment and precautions for fire fighters****Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## 6. Accidental release measures

**6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment. Avoid contact with skin, eyes and clothing. Avoid breathing vapors. Ensure adequate ventilation.

**6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas.

**6.3. Methods and material for containment and cleaning up**

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

## 7. Handling and storage

**7.1. Precautions for safe handling****Handling Precautions**

Avoid contact with eyes, skin, or clothing. Wash hands after use. Avoid breathing vapors. Ensure adequate ventilation. Slippery when wet. Launder contaminated clothing before reuse. Use appropriate protective equipment.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Store away from oxidizers. Keep container closed when not in use. Keep from heat, sparks, and open flames. Product has a shelf life of 24 months.

**Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

### Control parameters - exposure standards, biological monitoring

#### Exposure Limits

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Alcohols, C6-C12, ethoxylated propoxylated	68937-66-6	Not applicable	Not applicable
Alcohols, C10-C16, ethoxylated propoxylated	69227-22-1	Not applicable	Not applicable

### Appropriate engineering controls

**Engineering Controls** None known.

### Personal protective equipment (PPE)

**Personal Protective Equipment** If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

**Respiratory Protection** If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.

**Hand Protection** Impervious rubber gloves. Polyvinylchloride gloves.

**Skin Protection** Normal work coveralls.

**Eye Protection** Wear safety glasses or goggles to protect against exposure.

**Other Precautions** None known.

**Environmental Exposure Controls** Do not allow material to contaminate ground water system

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

**Physical State:** Liquid

**Odor:** Mild

**Color** Yellow

**Odor Threshold:** No information available

#### Property

Remarks/ - Method

#### Values

**pH:**

6.5 (1%)

**Freezing Point / Range**

-3 °C

**Melting Point / Range**

No data available

**Boiling Point / Range**

No data available

**Flash Point**

240 °C / 464 °F PMCC

**Evaporation rate**

No data available

**Vapor Pressure**

No data available

**Vapor Density**

> 10

**Specific Gravity**

0.98

**Water Solubility**

Soluble in water

**Solubility in other solvents**

No data available

**Partition coefficient: n-octanol/water**

No data available

**Autoignition Temperature**

No data available

**Decomposition Temperature**

No data available

**Viscosity**

No data available

**Explosive Properties**

No information available

**Oxidizing Properties**

No information available

### 9.2. Other information

**VOC Content (%)**

No data available

## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

### 10.2. Chemical stability

Stable

### 10.3. Possibility of hazardous reactions

Will Not Occur

### 10.4. Conditions to avoid

None anticipated

### 10.5. Incompatible materials

Strong oxidizers. Strong acids. Strong alkalis.

### 10.6. Hazardous decomposition products

Carbon monoxide and carbon dioxide.

## 11. Toxicological Information

### Information on routes of exposure

**Principle Route of Exposure** Eye or skin contact, inhalation.

### Symptoms related to exposure

#### **Most Important Symptoms/Effects**

Causes severe eye irritation which may damage tissue. Causes skin irritation. Harmful if swallowed.

### Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Alcohols, C6-C12, ethoxylated propoxylated	68937-66-6	600 mg/kg (Rat) (similar substance)	> 5200 mg/kg (Rabbit) (similar substance)	> 0.22 mg/L (saturated concentration) (Rat) (similar substance)
Alcohols, C10-C16, ethoxylated propoxylated	69227-22-1	600 mg/kg (Rat) (similar substance)	> 5200 mg/kg (Rabbit) (similar substance)	>0.22 mg/L (saturated concentration) (Rat) (similar substance)

### Immediate, delayed and chronic health effects from exposure

#### **Inhalation**

May cause mild respiratory irritation.

#### **Eye Contact**

Causes severe eye irritation which may damage tissue.

#### **Skin Contact**

Causes skin irritation.

#### **Ingestion**

Harmful if swallowed. Irritation of the mouth, throat, and stomach.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

### Exposure Levels

No data available

### Interactive effects

Skin disorders.

### Data limitations

No data available

Substances	CAS Number	Skin corrosion/irritation
Alcohols, C6-C12, ethoxylated propoxylated	68937-66-6	Causes skin irritation. (Rabbit) (similar substances)
Alcohols, C10-C16, ethoxylated propoxylated	69227-22-1	Causes skin irritation. (Rabbit) (similar substances)

Substances	CAS Number	Serious eye damage/irritation
Alcohols, C6-C12, ethoxylated propoxylated	68937-66-6	Causes severe eye irritation (Rabbit) (similar substances)
Alcohols, C10-C16, ethoxylated propoxylated	69227-22-1	Causes severe eye irritation (Rabbit) (similar substances)

Substances	CAS Number	Skin Sensitization
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Alcohols, C6-C12, ethoxylated propoxylated	68937-66-6	Did not cause sensitization on laboratory animals (guinea pig) (similar substances)
Alcohols, C10-C16, ethoxylated propoxylated	69227-22-1	Did not cause sensitization on laboratory animals (guinea pig) (similar substances)

Substances	CAS Number	Respiratory Sensitization
Alcohols, C6-C12, ethoxylated propoxylated	68937-66-6	No information available
Alcohols, C10-C16, ethoxylated propoxylated	69227-22-1	No information available

Substances	CAS Number	Mutagenic Effects
Alcohols, C6-C12, ethoxylated propoxylated	68937-66-6	In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects. (similar substances)
Alcohols, C10-C16, ethoxylated propoxylated	69227-22-1	In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects. (similar substances)

Substances	CAS Number	Carcinogenic Effects
Alcohols, C6-C12, ethoxylated propoxylated	68937-66-6	Did not show carcinogenic effects in animal experiments (similar substances)
Alcohols, C10-C16, ethoxylated propoxylated	69227-22-1	Did not show carcinogenic or teratogenic effects in animal experiments (similar substances)

Substances	CAS Number	Reproductive toxicity
Alcohols, C6-C12, ethoxylated propoxylated	68937-66-6	Animal testing did not show any effects on fertility.
Alcohols, C10-C16, ethoxylated propoxylated	69227-22-1	Animal testing did not show any effects on fertility.

Substances	CAS Number	STOT - single exposure
Alcohols, C6-C12, ethoxylated propoxylated	68937-66-6	No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)
Alcohols, C10-C16, ethoxylated propoxylated	69227-22-1	No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)

Substances	CAS Number	STOT - repeated exposure
Alcohols, C6-C12, ethoxylated propoxylated	68937-66-6	No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)
Alcohols, C10-C16, ethoxylated propoxylated	69227-22-1	No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)

Substances	CAS Number	Aspiration hazard
Alcohols, C6-C12, ethoxylated propoxylated	68937-66-6	No adverse health effects are expected from swallowing.
Alcohols, C10-C16, ethoxylated propoxylated	69227-22-1	No adverse health effects are expected from swallowing.

## 12. Ecological Information

### Ecotoxicity

#### Algae Toxicity

ErC50 (72h): 2.58 - 3.44 mg/L (Desmodesmus subspicatus)

#### Acute Crustaceans Toxicity:

EC50(48h): 1.45 - 1.79 mg/L (Daphnia magna)

### Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Alcohols, C6-C12, ethoxylated propoxylated	68937-66-6	EC50 (72h) 0.75 mg/L (Pseudokirchnerella subcapitata) (similar substance) EC50 (96h) 0.7 mg/L (Pseudokirchneriella subapitata) (similar substance) CD10 8 mg/L	LC50 (96h) 0.59 mg/L (Pleuronectes platessa) (similar substance) LC50 (96) 1.4 mg/L (Pimephales promelas) (similar substance) NOEC 4.4 mg/L (Pimephales promelas, juvenile)	ErC50 (16.9h) > 10 g/L (growth inhibition) (Pseudomonas putida) (similar substance)	EC50 (48h) 0.14 mg/L (Daphnia magna) (similar substance) EC50 (48h) 0.39 mg/L (Cerodaphnia dubia) (similar substance)

		(Pseudokirchneriella subcapitata) EC10 2 mg/L (Brachionus calyciflorus)			
Alcohols, C10-C16, ethoxylated propoxylated	69227-22-1	EC50 (72h) 0.75 mg/L (Pseudokirchneriella subcapitata) (similar substance) ErC50 (48h) 0.7 mg/L (Skeletonema costatum) EC10 9.79 mg/L (Selenastrum capricornutum) (similar substance) ErC50 1.1 mg/L (Scenedesmus subspicatus) (similar substance)	LC50 (96h) 0.59 mg/L (Pleuronectes platessa) (similar substance) LC50 (96h) 1.6 mg/L (Pimephales promelas) (similar substance) LC50 (96h) 3 mg/L (Brachydanio rerio) (similar substance)	ErC50 (16.9h) > 10 g/L (Pseudomonas putida) (similar substance)	EC50 (48h) 0.14 mg/L (Daphnia magna) (similar substance) EC50 (48h) 0.2 mg/L (Daphnia magna) (similar substance)

**12.2. Persistence and degradability**

Readily biodegradable

Substances	CAS Number	Persistence and Degradability
Alcohols, C6-C12, ethoxylated propoxylated	68937-66-6	Readily biodegradable (60% @ 28d) (similar substances)
Alcohols, C10-C16, ethoxylated propoxylated	69227-22-1	Readily biodegradable (84% @ 28d) (similar substances)

**12.3. Bioaccumulative potential**

Substances	CAS Number	Log Pow
Alcohols, C6-C12, ethoxylated propoxylated	68937-66-6	Log Pow: 4.3 - 5.36 (estimated) BCF: 1.1 - 1.8 (fish, estimated)
Alcohols, C10-C16, ethoxylated propoxylated	69227-22-1	Log Pow: 4.3 - 5.36 (estimated) BCF: 1.1 - 1.8 (fish, estimated)

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Alcohols, C6-C12, ethoxylated propoxylated	68937-66-6	KOC = >4
Alcohols, C10-C16, ethoxylated propoxylated	69227-22-1	KOC = >4

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

<b>13. Disposal Considerations</b>
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**Safe handling and disposal methods**

Disposal should be made in accordance with federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations. Contaminated packaging may be disposed of by: rendering packaging incapable of containing any substance, or treating packaging to remove residual contents, or treating packaging to make sure the residual contents are no longer hazardous, or by disposing of packaging into commercial waste collection.

**Environmental regulations**

Not applicable

<b>14. Transport Information</b>
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**Transportation Information****Australia ADG**

UN Number

Not restricted

**UN proper shipping name:** Not restricted  
**Transport Hazard Class(es):** Not applicable  
**Packing Group:** Not applicable  
**Environmental Hazards:** Not applicable

**IMDG/IMO**

**UN Number** Not restricted  
**UN proper shipping name:** Not restricted  
**Transport Hazard Class(es):** Not applicable  
**Packing Group:** Not applicable  
**Environmental Hazards:** Not applicable

**IATA/ICAO**

**UN Number** Not restricted  
**UN proper shipping name:** Not restricted  
**Transport Hazard Class(es):** Not applicable  
**Packing Group:** Not applicable  
**Environmental Hazards:** Not applicable

**Special precautions during transport**

None

**HazChem Code**

•3Z

**15. Regulatory Information****Safety, health and environmental regulations specific for the product****International Inventories****Australian AICS Inventory**

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

**New Zealand Inventory of Chemicals**

All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

**EINECS (European Inventory of Existing Chemical Substances)**

This product, and all its components, complies with EINECS

**US TSCA Inventory**

All components listed on inventory or are exempt.

**Canadian Domestic Substances List (DSL)**

All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

**International Agreements****Montreal Protocol - Ozone Depleting Substances:**

Does not apply

**Stockholm Convention - Persistent Organic Pollutants:**

Does not apply

**Rotterdam Convention - Prior Informed Consent:**

Does not apply

**Basel Convention - Hazardous Waste:**

Does not apply

**16. Other information****Date of preparation or review****Revision Date:** 07-Feb-2018**Revision Note**

SDS sections updated:

2

**Full text of H-Statements referred to under sections 2 and 3**

H302 - Harmful if swallowed

H315 - Causes skin irritation  
H318 - Causes serious eye damage

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight  
CAS – Chemical Abstracts Service  
EC50 – Effective Concentration 50%  
LC50 – Lethal Concentration 50%  
LD50 – Lethal Dose 50%  
LL50 – Lethal Loading 50%  
mg/kg – milligram/kilogram  
mg/L – milligram/liter  
NOEC – No Observed Effect Concentration  
OEL – Occupational Exposure Limit  
PBT – Persistent Bioaccumulative and Toxic  
ppm – parts per million  
STEL – Short Term Exposure Limit  
TWA – Time-Weighted Average  
vPvB – very Persistent and very Bioaccumulative  
h - hour  
mg/m<sup>3</sup> - milligram/cubic meter  
mm - millimeter  
mmHg - millimeter mercury  
w/w - weight/weight  
d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)  
NZ CCID

**Disclaimer Statement**

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

**End of Safety Data Sheet**

## SAFETY DATA SHEET

### DCA-32009

Revision Date: 20-Nov-2015

Revision Number: 7

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** DCA-32009

##### Other means of Identification

**Synonyms:** None  
**Product Code:** HM007719

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Cleaner  
**Uses Advised Against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road  
Jandakot  
WA 6164  
Australia  
  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-Mail address:** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951

##### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Acute Inhalation Toxicity - Dusts and Mists	Category 4 - H332
Skin Corrosion / irritation	Category 2 - H315
Serious Eye Damage / Eye Irritation	Category 2 - H319
Flammable Liquids.	Category 4 - H227

##### Label elements, including precautionary statements

##### **Hazard Pictograms**





<b>Signal Word</b>	Warning	
<b>Hazard Statements</b>	H227 - Combustible liquid H315 - Causes skin irritation H319 - Causes serious eye irritation H332 - Harmful if inhaled	
<b>Precautionary Statements</b>		
<b>Prevention</b>	P210 - Keep away from heat/sparks/open flames/hot surfaces. - No smoking P261 - Avoid breathing dust/fume/gas/mist/vapors/spray P264 - Wash face, hands and any exposed skin thoroughly after handling P280 - Wear protective gloves/eye protection/face protection	
<b>Response</b>	P302 + P352 - IF ON SKIN: Wash with plenty of soap and water P332 + P313 - If skin irritation occurs: Get medical advice/attention P362 - Take off contaminated clothing and wash before reuse P304 + P340 - IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing P312 - Call a POISON CENTER or doctor/physician if you feel unwell P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing P337 + P313 - If eye irritation persists: Get medical advice/attention P370 + P378 - In case of fire: Use water spray for extinction	
<b>Storage</b>	P403 + P235 - Store in a well-ventilated place. Keep cool	
<b>Disposal</b>	P501 - Dispose of contents/container in accordance with local/regional/national/international regulations	
<b>Contains Substances</b>	<b>CAS Number</b>	
Ethylene glycol monobutyl ether	111-76-2	
Oxylated alkylphenols	Proprietary	
Alkyl hexanol	Proprietary	
Isopropanol	67-63-0	
<b><u>Other hazards which do not result in classification</u></b>	None known	
<b>Australia Classification</b>	<i>For the full text of the H-phrases mentioned in this Section, see Section 16</i>	
<b>Classification</b>	Xn - Harmful.	
<b>Risk Phrases</b>	R20 Harmful by inhalation. R36/38 Irritating to eyes and skin.	

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Ethylene glycol monobutyl ether	111-76-2	30 - 60%	Acute Tox. 4 (H302) Acute Tox. 4 (H312) Acute Tox. 4 (H332) Skin Irrit. 2 (H315) Eye Irrit. 2 (H319) Flam. Liq. 4 (H227)
Oxylated alkylphenols	Proprietary	10 - 30%	Skin Irrit. 2 (H315) Eye Irrit. 2A (H319)
Alkyl hexanol	Proprietary	10 - 30%	Acute Tox. 4 (H332) Skin Irrit. 2 (H315) Eye Irrit. 2A (H319) STOT SE 3 (H335) Aquatic Acute 3 (H402) Flam. Liq. 4 (H227)
Isopropanol	67-63-0	10 - 30%	Eye Irrit. 2 (H319) STOT SE 3 (H336) Flam. Liq. 2 (H225)

#### 4. First aid measures

##### Description of necessary first aid measures

<b>Inhalation</b>	If inhaled, move victim to fresh air and seek medical attention.
<b>Eyes</b>	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
<b>Skin</b>	In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse. Destroy or properly dispose of contaminated shoes.
<b>Ingestion</b>	Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

##### Symptoms caused by exposure

Causes eye irritation Causes skin irritation. May be harmful if inhaled.

##### Medical Attention and Special Treatment

**Notes to Physician** Treat symptomatically

#### 5. Fire Fighting Measures

##### Suitable extinguishing equipment

##### **Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

##### **Extinguishing media which must not be used for safety reasons**

None known.

##### Specific hazards arising from the chemical

##### **Special Exposure Hazards**

Use water spray to cool fire exposed surfaces. Closed containers may explode in fire. Decomposition in fire may produce harmful gases.

##### Special protective equipment and precautions for fire fighters

##### **Special Protective Equipment for Fire-Fighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

#### 6. Accidental release measures

##### 6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment.

##### 6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

### **6.3. Methods and material for containment and cleaning up**

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

## **7. Handling and storage**

### **7.1. Precautions for Safe Handling**

#### **Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid breathing vapors.

#### **Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

### **7.2. Conditions for safe storage, including any incompatibilities**

#### **Storage Information**

Keep from heat, sparks, and open flames. Store in a cool well ventilated area. Keep container closed when not in use. Store locked up. Product has a shelf life of 24 months.

#### **Other Guidelines**

No information available

## **8. Exposure Controls/Personal Protection**

### **Control parameters - exposure standards, biological monitoring**

#### **Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Ethylene glycol monobutyl ether	111-76-2	TWA: 20 ppm TWA: 96.9 mg/m <sup>3</sup> STEL: 50 ppm STEL: 242 mg/m <sup>3</sup>	TWA: 20 ppm Skin
Oxylated alkylphenols	Proprietary	Not applicable	Not applicable
Alkyl hexanol	Proprietary	TWA: 50 ppm TWA: 266 mg/m <sup>3</sup>	TWA: 50 ppm
Isopropanol	67-63-0	TWA: 400 ppm TWA: 983 mg/m <sup>3</sup> STEL: 500 ppm STEL: 1230 mg/m <sup>3</sup>	TWA: 200 ppm STEL: 400 ppm

### **Appropriate engineering controls**

#### **Engineering Controls**

Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.

### **Personal protective equipment (PPE)**

#### **Respiratory Protection**

Organic vapor respirator.  
In high concentrations, supplied air respirator or a self-contained breathing apparatus.

#### **Hand Protection**

Impervious rubber gloves.

#### **Skin Protection**

Rubber apron.

#### **Eye Protection**

Chemical goggles; also wear a face shield if splashing hazard exists.

#### **Other Precautions**

None known.

#### **Environmental Exposure Controls**

No information available

## **9. Physical and Chemical Properties**

### **9.1. Information on basic physical and chemical properties**

**Physical State:** Liquid

**Color:** Clear light amber

**Odor:** Sweet

**Odor Threshold:** No information available

#### Property

#### Values

Remarks/ - Method

**pH:**

8

Freezing Point/Range	No data available
Melting Point/Range	No data available
Boiling Point/Range	136 °C / 278 °F
Flash Point	79 °C / 175 °F PMCC
upper flammability limit	10.6%
lower flammability limit	1.5%
Evaporation rate	No data available
Vapor Pressure	0.8 mmHg
Vapor Density	No data available
Specific Gravity	0.92
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

**9.2. Other information**

VOC Content (%) No data available

## 10. Stability and Reactivity

**10.1. Reactivity**

Not expected to be reactive.

**10.2. Chemical Stability**

Stable

**10.3. Possibility of Hazardous Reactions**

Will Not Occur

**10.4. Conditions to Avoid**

Keep away from heat, sparks and flame.

**10.5. Incompatible Materials**

Strong oxidizers. Strong alkalis. Amphoteric metals such as aluminum, magnesium, lead, tin, or zinc.

**10.6. Hazardous Decomposition Products**

Toxic fumes. Carbon monoxide and carbon dioxide.

## 11. Toxicological Information

**Information on routes of exposure**

**Principle Route of Exposure** Eye or skin contact, inhalation.

**Symptoms related to exposure****Most Important Symptoms/Effects**

Causes eye irritation Causes skin irritation. May be harmful if inhaled.

**Numerical measures of toxicity****Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Ethylene glycol monobutyl ether	111-76-2	470 mg/kg (Rat) 1414 mg/kg (Guinea pig) 1746 mg/kg (Rat) 320 mg/kg (Rabbit) 530 mg/kg (Rat) 560 mg/kg (Rat) 3000 mg/kg (Rat) 2400 mg/kg (Rat)	220 mg/kg (Rabbit) 2270 mg/kg (Rat) 200 mg/kg (Guinea pig) >2000 mg/kg (Rabbit) 841 mg/kg (Rabbit) 435 mg/kg (Rabbit) >2000 mg/kg (Guinea pig) >2000 mg/kg (Rat) 100 mg/kg (Rabbit) 207 mg/kg (Guinea pig) 400-500 mg/kg (Rabbit)	450 mg/L (Rat) 4h 2.174 mg/L (Rat) 4h 2.21 mg/L (Rat) 4h 450-486 mg/L (Rat) 4h 925 mg/L (Rat) 4h >633 mg/L (Guinea pig) 1h
Oxylated alkylphenols	Proprietary	No data available	No data available	No data available

Alkyl hexanol	Proprietary	> 2000 mg/kg	1980 mg/kg	1.45 mg/L (Rat) 4h
Isopropanol	67-63-0	4396 mg/kg (Rat) 5840 mg/kg (Rat) 3600 mg/kg (Mouse)	12,800 mg/kg (Rat) 12,870 mg/kg (Rabbit) 6280 mg/kg (Rabbit)	72.6 mg/L (Rat) 4h > 10,000 mg/L (Rat) 6h

**Immediate, delayed and chronic health effects from exposure****Product Information****Inhalation**

Under certain conditions of use, some of the product ingredients may cause the following:  
Harmful if inhaled. May cause mild respiratory irritation. May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.

**Eye Contact**

Causes moderate eye irritation.

**Skin Contact**

Causes moderate skin irritation.

**Ingestion**

May cause abdominal pain, vomiting, nausea, and diarrhea.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

**Exposure Levels**

No data available

**Interactive effects**

Skin disorders. Eye ailments.

**Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Ethylene glycol monobutyl ether	111-76-2	Causes moderate skin irritation. (Rabbit)
Oxylated alkylphenols		Irritating to skin. (Rabbit)
Alkyl hexanol		Causes moderate skin irritation. (Rabbit)
Isopropanol	67-63-0	Non-irritating to the skin (Rabbit)

Substances	CAS Number	Eye damage/irritation
Ethylene glycol monobutyl ether	111-76-2	Causes moderate eye irritation. (Rabbit)
Oxylated alkylphenols		Irritating to eyes. (Rabbit)
Alkyl hexanol		Causes moderate eye irritation. (Rabbit)
Isopropanol	67-63-0	Causes moderate eye irritation. (Rabbit)

Substances	CAS Number	Skin Sensitization
Ethylene glycol monobutyl ether	111-76-2	Did not cause sensitization on laboratory animals (guinea pig)
Oxylated alkylphenols		No information available
Alkyl hexanol		Did not cause sensitization on laboratory animals (guinea pig)
Isopropanol	67-63-0	Did not cause sensitization on laboratory animals (guinea pig)

Substances	CAS Number	Respiratory Sensitization
Ethylene glycol monobutyl ether	111-76-2	No information available
Oxylated alkylphenols		No information available
Alkyl hexanol		Not regarded as a sensitizer.
Isopropanol	67-63-0	No information available

Substances	CAS Number	Mutagenic Effects
Ethylene glycol monobutyl ether	111-76-2	In vivo tests did not show mutagenic effects. In vitro tests did not show mutagenic effects
Oxylated alkylphenols		Not regarded as mutagenic.
Alkyl hexanol		In vitro tests did not show mutagenic effects.
Isopropanol	67-63-0	In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects.

Substances	CAS Number	Carcinogenic Effects
------------	------------	----------------------

Ethylene glycol monobutyl ether	111-76-2	Not regarded as carcinogenic.
Oxylated alkylphenols		No information available.
Alkyl hexanol		Did not show carcinogenic effects in animal experiments
Isopropanol	67-63-0	Did not show carcinogenic effects in animal experiments

Substances	CAS Number	Reproductive toxicity
Ethylene glycol monobutyl ether	111-76-2	Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments.
Oxylated alkylphenols		No information available
Alkyl hexanol		Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments.
Isopropanol	67-63-0	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	STOT - single exposure
Ethylene glycol monobutyl ether	111-76-2	No data of sufficient quality are available.
Oxylated alkylphenols		No significant toxicity observed in animal studies at concentration requiring classification.
Alkyl hexanol		May cause respiratory irritation.
Isopropanol	67-63-0	May cause headache, dizziness, and other central nervous system effects.

Substances	CAS Number	STOT - repeated exposure
Ethylene glycol monobutyl ether	111-76-2	No data of sufficient quality are available.
Oxylated alkylphenols		No significant toxicity observed in animal studies at concentration requiring classification.
Alkyl hexanol		No significant toxicity observed in animal studies at concentration requiring classification.
Isopropanol	67-63-0	No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)

Substances	CAS Number	Aspiration hazard
Ethylene glycol monobutyl ether	111-76-2	No adverse health effects are expected from swallowing.
Oxylated alkylphenols		Not applicable
Alkyl hexanol		Not applicable
Isopropanol	67-63-0	Not applicable

## 12. Ecological Information

### Ecotoxicity

#### Product Ecotoxicity Data

No data available

#### Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Ethylene glycol monobutyl ether	111-76-2	EC50 839.56 mg/L (Skeletonema costatum) EbC50 (72h) 911 mg/L EC50 > 500 mg/L (Scenedesmus subspicatus) NOEC (72h) 88 mg/L (biomass)(Pseudokirchnerella subcapitata)	LC50 > 1000 mg/L (Scophthalmus maximus, juvenile) LC50 (96h) 1474 mg/L (Oncorhynchus mykiss) NOEC (21d) > 100mg/L (Danio rerio)	TT/EC3 (48h) 463 mg/L (Uronema parduzci) TT/EC3 (72h) 73 mg/L (Entosiphon sulcatum) TT/EC3 (16h) 700 mg/L (Pseudomonas putida)	No information available
Oxylated alkylphenols	Proprietary	No information available	EC50 (96h) 1.2 - 9.3 mg/L (Pimephales promelas)	No information available	EC50 (48h) 1.6 - 10 mg/L (Daphnia magna)
Alkyl hexanol	Proprietary	No information available	LC50 (96h) 17.1 mg/L (Leuciscus idus melanotus)	No information available	No information available
Isopropanol	67-63-0	EC50 (72h) > 1000 mg/L (Desmodesmus subspicatus) EC50 (7d) 1800 mg/L (Scenedesmus quadricauda)	LC50 (96h) 9640 mg/L (Pimephales promelas) LC50 (7d) 7060 mg/L (Poecilia reticulata)	TT (16h) 1050 mg/L (Pseudomonas putida)	EC50 (48h) 13,299 mg/L (Daphnia magna) EC50 (24h) > 10,000 mg/L (Daphnia magna)

**12.2. Persistence and degradability**

Substances	CAS Number	Persistence and Degradability
Ethylene glycol monobutyl ether	111-76-2	Readily biodegradable (75-88% @ 28d)
Oxylated alkylphenols	Proprietary	No information available
Alkyl hexanol	Proprietary	Readily biodegradable (100 @ 14d)
Isopropanol	67-63-0	Readily biodegradable (53% @ 5d)

**12.3. Bioaccumulative potential**

Substances	CAS Number	Log Pow
Ethylene glycol monobutyl ether	111-76-2	0.81
Oxylated alkylphenols	Proprietary	No information available
Alkyl hexanol	Proprietary	2.73 BCF = 25.33
Isopropanol	67-63-0	0.05

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Ethylene glycol monobutyl ether	111-76-2	No information available
Oxylated alkylphenols	Proprietary	No information available
Alkyl hexanol	Proprietary	KOC = 26
Isopropanol	67-63-0	KOC = 1.5

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

<b>13. Disposal Considerations</b>
------------------------------------

**Safe handling and disposal methods**

Disposal should be made in accordance with federal, state, and local regulations. Substance should NOT be deposited into a sewage facility.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

<b>14. Transport Information</b>
----------------------------------

**Transportation Information**

<b>UN Number:</b>	Not restricted
<b>UN Proper Shipping Name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

<b>15. Regulatory Information</b>
-----------------------------------

**Safety, health and environmental regulations specific for the product****International Inventories****Australian AICS Inventory**

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

**New Zealand Inventory of Chemicals**

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

**EINECS Inventory**

This product does not comply with EINECS

**US TSCA Inventory**

All components listed on inventory or are exempt.

**Canadian DSL Inventory**

All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

**International Agreements****Montreal Protocol - Ozone Depleting Substances:**

Does not apply

**Stockholm Convention - Persistent Organic Pollutants:**

Does not apply

**Rotterdam Convention - Prior Informed Consent:**

Does not apply

**Basel Convention - Hazardous Waste:**

Does not apply

**16. Other information****Date of preparation or review**

**Revision Date:** 20-Nov-2015

**Revision Note**

SDS sections updated: 2

**Full text of R-phrases referred to under Sections 2 and 3**

R20 Harmful by inhalation.

R36/38 Irritating to eyes and skin.

**Full text of H-Statements referred to under sections 2 and 3**

H225 - Highly flammable liquid and vapor

H227 - Combustible liquid

H302 - Harmful if swallowed

H312 - Harmful in contact with skin

H315 - Causes skin irritation

H319 - Causes serious eye irritation

H332 - Harmful if inhaled

H335 - May cause respiratory irritation

H336 - May cause drowsiness or dizziness

H402 - Harmful to aquatic life

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight

CAS – Chemical Abstracts Service

EC50 – Effective Concentration 50%

LC50 – Lethal Concentration 50%

LD50 – Lethal Dose 50%

LL50 – Lethal Loading 50%

mg/kg – milligram/kilogram

mg/L – milligram/liter

NOEC – No Observed Effect Concentration



OEL – Occupational Exposure Limit  
PBT – Persistent Bioaccumulative and Toxic  
ppm – parts per million  
STEL – Short Term Exposure Limit  
TWA – Time-Weighted Average  
vPvB – very Persistent and very Bioaccumulative  
h - hour  
mg/m<sup>3</sup> - milligram/cubic meter  
mm - millimeter  
mmHg - millimeter mercury  
w/w - weight/weight  
d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)  
NZ CCID  
Bioaquatics Testing, 1990

**Disclaimer Statement**

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

**End of Safety Data Sheet**

**SAFETY DATA SHEET****DCA-32014**

Revision Date: 31-Aug-2017

Revision Number: 3

**1. Product Identifier & Identity for the Chemical**

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

**1.1. Product Identifier**

**Product Name** DCA-32014

**Other means of Identification**

**Synonyms** None  
**Hazardous Material Number:** HM008547

**Recommended use of the chemical and restrictions on use**

**Recommended Use** Surfactant  
**Uses advised against** Consumer use

**Supplier's name, address and phone number**

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road, Jandakot, WA 6164  
Australia  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-mail Address** fdunexchem@halliburton.com

**Emergency phone number**

+ 61 1 800 686 951  
Global Incident Response Access Code: 334305  
Contract Number: 14012

**Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

**2. Hazard Identification**

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

**Classification of the hazardous chemical**

Aspiration Toxicity	Category 1 - H304
Skin Corrosion/Irritation	Category 2 - H315
Serious Eye Damage/Irritation	Category 1 - H318
Reproductive Toxicity	Category 1B - H360
Acute Aquatic Toxicity	Category 2 - H401
Flammable liquids.	Category 3 - H226

**Label elements, including precautionary statements**

**Hazard Pictograms****Signal Word**

DANGER

**Hazard Statements:**

H226 - Flammable liquid and vapor  
 H304 - May be fatal if swallowed and enters airways  
 H315 - Causes skin irritation  
 H318 - Causes serious eye damage  
 H360 - May damage fertility or the unborn child  
 H401 - Toxic to aquatic life

**Precautionary Statements****Prevention**

P201 - Obtain special instructions before use  
 P202 - Do not handle until all safety precautions have been read and understood  
 P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.  
 P233 - Keep container tightly closed  
 P240 - Ground and bond container and receiving equipment.  
 P241 - Use explosion-proof electrical/ventilating/lighting/equipment  
 P242 - Use only non-sparking tools  
 P243 - Take action to prevent static discharges.  
 P264 - Wash face, hands and any exposed skin thoroughly after handling  
 P273 - Avoid release to the environment  
 P280 - Wear protective gloves/protective clothing/eye protection/face protection  
 P281 - Use personal protective equipment as required

**Response**

P301 + P310 - IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician  
 P331 - Do NOT induce vomiting  
 P302 + P352 - IF ON SKIN: Wash with plenty of water.  
 P332 + P313 - If skin irritation occurs: Get medical advice/attention  
 P362 + P364 - Take off contaminated clothing and wash before reuse  
 P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
 P310 - Immediately call a POISON CENTER or doctor/physician  
 P308 + P313 - IF exposed or concerned: Get medical advice/attention  
 P370 + P378 - In case of fire: Use water spray for extinction

**Storage**

P403 + P235 - Store in a well-ventilated place. Keep cool  
 P405 - Store locked up

**Disposal**

P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Contains Substances**

Hydrotreated light petroleum distillate  
 Ethanol  
 Fatty acids, tall-oil, ethoxylated  
 C12-C15 Ethoxylated alcohols  
 Amides, tall-oil fatty, N,N-bis(hydroxyethyl)  
 Butyl alcohol

**CAS Number**

64742-47-8  
 64-17-5  
 61791-00-2  
 68131-39-5  
 68155-20-4  
 71-36-3

Methanol

67-56-1

**Other hazards which do not result in classification**

None known

For the full text of the H-phrases mentioned in this Section, see Section 16

<b>3. Composition/information on Ingredients</b>
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Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Hydrotreated light petroleum distillate	64742-47-8	10 - 30%	Asp. Tox. 1 (H304)
Ethanol	64-17-5	10 - 30%	Eye Irrit. 2A (H319) Flam. Liq. 2 (H225)
Fatty acids, tall-oil, ethoxylated	61791-00-2	10 - 30%	Skin Irrit. 2 (H315) Eye Irrit. 2A (H319)
C12-C15 Ethoxylated alcohols	68131-39-5	10 - 30%	Acute Tox. 4 (H302) Skin Irrit. 2 (H315) Eye Corr. 1 (H318) Aquatic Acute 1 (H400) Aquatic Chronic 3 (H412)
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	10 - 30%	Skin Irrit. 2 (H315) Eye Corr. 1 (H318) Aquatic Acute 2 (H401) Aquatic Chronic 3 (H412)
Butyl alcohol	71-36-3	5 - 10%	Acute Tox. 4 (H302) Skin Irrit. 2 (H315) Eye Corr. 1 (H318) STOT SE 3 (H335) Flam. Liq. 3 (H226)
Methanol	67-56-1	0.1 - 1%	Acute Tox. 3 (H301) Acute Tox. 3 (H311) Acute Tox. 3 (H331) Repr. 1B (H360) STOT SE 1 (H370) Flam. Liq. 2 (H225)

<b>4. First aid measures</b>
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**Description of necessary first aid measures****Inhalation**

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

**Eyes**

In case of contact, immediately flush eyes with plenty of water for at least 30 minutes. Remove contact lenses after the first 5 minutes and continue washing. Seek immediate medical attention/advice. Suitable emergency eye wash facility should be immediately available

**Skin**

In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention.

**Ingestion**

Get medical attention! If vomiting occurs, keep head lower than hips to prevent aspiration. Rinse mouth. Never give anything by mouth to an unconscious person. Following ingestion, onset of symptoms may be delayed by 12 to 24 hours. Admission to hospital should be the first priority even if symptoms are absent.

**Symptoms caused by exposure**

Causes severe eye irritation which may damage tissue. Causes skin irritation. Aspiration into the lungs may cause chemical pneumonitis including coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal. Potential reproductive hazard. May cause birth defects.

**Medical Attention and Special Treatment****Notes to Physician**

Treat symptomatically

## 5. Fire Fighting Measures

### Suitable extinguishing equipment

#### **Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

#### **Extinguishing media which must not be used for safety reasons**

Do NOT spray pool fires directly with water. A solid stream of water directed into hot burning liquid can cause splattering.

### Specific hazards arising from the chemical

#### **Special exposure hazards in a fire**

Decomposition in fire may produce harmful gases.

### Special protective equipment and precautions for fire fighters

#### **Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## 6. Accidental release measures

### 6.1. Personal precautions, protective equipment and emergency procedures

Ensure adequate ventilation. Use appropriate protective equipment. Remove sources of ignition. Take precautionary measures against static discharges All equipment used when handling the product must be grounded Avoid contact with skin, eyes and clothing.

### 6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

### 6.3. Methods and material for containment and cleaning up

Dike far ahead of liquid spill for later disposal. Soak up with inert absorbent material. Pick up and transfer to properly labeled containers. Remove ignition sources and work with non-sparking tools.

## 7. Handling and storage

### 7.1. Precautions for safe handling

#### **Handling Precautions**

Ensure adequate ventilation. Use appropriate protective equipment. Remove sources of ignition. Ground and bond containers when transferring from one container to another. Avoid contact with eyes, skin, or clothing.

#### **Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

### 7.2. Conditions for safe storage, including any incompatibilities

#### **Storage Information**

Store in a cool well ventilated area. Keep from heat, sparks, and open flames.

#### **Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

### Control parameters - exposure standards, biological monitoring

#### **Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Hydrotreated light petroleum distillate	64742-47-8	Not applicable	Not applicable
Ethanol	64-17-5	TWA: 1000 ppm TWA: 1880 mg/m <sup>3</sup>	STEL: 1000 ppm
Fatty acids, tall-oil, ethoxylated	61791-00-2	Not applicable	Not applicable
C12-C15 Ethoxylated alcohols	68131-39-5	Not applicable	Not applicable
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	Not applicable	Not applicable
Butyl alcohol	71-36-3	50 ppm	TWA: 20 ppm

Methanol	67-56-1	TWA: 200 ppm TWA: 262 mg/m <sup>3</sup> STEL: 250 ppm STEL: 328 mg/m <sup>3</sup>	TWA: 200 ppm STEL: 250 ppm
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**Appropriate engineering controls**

**Engineering Controls** Ensure adequate ventilation, especially in confined areas

**Personal protective equipment (PPE)**

**Personal Protective Equipment** If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

**Respiratory Protection** If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.  
Organic vapor respirator.

**Hand Protection** Use gloves which are suitable for the chemicals present in this product as well as other environmental factors in the workplace.

**Skin Protection** Wear impervious protective clothing, including boots, gloves, lab coat, apron, rain jacket, pants or coverall, as appropriate, to prevent skin contact.

**Eye Protection** Chemical goggles; also wear a face shield if splashing hazard exists.

**Other Precautions** Eyewash fountains and safety showers must be easily accessible.

**Environmental Exposure Controls** No information available

## 9. Physical and Chemical Properties

**9.1. Information on basic physical and chemical properties**

**Physical State:** Liquid  
**Color** Colorless to Light Amber  
**Odor:** Mild hydrocarbon  
**Odor Threshold:** No information available

<u>Property</u>	<u>Values</u>
<u>Remarks/ - Method</u>	
<b>pH:</b>	No data available
<b>Freezing Point / Range</b>	-44.2 °C
<b>Melting Point / Range</b>	No data available
<b>Boiling Point / Range</b>	No data available
<b>Flash Point</b>	34 °C / 93.2 °F
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	0.918
<b>Water Solubility</b>	No data available
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

**9.2. Other information**

**VOC Content (%)** No data available

## 10. Stability and Reactivity

**10.1. Reactivity**

Not expected to be reactive.

**10.2. Chemical stability**

Stable

**10.3. Possibility of hazardous reactions**

Will Not Occur

**10.4. Conditions to avoid**

Keep away from heat, sparks and flame.

**10.5. Incompatible materials**

Strong oxidizers. Strong acids. Strong alkalis.

**10.6. Hazardous decomposition products**

Carbon oxides. Oxides of nitrogen.

**11. Toxicological Information****Information on routes of exposure****Principle Route of Exposure** Skin contact. Eye contact. Inhalation.**Symptoms related to exposure****Most Important Symptoms/Effects**

Causes severe eye irritation which may damage tissue. Causes skin irritation. Aspiration into the lungs may cause chemical pneumonitis including coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal. Potential reproductive hazard. May cause birth defects.

**Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Hydrotreated light petroleum distillate	64742-47-8	>5000 mg/kg-bw (rat) (similar substance)	>2000 mg/kg-bw (rabbit) (similar substance)	>5.2 mg/L (rat, 4 h, vapor) (similar substance)
Ethanol	64-17-5	7060 mg/kg (Rat) 10,470 mg/kg (Rat)	> 15,800 mg/kg (Rabbit) 17,100 mg/kg (Rabbit)	124.7 mg/L (Rat) 4h
Fatty acids, tall-oil, ethoxylated	61791-00-2	> 6400 mg/kg (Rat)	No data available	No data available
C12-C15 Ethoxylated alcohols	68131-39-5	2 g/kg (Rat) 1600 mg/kg (Rat) > 5000 mg/kg (Rat)	> 2000 mg/kg (Rat) 2500 mg/kg (Rabbit)	No data available
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	3500 mg/kg (Rat) > 5000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 0.219 mg/L (Mouse) 4h (similar substance)
Butyl alcohol	71-36-3	790 mg/kg (Rat)	3400 mg/kg (Rabbit)	> 17.6 mg/L (Rat) 4h
Methanol	67-56-1	300 mg/kg-bw (human) < 790 to 13,000 mg/kg (rat)	1000 mg/kg-bw (human) 17,100 mg/kg (rabbit)	10 mg/L (human, 4h, vapor)

**Immediate, delayed and chronic health effects from exposure****Inhalation**

May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.

**Eye Contact**

Causes severe eye irritation which may damage tissue.

**Skin Contact**

Causes skin irritation.

**Ingestion**

Aspiration into the lungs may cause chemical pneumonitis including coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal. Ingestion of this product may cause blindness due to the presence of methanol.

**Chronic Effects/Carcinogenicity** Prolonged or repeated exposure may cause reproductive system damage. May cause birth defects.

**Exposure Levels**

No data available

**Interactive effects**

No data available

**Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Hydrotreated light petroleum distillate	64742-47-8	Non-irritating to the skin (similar substances)
Ethanol	64-17-5	Not irritating to skin in rabbits.
Fatty acids, tall-oil, ethoxylated	61791-00-2	Irritating to skin.
C12-C15 Ethoxylated alcohols	68131-39-5	May cause moderate skin irritation. (Rabbit)
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	Skin, rabbit: Causes moderate skin irritation. (similar substances)
Butyl alcohol	71-36-3	Causes moderate skin irritation.
Methanol	67-56-1	Non-irritating to the skin (Rabbit)

Substances	CAS Number	Serious eye damage/irritation
Hydrotreated light petroleum distillate	64742-47-8	Non-irritating to rabbit's eye (similar substances)
Ethanol	64-17-5	Causes moderate eye irritation (Rabbit)
Fatty acids, tall-oil, ethoxylated	61791-00-2	Irritating to eyes
C12-C15 Ethoxylated alcohols	68131-39-5	Risk of serious damage to eyes (Rabbit) (similar substances)
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	Causes severe eye irritation (similar substances)
Butyl alcohol	71-36-3	Causes severe eye irritation
Methanol	67-56-1	Non-irritating to the eye (Rabbit)

Substances	CAS Number	Skin Sensitization
Hydrotreated light petroleum distillate	64742-47-8	Did not cause sensitization on laboratory animals (guinea pig) (similar substances)
Ethanol	64-17-5	Did not cause sensitization on laboratory animals
Fatty acids, tall-oil, ethoxylated	61791-00-2	No information available
C12-C15 Ethoxylated alcohols	68131-39-5	Did not cause sensitization on laboratory animals (guinea pig)
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	Did not cause sensitization on laboratory animals (similar substances)
Butyl alcohol	71-36-3	Not confirmed to cause skin or respiratory sensitization.
Methanol	67-56-1	Did not cause sensitization on laboratory animals (guinea pig)

Substances	CAS Number	Respiratory Sensitization
Hydrotreated light petroleum distillate	64742-47-8	No information available
Ethanol	64-17-5	Did not cause sensitization on laboratory animals
Fatty acids, tall-oil, ethoxylated	61791-00-2	No information available
C12-C15 Ethoxylated alcohols	68131-39-5	No information available
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	No information available
Butyl alcohol	71-36-3	No information available
Methanol	67-56-1	No information available

Substances	CAS Number	Mutagenic Effects
Hydrotreated light petroleum distillate	64742-47-8	In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects. (similar substances)
Ethanol	64-17-5	Not regarded as mutagenic.
Fatty acids, tall-oil, ethoxylated	61791-00-2	No information available
C12-C15 Ethoxylated alcohols	68131-39-5	In vivo tests did not show mutagenic effects. In vitro tests did not show mutagenic effects.
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects. (similar substances)
Butyl alcohol	71-36-3	In vitro tests did not show mutagenic effects.
Methanol	67-56-1	The weight of evidence from available in vitro and in vivo studies indicates that this substance is not expected to be mutagenic.

Substances	CAS Number	Carcinogenic Effects
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Hydrotreated light petroleum distillate	64742-47-8	Did not show carcinogenic effects in animal experiments (similar substances)
Ethanol	64-17-5	Did not show carcinogenic effects in animal experiments
Fatty acids, tall-oil, ethoxylated	61791-00-2	No information available
C12-C15 Ethoxylated alcohols	68131-39-5	Did not show carcinogenic effects in animal experiments
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	Not regarded as carcinogenic.
Butyl alcohol	71-36-3	No information available
Methanol	67-56-1	No data of sufficient quality are available.

Substances	CAS Number	Reproductive toxicity
Hydrotreated light petroleum distillate	64742-47-8	Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments. (similar substances)
Ethanol	64-17-5	Animal testing did not show any effects on fertility.
Fatty acids, tall-oil, ethoxylated	61791-00-2	No information available
C12-C15 Ethoxylated alcohols	68131-39-5	No significant toxicity observed in animal studies at concentration requiring classification.
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	Not a confirmed teratogen or embryotoxin.
Butyl alcohol	71-36-3	Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments.
Methanol	67-56-1	Experiments have shown reproductive toxicity effects on laboratory animals

Substances	CAS Number	STOT - single exposure
Hydrotreated light petroleum distillate	64742-47-8	No significant toxicity observed in animal studies at concentration requiring classification.
Ethanol	64-17-5	No significant toxicity observed in animal studies at concentration requiring classification.
Fatty acids, tall-oil, ethoxylated	61791-00-2	No information available
C12-C15 Ethoxylated alcohols	68131-39-5	No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	No significant toxicity observed in animal studies at concentration requiring classification.
Butyl alcohol	71-36-3	May cause respiratory irritation.
Methanol	67-56-1	May cause disorder and damage to the Central Nervous System (CNS)

Substances	CAS Number	STOT - repeated exposure
Hydrotreated light petroleum distillate	64742-47-8	No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)
Ethanol	64-17-5	No significant toxicity observed in animal studies at concentration requiring classification.
Fatty acids, tall-oil, ethoxylated	61791-00-2	No information available
C12-C15 Ethoxylated alcohols	68131-39-5	No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	No significant toxicity observed in animal studies at concentration requiring classification.
Butyl alcohol	71-36-3	No significant toxicity observed in animal studies at concentration requiring classification.
Methanol	67-56-1	No data of sufficient quality are available.

Substances	CAS Number	Aspiration hazard
Hydrotreated light petroleum distillate	64742-47-8	Aspiration into the lungs may cause chemical pneumonitis including coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal.
Ethanol	64-17-5	Not applicable
Fatty acids, tall-oil, ethoxylated	61791-00-2	Not applicable
C12-C15 Ethoxylated alcohols	68131-39-5	No adverse health effects are expected from swallowing.
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	No information available
Butyl alcohol	71-36-3	Aspiration into the lungs may cause chemical pneumonitis including coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal.
Methanol	67-56-1	Not applicable

## 12. Ecological Information

### Ecotoxicity

#### Product Ecotoxicity Data

Product is not classified as hazardous to the environment.

#### Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Hydrotreated light petroleum distillate	64742-47-8	ErL50(72 h)>10000 mg/L (Skeletonema costatum)	LC50(96 h)>10000 mg/L (Scophthalmus maximus) NOELC(28 d)>1000 mg/L (fish)	No information available	LC50(48 h)>10000 mg/L (Acartia tonsa) NOEC(21 d)=1000 mg/L (Daphnia magna)
Ethanol	64-17-5	No information available	LC50 > 100 mg/L (Pimephales promelas)	No information available	LC50 9268 - 14,221 mg/L (Daphnia magna) LC50 5012 mg/L (Ceriodaphnia dubia) NOEC 9.6 mg/L (Daphnia magna)
Fatty acids, tall-oil, ethoxylated	61791-00-2	EC50 (72h) > 44 mg/L EC50 (72h) 2.5 mg/L (Skeletonema costatum)	LC50 (95h) 7.8 mg/L (Brachydanio rerio) LC50 (96h) 45 mg/L (Cyprinodon variegatus)	EC20 (180m) >1000 mg/L	EC50 (48h) 16 mg/L (Daphnia magna) EC50 (48h) 26.8 mg/L (Acartia tonsa)
C12-C15 Ethoxylated alcohols	68131-39-5	No information available	EC50 (48h) 0.39 mg/L (Ceriodaphnia dubia) NOEC (30d) 0.28 mg/L (Pimephales promelas) NOEC (16d) 0.16 mg/L (Lepomis macrochirus)	No information available	No information available
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	EC50 (72h) 2.2 mg/L (Scenedesmus subspicatus) (similar substance)	LC50 (96h) 6.7 mg/L (Danio rerio) (similar substance)	No information available	LC50 (21d) = 0.1 mg/L (Daphnia magna) LC50 (48h) = 2.15 mg/L
Butyl alcohol	71-36-3	EC50 (96h) 225 mg/L (Pseudokirchnerella subcapitata)	LC50 (96h) 1376 mg/L (Pimephales promelas)	No information available	EC50 (48h) 1328 mg/L (Daphnia magna) NOEC (21d) 4.1 mg/L (Daphnia magna) EC50 (21d) 18 mg/L (Daphnia magna)
Methanol	67-56-1	EC50 (96 h) =22000 mg/L (Pseudokirchnerella subcapitata) NOEC (8 d) =8000 mg/L (Scenedesmus quadricauda)	LC50 (96 h) =15400 mg/L (Lepomis macrochirus) EC50 (200 h) =14536 mg/L (Oryzias latipes)	IC50 (3h) > 1000 mg/L (activated sludge)	EC50 (96 h) =18260 mg/L (Daphnia magna) NOEC (21 d) =208 mg/L (Daphnia magna)

### 12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Hydrotreated light petroleum distillate	64742-47-8	Readily biodegradable (68.1% @ 28d)
Ethanol	64-17-5	No information available
Fatty acids, tall-oil, ethoxylated	61791-00-2	Readily biodegradable (74% @ 28d)
C12-C15 Ethoxylated alcohols	68131-39-5	Readily biodegradable
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	Readily biodegradable (77% @ 28d)
Butyl alcohol	71-36-3	Biodegradable. (92% @ 20d)
Methanol	67-56-1	Readily biodegradable (95% @ 20d)

### 12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Hydrotreated light petroleum distillate	64742-47-8	No information available
Ethanol	64-17-5	-0.32
Fatty acids, tall-oil, ethoxylated	61791-00-2	MW > 700
C12-C15 Ethoxylated alcohols	68131-39-5	3
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	3.2 (estimated)

Butyl alcohol	71-36-3	1
Methanol	67-56-1	Not Bioaccumulative; BCF=1

#### 12.4. Mobility in soil

Substances	CAS Number	Mobility
Hydrotreated light petroleum distillate	64742-47-8	No information available
Ethanol	64-17-5	No information available
Fatty acids, tall-oil, ethoxylated	61791-00-2	No information available
C12-C15 Ethoxylated alcohols	68131-39-5	No information available
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	No information available
Butyl alcohol	71-36-3	KOC = 72
Methanol	67-56-1	No information available

#### 12.6. Other adverse effects

##### Endocrine Disruptor Information

This product does not contain any known or suspected endocrine disruptors

### 13. Disposal Considerations

#### Safe handling and disposal methods

Disposal should be made in accordance with federal, state, and local regulations.

#### Disposal of any contaminated packaging

Follow all applicable national or local regulations.

#### Environmental regulations

Not applicable

### 14. Transport Information

#### Transportation Information

##### Australia ADG

UN Number	UN1993
UN proper shipping name:	Flammable Liquid, N.O.S. (Contains Ethanol, Butanol)
Transport Hazard Class(es):	3
Packing Group:	III
Environmental Hazards:	Not applicable

##### IMDG/IMO

UN Number	UN1993
UN proper shipping name:	Flammable Liquid, N.O.S. (Contains Ethanol, Butanol)
Transport Hazard Class(es):	3
Packing Group:	III
Environmental Hazards:	Not applicable

##### IATA/ICAO

UN Number	UN1993
UN proper shipping name:	Flammable Liquid, N.O.S. (Contains Ethanol, Butanol)
Transport Hazard Class(es):	3
Packing Group:	III
Environmental Hazards:	Not applicable

#### Special precautions during transport

None

#### HazChem Code

•3Y

### 15. Regulatory Information

**Safety, health and environmental regulations specific for the product****International Inventories****Australian AICS Inventory**

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

**New Zealand Inventory of Chemicals**

All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

**EINECS (European Inventory of Existing Chemical Substances)**

This product does not comply with EINECS

**US TSCA Inventory**

All components listed on inventory or are exempt.

**Canadian Domestic Substances List (DSL)**

All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

**International Agreements****Montreal Protocol - Ozone Depleting Substances:**

Does not apply

**Stockholm Convention - Persistent Organic Pollutants:**

Does not apply

**Rotterdam Convention - Prior Informed Consent:**

Does not apply

**Basel Convention - Hazardous Waste:**

Does not apply

**16. Other information****Date of preparation or review**

**Revision Date:** 31-Aug-2017

**Revision Note**

SDS sections updated:

2

**Full text of H-Statements referred to under sections 2 and 3**

H225 - Highly flammable liquid and vapor

H226 - Flammable liquid and vapor

H301 - Toxic if swallowed

H302 - Harmful if swallowed

H304 - May be fatal if swallowed and enters airways

H311 - Toxic in contact with skin

H315 - Causes skin irritation

H318 - Causes serious eye damage

H319 - Causes serious eye irritation

H331 - Toxic if inhaled

H335 - May cause respiratory irritation

H360 - May damage fertility or the unborn child

H370 - Causes damage to organs

H400 - Very toxic to aquatic life

H401 - Toxic to aquatic life

H412 - Harmful to aquatic life with long lasting effects

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight

CAS – Chemical Abstracts Service

EC50 – Effective Concentration 50%

LC50 – Lethal Concentration 50%

LD50 – Lethal Dose 50%  
LL50 – Lethal Loading 50%  
mg/kg – milligram/kilogram  
mg/L – milligram/liter  
NOEC – No Observed Effect Concentration  
OEL – Occupational Exposure Limit  
PBT – Persistent Bioaccumulative and Toxic  
ppm – parts per million  
STEL – Short Term Exposure Limit  
TWA – Time-Weighted Average  
vPvB – very Persistent and very Bioaccumulative  
h - hour  
mg/m<sup>3</sup> - milligram/cubic meter  
mm - millimeter  
mmHg - millimeter mercury  
w/w - weight/weight  
d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

**Disclaimer Statement**

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

**End of Safety Data Sheet**

## SAFETY DATA SHEET

### DCA-2120875

Revision Date: 25-Jun-2015

Revision Number: 3

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** DCA-2120875

##### Other means of Identification

**Synonyms:** None  
**Product Code:** HM008041

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Diverter  
**Uses Advised Against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton/Baroid Australia Pty. Ltd.  
15 Marriott Road  
Jandakot  
WA 6164  
Australia

ACN Number: 009 000 775  
Telephone Number: 61 (08) 9455 8300  
Fax Number: 61 (08) 9455 5300

##### **Product Emergency Telephone**

Australia: + 61 1 800 686 951  
Papua New Guinea: + 61 1 800 686 951  
NewZealand: +64 800 451719

##### **Fire, Police & Ambulance - Emergency Telephone**

Australia: 000  
Papua New Guinea: 000  
New Zealand: 111

**E-Mail address:** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951

##### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

**Classification of the hazardous chemical**

Not classified

**Label elements, including precautionary statements****Hazard Pictograms****Signal Word** Not Hazardous**Hazard Statements** Not Classified**Precautionary Statements****Prevention** None**Response** None**Storage** None**Disposal** None**Contains Substances**

Contains no hazardous substances in concentrations above cut-off values according to the competent authority

**CAS Number**

NA

**Other hazards which do not result in classification**

None known

**Australia Classification***For the full text of the H-phrases mentioned in this Section, see Section 16***Classification** Not Classified**Risk Phrases** None**3. Composition/information on Ingredients**

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	60 - 100%	Not Applicable

**4. First aid measures****Description of necessary first aid measures****Inhalation** If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.**Eyes** In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.**Skin** Wash with soap and water. Get medical attention if irritation persists.**Ingestion** Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.**Symptoms caused by exposure**

No significant hazards expected.

**Medical Attention and Special Treatment****Notes to Physician** Treat symptomatically

## 5. Fire Fighting Measures

### Suitable extinguishing equipment

#### **Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

#### **Extinguishing media which must not be used for safety reasons**

None known.

### Specific hazards arising from the chemical

#### **Special Exposure Hazards**

Decomposition in fire may produce harmful gases.

### Special protective equipment and precautions for fire fighters

#### **Special Protective Equipment for Fire-Fighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## 6. Accidental release measures

### 6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment. Slippery when wet.

### 6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

### 6.3. Methods and material for containment and cleaning up

Scoop up and remove.

## 7. Handling and storage

### 7.1. Precautions for Safe Handling

#### **Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust. Avoid dust accumulations.

#### **Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

### 7.2. Conditions for safe storage, including any incompatibilities

#### **Storage Information**

Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Store between 40.5 F (4.7 C) and 120.5 F (49 C). Store away from oxidizers. Store in a cool, dry location. Product has a shelf life of 12 months.

#### **Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

### Control parameters - exposure standards, biological monitoring

#### **Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	Not applicable	Not applicable

### Appropriate engineering controls

#### **Engineering Controls**

Use in a well ventilated area.

### Personal protective equipment (PPE)

#### **Respiratory Protection**

Not normally needed. But if significant exposures are possible then the following respirator



	is recommended:
<b>Hand Protection</b>	Dust/mist respirator. (N95, P2/P3)
<b>Skin Protection</b>	Normal work gloves.
<b>Eye Protection</b>	Normal work coveralls.
<b>Other Precautions</b>	Wear safety glasses or goggles to protect against exposure.
<b>Environmental Exposure Controls</b>	None known.
	No information available

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

<b>Physical State:</b>	Beads	<b>Color:</b>	Green
<b>Odor:</b>	Odorless - Acidic	<b>Odor Threshold:</b>	No information available

<u>Property</u>	<u>Values</u>
Remarks/ - Method	
<b>pH:</b>	6-8
<b>Freezing Point/Range</b>	150-230 °C
<b>Melting Point/Range</b>	No data available
<b>Boiling Point/Range</b>	No data available
<b>Flash Point</b>	No data available
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	1.16 - 1.20
<b>Water Solubility</b>	Insoluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	300 °C / 572 °F
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

### 9.2. Other information

<b>VOC Content (%)</b>	No data available
------------------------	-------------------

## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

### 10.2. Chemical Stability

Stable

### 10.3. Possibility of Hazardous Reactions

Will Not Occur

### 10.4. Conditions to Avoid

Temperature over 440 F (240 C).

### 10.5. Incompatible Materials

Strong oxidizers. Strong alkalis.

### 10.6. Hazardous Decomposition Products

Toxic fumes. Aldehydes. Carbon monoxide and carbon dioxide.

## 11. Toxicological Information

### Information on routes of exposure

**Principle Route of Exposure** Eye or skin contact, inhalation.

### Symptoms related to exposure

### Most Important Symptoms/Effects

No significant hazards expected.

**Numerical measures of toxicity**

**LD50 Oral:** No information available.  
**LD50 Dermal:** No information available.

**Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No data available	No data available	No data available

**Immediate, delayed and chronic health effects from exposure**

**Inhalation** None known.  
**Eye Contact** None known.  
**Skin Contact** None known.  
**Ingestion** May cause abdominal pain, vomiting, nausea, and diarrhea.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

**Exposure Levels**

No data available

**Interactive effects**

None known.

**Data limitations**

No data available

## 12. Ecological Information

**Ecotoxicity****Product Ecotoxicity Data**

No data available

**Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available	No information available	No information available	No information available

**12.2. Persistence and degradability**

Expected to be biodegradable

Substances	CAS Number	Persistence and Degradability
------------	------------	-------------------------------

Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available
--	----	--------------------------

**12.3. Bioaccumulative potential**

Does not bioaccumulate

Substances	CAS Number	Log Pow
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

<b>13. Disposal Considerations</b>
------------------------------------

**Safe handling and disposal methods**

Bury in a licensed landfill according to federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

<b>14. Transport Information</b>
----------------------------------

**Transportation Information**

<b>UN Number:</b>	Not restricted
<b>UN Proper Shipping Name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

<b>15. Regulatory Information</b>
-----------------------------------

**Safety, health and environmental regulations specific for the product****International Inventories****Australian AICS Inventory**

All components listed on inventory or are exempt.

**New Zealand Inventory of Chemicals**

All components listed on inventory or are exempt.

**EINECS Inventory**

This product, and all its components, complies with EINECS

**US TSCA Inventory**

All components listed on inventory or are exempt.

**Canadian DSL Inventory**

All components listed on inventory or are exempt.

**Poisons Schedule number**

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None Allocated

<b>16. Other information</b>
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**Date of preparation or review****Revision Date:** 25-Jun-2015**Revision Note**

SDS sections updated: 2

**Full text of R-phrases referred to under Sections 2 and 3**

None

**Full text of H-Statements referred to under sections 2 and 3**

None

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight

CAS – Chemical Abstracts Service

EC50 – Effective Concentration 50%

LC50 – Lethal Concentration 50%

LD50 – Lethal Dose 50%

LL50 – Lethal Loading 50%

mg/kg – milligram/kilogram

mg/L – milligram/liter

NOEC – No Observed Effect Concentration

OEL – Occupational Exposure Limit

PBT – Persistent Bioaccumulative and Toxic

ppm – parts per million

STEL – Short Term Exposure Limit

TWA – Time-Weighted Average

vPvB – very Persistent and very Bioaccumulative

h - hour

mg/m<sup>3</sup> - milligram/cubic meter

mm - millimeter

mmHg - millimeter mercury

w/w - weight/weight

d - day

**Key literature references and sources for data**[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)**Disclaimer Statement**

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**End of Safety Data Sheet**

## SAFETY DATA SHEET

### EC9374A ACID CORROSION INHIBITOR

#### Section: 1. PRODUCT AND COMPANY IDENTIFICATION

Product name : EC9374A ACID CORROSION INHIBITOR

Other means of identification : Not applicable.

Recommended use : ACID CORROSION INHIBITOR

Restrictions on use : Refer to available product literature or ask your local Sales Representative for restrictions on use and dose limits.

Company : ECOLAB PTY LTD  
2 Drake Avenue  
Macquarie Park NSW 2113  
Australia  
A.B.N. 59 000 449 990  
TEL: 1300 654 224  
FAX: +61 2 8870 8680

Emergency telephone number : 1800 205 506  
International: +64 7 958 2372

Issuing date : 10.06.2016

#### Section: 2. HAZARDS IDENTIFICATION

##### GHS Classification

Flammable liquids : Category 2  
Skin corrosion/irritation : Category 1B  
Serious eye damage/eye irritation : Category 1  
Skin sensitization : Category 1

##### GHS Label element

Hazard pictograms : 

Signal Word : Danger

Hazard Statements : Highly flammable liquid and vapour.  
Causes severe skin burns and eye damage.  
May cause an allergic skin reaction.

Precautionary Statements : **Prevention:**  
Keep away from heat/sparks/open flames/hot surfaces. - No smoking.  
Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilating/ lighting/ equipment. Take precautionary measures against static discharge. Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray. Wear protective gloves/ protective clothing/ eye protection/ face protection. Use only non-sparking tools.

**Response:**  
IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Immediately call a POISON CENTER or doctor/ physician. IF IN EYES: Rinse cautiously with water for several minutes. Remove

# SAFETY DATA SHEET

## EC9374A ACID CORROSION INHIBITOR

contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/ physician.

Specific treatment (see supplemental first aid instructions on this label).

### Storage:

Store locked up. Store in a well-ventilated place. Keep cool.

### Disposal:

Dispose of contents/container to an approved facility in accordance with local, regional, national and international regulations.

**Other hazards** : None known.

### Section: 3. COMPOSITION/INFORMATION ON INGREDIENTS

Pure substance/mixture : Mixture

Chemical Name	CAS-No.	Concentration: (%)
Formic Acid	64-18-6	30 - 60
Aromatic aldehyde	Proprietary	10 - 30
Isopropanol	67-63-0	5 - 10
2-Mercaptoethanol	60-24-2	1 - 5
Methanol	67-56-1	1 - 5

### Section: 4. FIRST AID MEASURES

- In case of eye contact : Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention immediately.
- In case of skin contact : Wash off immediately with plenty of water for at least 15 minutes. Use a mild soap if available. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.
- If swallowed : Contact the Poison's Information Centre (eg Australia 13 1126; New Zealand 0800 764 766).  
  
Rinse mouth with water. Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Get medical attention immediately.
- If inhaled : Remove to fresh air. Treat symptomatically. Get medical attention if symptoms occur.
- Protection of first-aiders : In event of emergency assess the danger before taking action. Do not put yourself at risk of injury. If in doubt, contact emergency responders. Use personal protective equipment as required.
- Notes to physician : Treat symptomatically.
- Most important symptoms and effects, both acute and delayed : See Section 11 for more detailed information on health effects and symptoms.

### Section: 5. FIREFIGHTING MEASURES

- Suitable extinguishing media : Foam  
Carbon dioxide  
Dry powder  
Other extinguishing agent suitable for Class B fires  
For large fires, use water spray or fog, thoroughly drenching the burning material.

## SAFETY DATA SHEET

### EC9374A ACID CORROSION INHIBITOR

- Unsuitable extinguishing media : None known.
- Specific hazards during firefighting : Fire Hazard  
Keep away from heat and sources of ignition.  
Flash back possible over considerable distance.  
Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.
- Hazardous combustion products : Decomposition products may include the following materials: Carbon oxides
- Special protective equipment for firefighters : Use personal protective equipment.
- Specific extinguishing methods : Use water spray to cool unopened containers. Collect contaminated fire extinguishing water separately. This must not be discharged into drains. Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations.
- Hazchem Code : ●3WE

### Section: 6. ACCIDENTAL RELEASE MEASURES

- Initial Emergency Response Guide No : 18
- Personal precautions, protective equipment and emergency procedures : Ensure adequate ventilation. Remove all sources of ignition. Keep people away from and upwind of spill/leak. Avoid inhalation, ingestion and contact with skin and eyes. When workers are facing concentrations above the exposure limit they must use appropriate certified respirators. Ensure clean-up is conducted by trained personnel only. Refer to protective measures listed in sections 7 and 8.
- Environmental precautions : Do not allow contact with soil, surface or ground water.
- Methods and materials for containment and cleaning up : Eliminate all ignition sources if safe to do so. Stop leak if safe to do so. Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13). Flush away traces with water. For large spills, dike spilled material or otherwise contain material to ensure runoff does not reach a waterway.

### Section: 7. HANDLING AND STORAGE

- Advice on safe handling : Open drum carefully as content may be under pressure. Take necessary action to avoid static electricity discharge (which might cause ignition of organic vapours). Do not ingest. Keep away from fire, sparks and heated surfaces. Do not breathe dust/fume/gas/mist/vapours/spray. Do not get in eyes, on skin, or on clothing. Wash hands thoroughly after handling. Use only with adequate ventilation.
- Conditions for safe storage : Keep away from heat and sources of ignition. Keep in a cool, well-ventilated place. Keep away from oxidizing agents. Keep out of reach of children. Keep container tightly closed. Store in suitable labeled containers.

# SAFETY DATA SHEET

## EC9374A ACID CORROSION INHIBITOR

Suitable material : The following compatibility data is suggested based on similar product data and/or industry experience: HDPE (high density polyethylene), Stainless Steel 304, Stainless Steel 316L, Hastelloy C-276, PTFE, Perfluoroelastomer

Unsuitable material : The following compatibility data is suggested based on similar product data and/or industry experience: Copper, Ethylene propylene, Mild steel, Polypropylene, Polyethylene, Plexiglass, EPDM, Brass, PVC, Buna-N, Polyurethane, Neoprene, Aluminum, Chlorosulfonated polyethylene rubber, Polytetrafluoroethylene/polypropylene copolymer, Fluoroelastomer

### Section: 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

#### Components with workplace control parameters

Exposure guidelines have not been established for this product. Available exposure limits for the substance(s) are shown below.

Components	CAS-No.	Form of exposure	Permissible concentration	Basis
Formic Acid	64-18-6	TWA	5 ppm 9.4 mg/m <sup>3</sup>	AU OEL
		VLE	10 ppm 19 mg/m <sup>3</sup>	AU OEL
Formic Acid	64-18-6	WES-STEL	10 ppm 19 mg/m <sup>3</sup>	NZ OEL
		WES-TWA	5 ppm 9.4 mg/m <sup>3</sup>	NZ OEL
Formic Acid	64-18-6	TWA	5 ppm	ACGIH
		STEL	10 ppm	ACGIH
		TWA	5 ppm 9 mg/m <sup>3</sup>	NIOSH REL
		TWA	5 ppm 9 mg/m <sup>3</sup>	OSHA Z1
Isopropanol	67-63-0	TWA	400 ppm 983 mg/m <sup>3</sup>	AU OEL
		VLE	500 ppm 1,230 mg/m <sup>3</sup>	AU OEL
Isopropanol	67-63-0	WES-TWA	400 ppm 983 mg/m <sup>3</sup>	NZ OEL
		WES-STEL	500 ppm 1,230 mg/m <sup>3</sup>	NZ OEL
Isopropanol	67-63-0	TWA	200 ppm	ACGIH
		STEL	400 ppm	ACGIH
		TWA	400 ppm 980 mg/m <sup>3</sup>	NIOSH REL
		STEL	500 ppm 1,225 mg/m <sup>3</sup>	NIOSH REL
Heavy Aromatic Naphtha	64742-94-5	TWA	400 ppm 980 mg/m <sup>3</sup>	OSHA Z1
		TWA	500 ppm 2,000 mg/m <sup>3</sup>	OSHA Z1
Methanol	67-56-1	TWA	200 mg/m <sup>3</sup> (as total hydrocarbon vapor)	ACGIH
		TWA	200 ppm 262 mg/m <sup>3</sup>	AU OEL
Methanol	67-56-1	VLE	250 ppm 328 mg/m <sup>3</sup>	AU OEL
		VLE	250 ppm 328 mg/m <sup>3</sup>	AU OEL



## SAFETY DATA SHEET

### EC9374A ACID CORROSION INHIBITOR

Methanol	67-56-1	WES-TWA	200 ppm 262 mg/m <sup>3</sup>	NZ OEL
		WES-STEL	250 ppm 328 mg/m <sup>3</sup>	NZ OEL
Methanol	67-56-1	TWA	200 ppm	ACGIH
		STEL	250 ppm	ACGIH
		TWA	200 ppm 260 mg/m <sup>3</sup>	NIOSH REL
		STEL	250 ppm 325 mg/m <sup>3</sup>	NIOSH REL
		TWA	200 ppm 260 mg/m <sup>3</sup>	OSHA Z1

Engineering measures : Effective exhaust ventilation system. Maintain air concentrations below occupational exposure standards.

#### Personal protective equipment

Eye protection : Safety goggles  
Face-shield

Hand protection : Wear the following personal protective equipment:  
Standard glove type.  
Laminate film  
Nitrile  
Unsupported neoprene  
PVC  
Natural rubber  
Neoprene/natural rubber blend  
Gloves should be discarded and replaced if there is any indication of degradation or chemical breakthrough.

Skin protection : Personal protective equipment comprising: suitable protective gloves, safety goggles and protective clothing

Respiratory protection : When workers are facing concentrations above the exposure limit they must use appropriate certified respirators.

Hygiene measures : Handle in accordance with good industrial hygiene and safety practice. Remove and wash contaminated clothing before re-use. Wash face, hands and any exposed skin thoroughly after handling. Provide suitable facilities for quick drenching or flushing of the eyes and body in case of contact or splash hazard.

#### Section: 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance : Liquid  
Colour : dark brown  
Odour : Sharp  
Flash point : 13 °C, Method: ASTM D 93, Pensky-Martens closed cup  
pH : 3.1, 5 %  
Odour Threshold : no data available  
Melting point/freezing point : no data available  
Initial boiling point and boiling range : 64.4 °C

## SAFETY DATA SHEET

### EC9374A ACID CORROSION INHIBITOR

Evaporation rate	:	no data available
Flammability (solid, gas)	:	no data available
Upper explosion limit	:	no data available
Lower explosion limit	:	no data available
Vapour pressure	:	92.5 mm Hg, (15.6 °C), 118.4 mm Hg, (37.7 °C),
Relative vapour density	:	1.11
Relative density	:	1.11, (15.6 °C),
Density	:	9.26 lb/gal
Water solubility	:	dispersible
Solubility in other solvents	:	no data available
Partition coefficient: n-octanol/water	:	no data available
Auto-ignition temperature	:	no data available
Thermal decomposition temperature	:	no data available
Viscosity, dynamic	:	no data available
Viscosity, kinematic	:	12 mm <sup>2</sup> /s (40 °C)
Molecular weight	:	no data available
VOC	:	no data available

### Section: 10. STABILITY AND REACTIVITY

Chemical stability	:	Stable under normal conditions.
Possibility of hazardous reactions	:	No dangerous reaction known under conditions of normal use.
Conditions to avoid	:	Heat, flames and sparks.
Incompatible materials	:	Strong oxidizing agents
Hazardous decomposition products	:	Decomposition products may include the following materials: Carbon oxides

### Section: 11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure : Inhalation, Eye contact, Skin contact

#### Potential Health Effects

Eyes	:	Causes serious eye damage.
Skin	:	Causes severe skin burns. May cause allergic skin reaction.
Ingestion	:	Causes digestive tract burns.
Inhalation	:	May cause nose, throat, and lung irritation.

## SAFETY DATA SHEET

### EC9374A ACID CORROSION INHIBITOR

Chronic Exposure : Health injuries are not known or expected under normal use.

#### Experience with human exposure

Eye contact : Redness, Pain, Corrosion  
Skin contact : Redness, Pain, Irritation, Corrosion, Allergic reactions  
Ingestion : Corrosion, Abdominal pain  
Inhalation : Respiratory irritation, Cough

#### Toxicity

##### Product

Acute oral toxicity : Acute toxicity estimate: > 2,000 mg/kg  
Acute inhalation toxicity : Acute toxicity estimate: > 20 mg/l  
Exposure time: 4 h  
Acute dermal toxicity : Acute toxicity estimate: > 2,000 mg/kg  
Skin corrosion/irritation : no data available  
Serious eye damage/eye irritation : no data available  
Respiratory or skin sensitization : no data available  
Carcinogenicity : No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.  
Reproductive effects : No toxicity to reproduction  
Germ cell mutagenicity : Contains no ingredient listed as a mutagen  
Teratogenicity : no data available  
STOT - single exposure : no data available  
STOT - repeated exposure : no data available  
Aspiration toxicity : No aspiration toxicity classification

#### Human Hazard Characterization

Based on our hazard characterization, the potential human hazard is: High

### Section: 12. ECOLOGICAL INFORMATION

#### Ecotoxicity

Environmental Effects : This product has no known ecotoxicological effects.

#### Product

Toxicity to fish : no data available  
Toxicity to daphnia and other aquatic invertebrates : no data available  
Toxicity to algae : no data available

#### Components

## SAFETY DATA SHEET

### EC9374A ACID CORROSION INHIBITOR

Toxicity to fish : Formic Acid  
LC50 : > 100 mg/l  
Exposure time: 96 h

Aromatic aldehyde  
LC50 : 103.085 mg/l  
Exposure time: 96 h

Isopropanol  
LC50 Pimephales promelas (fathead minnow): 9,640 mg/l  
Exposure time: 96 h

Methanol  
LC50 : 15,400 mg/l  
Exposure time: 96 h

#### Components

Toxicity to daphnia and other aquatic invertebrates : Aromatic aldehyde  
EC50 Daphnia magna (Water flea): 119.56 mg/l  
Exposure time: 48 h

Isopropanol  
LC50 Daphnia magna (Water flea): > 10,000 mg/l

2-Mercaptoethanol  
EC50 : 0.89 mg/l  
Exposure time: 48 h

Methanol  
EC50 : > 10,000 mg/l  
Exposure time: 48 h

#### Components

Toxicity to algae : Aromatic aldehyde  
NOEC : 37.2314 mg/l  
Exposure time: 72 h

Methanol  
EC50 : 22,000 mg/l  
Exposure time: 72 h

#### Components

Toxicity to bacteria : Aromatic aldehyde  
8.612 mg/l

Isopropanol  
1,050 mg/l

Methanol  
> 1,000 mg/l

#### Components

Toxicity to fish (Chronic toxicity) : Methanol  
NOEC: 7,900 mg/l  
Exposure time: 8.3 d

#### Persistence and degradability

# SAFETY DATA SHEET

## EC9374A ACID CORROSION INHIBITOR

The organic portion of this preparation is expected to be inherently biodegradable.

### Mobility

The environmental fate was estimated using a level III fugacity model embedded in the EPI (estimation program interface) Suite TM, provided by the US EPA. The model assumes a steady state condition between the total input and output. The level III model does not require equilibrium between the defined media. The information provided is intended to give the user a general estimate of the environmental fate of this product under the defined conditions of the models.

If released into the environment this material is expected to distribute to the air, water and soil/sediment in the approximate respective percentages;

Air	:	<5%
Water	:	10 - 30%
Soil	:	50 - 70%

The portion in water is expected to float on the surface.

### Bioaccumulative potential

Component substances have a low potential to bioconcentrate.

### Other information

no data available

### ENVIRONMENTAL HAZARD AND EXPOSURE CHARACTERIZATION

Based on our hazard characterization, the potential environmental hazard is: Low

## Section: 13. DISPOSAL CONSIDERATIONS

Disposal methods	:	The product should not be allowed to enter drains, water courses or the soil. Where possible recycling is preferred to disposal or incineration. If recycling is not practicable, dispose of in compliance with local regulations. Dispose of wastes in an approved waste disposal facility.
Disposal considerations	:	Dispose of as unused product. Empty containers should be taken to an approved waste handling site for recycling or disposal. Do not re-use empty containers.

## Section: 14. TRANSPORT INFORMATION

The shipper/consignor/sender is responsible to ensure that the packaging, labeling, and markings are in compliance with the selected mode of transport.

### Land transport

Proper shipping name	:	FLAMMABLE LIQUID, CORROSIVE, N.O.S.
Technical name(s):	:	Isopropanol, Formic Acid
UN/ID No.	:	UN 2924
Transport hazard class(es)	:	3, 8
Packing group	:	II
IERG No	:	18
Hazchem Code	:	●3WE
Special precautions for user	:	Dangerous goods of Class 3 (Flammable Liquid) Subsidiary Class 8 (Alkali) are incompatible in a placard load with any of

## SAFETY DATA SHEET

### EC9374A ACID CORROSION INHIBITOR

the following:  
and are incompatible with food or food packaging in any quantity.

Class 1 Explosives  
Class 2.1 Flammable gases (where both are in bulk)  
Class 2.3 Poisonous gases  
Class 4.2 Spontaneously combustible substances  
Class 4.3 Dangerous when wet substances  
Class 5.1 Oxidising agents  
Class 5.2 Organic peroxides  
Class 7 Radioactive substances

#### Air transport (IATA)

UN/ID No. : UN 2924  
Proper shipping name : FLAMMABLE LIQUID, CORROSIVE, N.O.S.  
Technical name(s) : Isopropanol, Formic Acid  
Transport hazard class(es) : 3, 8  
Packing group : II

#### Sea transport (IMDG/IMO)

UN/ID No. : UN 2924  
Proper shipping name : FLAMMABLE LIQUID, CORROSIVE, N.O.S.  
Technical name(s) : Isopropanol, Formic Acid  
Transport hazard class(es) : 3, 8  
Packing group : II

### Section: 15. REGULATORY INFORMATION

Standard for the Uniform : Schedule 6  
Scheduling of Medicines and  
Poisons

#### INTERNATIONAL CHEMICAL CONTROL LAWS :

##### TOXIC SUBSTANCES CONTROL ACT (TSCA)

The substances in this preparation are included on or exempted from the TSCA 8(b) Inventory (40 CFR 710)

##### CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA)

The substance(s) in this preparation are included in or exempted from the Domestic Substance List (DSL).

##### AUSTRALIA

All substances in this product comply with the National Industrial Chemicals Notification & Assessment Scheme (NICNAS).

##### CHINA

This product contains substance(s) which are not in compliance with the Provisions on the Environmental Administration of New Chemical Substances and may require additional review.

##### JAPAN

This product contains substance(s) which are not in compliance with the Law Regulating the Manufacture and Importation Of Chemical Substances and are not listed on the Existing and New Chemical Substances list (ENCS).

##### KOREA

This product contains substance(s) which are not in compliance with the Chemical Control Act (CCA) and may require additional review.

## SAFETY DATA SHEET

### EC9374A ACID CORROSION INHIBITOR

#### PHILIPPINES

All substances in this product comply with the Republic Act 6969 (RA 6969) and are listed on the Philippines Inventory of Chemicals & Chemical Substances (PICCS).

#### Section: 16. OTHER INFORMATION

#### REFERENCES

Hazardous Substances Data Bank, National Library of Medicine, Bethesda, Maryland (TOMES CPS™ CD-ROM Version), Micromedex, Inc., Englewood, CO.

IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man, Geneva: World Health Organization, International Agency for Research on Cancer.

Integrated Risk Information System, U.S. Environmental Protection Agency, Washington, D.C. (TOMES CPS™ CD-ROM Version),  
Micromedex, Inc., Englewood, CO.

Annual Report on Carcinogens, National Toxicology Program, U.S. Department of Health and Human Services, Public Health Service.

Registry of Toxic Effects of Chemical Substances, National Institute for Occupational Safety and Health, Cincinnati, OH,  
(TOMES CPS™ CD-ROM Version), Micromedex, Inc., Englewood, CO.

The Teratogen Information System, University of Washington, Seattle, WA (TOMES CPS™ CD-ROM Version),  
Micromedex, Inc., Englewood, CO.

Revision Date : 10.06.2016  
Date of first issue : 10.06.2016  
Version Number : 1.0  
Prepared By : Regulatory Affairs

REVISED INFORMATION: Significant changes to regulatory or health information for this revision is indicated by a bar in the left-hand margin of the SDS.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text. For additional copies of an SDS visit [www.nalco.com](http://www.nalco.com) and request access.

## SAFETY DATA SHEET

### FDP-S1246-16

Revision Date: 26-May-2016

Revision Number: 1

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** FDP-S1246-16

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM008363

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Viscosifier  
**Uses advised against** Consumer use

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton/Baroid Australia Pty. Ltd.  
15 Marriott Road  
Jandakot  
WA 6164  
Australia

ACN Number: 009 000 775  
Telephone Number: 61 (08) 9455 8300  
Fax Number: 61 (08) 9455 5300

##### **Product Emergency Telephone**

Australia: + 61 1 800 686 951  
Papua New Guinea: + 61 1 800 686 951  
NewZealand: +64 800 451719

##### **Fire, Police & Ambulance - Emergency Telephone**

Australia: 000  
Papua New Guinea: 000  
New Zealand: 111

**E-mail Address** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951

##### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Non-Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.



**Classification of the hazardous chemical**

Not classified

**Label elements, including precautionary statements****Hazard pictograms****Signal Word** Not Hazardous**Hazard Statements:** Not Classified**Precautionary Statements**

**Prevention** None  
**Response** None  
**Storage** None  
**Disposal** None

**Contains****Substances****CAS Number**

Contains no hazardous substances in concentrations above cut-off values according to the competent authority

NA

**Other hazards which do not result in classification**

This substance is not considered to be persistent, bioaccumulating nor toxic (PBT).  
This substance is not considered to be very persistent nor very bioaccumulating (vPvB).

*For the full text of the H-phrases mentioned in this Section, see Section 16*

**3. Composition/information on Ingredients**

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	60 - 100%	Not Applicable

The specific chemical identity of the composition has been withheld as proprietary. The exact percentage (concentration) of the composition has been withheld as proprietary.

**4. First aid measures****Description of necessary first aid measures**

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

**Eyes** In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

**Skin** Flush skin with large amounts of water. If irritation persists, get medical attention.

**Ingestion** Rinse mouth with water many times. Get medical attention if symptoms occur

**Symptoms caused by exposure**

No information available

**Medical Attention and Special Treatment**

**Notes to Physician** Treat symptomatically

**5. Fire Fighting Measures**

**Suitable extinguishing equipment****Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

**Extinguishing media which must not be used for safety reasons**

Avoid creating dust clouds with extinguishers.

**Specific hazards arising from the chemical****Special exposure hazards in a fire**

Decomposition in fire may produce harmful gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

**Special protective equipment and precautions for fire fighters****Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## 6. Accidental release measures

**6.1. Personal precautions, protective equipment and emergency procedures**

Avoid creating and breathing dust. Ensure adequate ventilation. Use appropriate protective equipment. Remove sources of ignition. Take precautionary measures against static discharges. All equipment used when handling the product must be grounded. Avoid contact with skin, eyes and clothing. Use only competent persons for cleanup.

**6.2. Environmental precautions**

None known.

**6.3. Methods and material for containment and cleaning up**

Scoop up and remove. Remove ignition sources and work with non-sparking tools.

## 7. Handling and storage

**7.1. Precautions for safe handling****Handling Precautions**

Ensure adequate ventilation. Use appropriate protective equipment. Remove sources of ignition. Ground and bond containers when transferring from one container to another.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Store in a cool well ventilated area. Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Keep from heat, sparks, and open flames.

**Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

**Control parameters - exposure standards, biological monitoring****Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	Not applicable	Not applicable

**Appropriate engineering controls****Engineering Controls**

Localized ventilation should be used to control dust levels. Ensure adequate ventilation, especially in confined areas

**Personal protective equipment (PPE)****Personal Protective Equipment**

If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an

	industrial hygienist or other qualified professional based on the specific application of this product.
<b>Respiratory Protection</b>	If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Dust/mist respirator. (N95, P2/P3)
<b>Hand Protection</b>	Use gloves which are suitable for the chemicals present in this product as well as other environmental factors in the workplace.
<b>Skin Protection</b>	Wear protective clothing appropriate for the work environment.
<b>Eye Protection</b>	Wear safety glasses or goggles to protect against exposure.
<b>Other Precautions</b>	Eyewash fountains and safety showers must be easily accessible.
<b>Environmental Exposure Controls</b>	Do not allow material to contaminate ground water system

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

<b>Physical State:</b>	Powder	<b>Color</b>	Clear
<b>Odor:</b>	Sweet	<b>Odor Threshold:</b>	No information available

Property	Values
Remarks/ - Method	
<b>pH:</b>	No data available
<b>Freezing Point / Range</b>	No data available
<b>Melting Point / Range</b>	
<b>Boiling Point / Range</b>	No data available
<b>Flash Point</b>	No data available
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	1.25
<b>Water Solubility</b>	Insoluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

### 9.2. Other information

<b>VOC Content (%)</b>	No data available
<b>Bulk Density</b>	54.5 lbs/ft <sup>3</sup>

## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

### 10.2. Chemical stability

Stable

### 10.3. Possibility of hazardous reactions

Will Not Occur

### 10.4. Conditions to avoid

Keep away from heat, sparks and flame.

### 10.5. Incompatible materials

Strong oxidizers. Strong acids. Strong alkalis.

### 10.6. Hazardous decomposition products

Toxic fumes. Aldehydes. Carbon monoxide and carbon dioxide.

## 11. Toxicological Information

**Information on routes of exposure****Principle Route of Exposure** Eye or skin contact, inhalation. Ingestion.**Symptoms related to exposure****Numerical measures of toxicity****Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No data available	No data available	No data available

**Immediate, delayed and chronic health effects from exposure**

**Inhalation** May cause mild respiratory irritation.  
**Eye Contact** May cause mild eye irritation.  
**Skin Contact** May cause mild skin irritation.  
**Ingestion** May cause abdominal pain, vomiting, nausea, and diarrhea.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

**Exposure Levels**

No data available

**Interactive effects**

None known.

**Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

Substances	CAS Number	Serious eye damage/irritation
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

Substances	CAS Number	Skin Sensitization
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

Substances	CAS Number	Respiratory Sensitization
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

Substances	CAS Number	Mutagenic Effects
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

Substances	CAS Number	Carcinogenic Effects
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

Substances	CAS Number	Reproductive toxicity
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

Substances	CAS Number	STOT - single exposure
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

Substances	CAS Number	STOT - repeated exposure
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

Substances	CAS Number	Aspiration hazard
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	

## 12. Ecological Information

### Ecotoxicity

#### Product Ecotoxicity Data

No data available

#### Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available	No information available	No information available	No information available

### 12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.3. Bioaccumulative potential**

Substances	CAS Number	Log Pow
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Contains no hazardous substances in concentrations above cut-off values according to the competent authority	NA	No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

<b>13. Disposal Considerations</b>
------------------------------------

**Safe handling and disposal methods**

Follow all applicable community, national or regional regulations regarding waste management methods.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

<b>14. Transport Information</b>
----------------------------------

**Transportation Information**

<b>UN Number</b>	Not restricted
<b>UN proper shipping name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

<b>15. Regulatory Information</b>
-----------------------------------

**Safety, health and environmental regulations specific for the product****International Inventories**

<b>Australian AICS Inventory</b>	All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.
<b>New Zealand Inventory of Chemicals</b>	All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.
<b>EINECS (European Inventory of Existing Chemical Substances)</b>	This product, and all its components, complies with EINECS
<b>US TSCA Inventory</b>	All components listed on inventory or are exempt.
<b>Canadian Domestic Substances List (DSL)</b>	All components listed on inventory or are exempt.

**Poisons Schedule number**

---

None Allocated

**International Agreements**

<b>Montreal Protocol - Ozone Depleting Substances:</b>	Does not apply
<b>Stolkhom Convention - Persistent Organic Pollutants:</b>	Does not apply
<b>Rotterdam Convention - Prior Informed Consent:</b>	Does not apply
<b>Basel Convention - Hazardous Waste:</b>	Does not apply

<b>16. Other information</b>
------------------------------

**Date of preparation or review**

**Revision Date:** 26-May-2016

**Revision Note****Full text of H-Statements referred to under sections 2 and 3**

None

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight  
CAS – Chemical Abstracts Service  
EC50 – Effective Concentration 50%  
LC50 – Lethal Concentration 50%  
LD50 – Lethal Dose 50%  
LL50 – Lethal Loading 50%  
mg/kg – milligram/kilogram  
mg/L – milligram/liter  
NOEC – No Observed Effect Concentration  
OEL – Occupational Exposure Limit  
PBT – Persistent Bioaccumulative and Toxic  
ppm – parts per million  
STEL – Short Term Exposure Limit  
TWA – Time-Weighted Average  
vPvB – very Persistent and very Bioaccumulative  
h - hour  
mg/m<sup>3</sup> - milligram/cubic meter  
mm - millimeter  
mmHg - millimeter mercury  
w/w - weight/weight  
d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

**Disclaimer Statement**

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

**End of Safety Data Sheet**

## SAFETY DATA SHEET

### FE-2

Revision Date: 16-Apr-2015

Revision Number: 28

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** FE-2

##### Other means of Identification

**Synonyms:** None  
**Product Code:** HM000682

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Iron Control Agent  
**Uses Advised Against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road  
Jandakot  
WA 6164  
Australia  
  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-Mail address:** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951

##### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Serious Eye Damage / Eye Irritation	Category 2 - H319
-------------------------------------	-------------------

##### Label elements, including precautionary statements

##### **Hazard Pictograms**





<b>Signal Word</b>	Warning
<b>Hazard Statements</b>	H319 - Causes serious eye irritation
<b>Precautionary Statements</b>	
<b>Prevention</b>	P264 - Wash face, hands and any exposed skin thoroughly after handling P280 - Wear eye protection/face protection
<b>Response</b>	P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing P337 + P313 - If eye irritation persists: Get medical advice/attention
<b>Storage</b>	None
<b>Disposal</b>	None
<b>Contains Substances</b>	<b>CAS Number</b>
Citric acid	77-92-9

**Other hazards which do not result in classification**

This substance is not considered to be persistent, bioaccumulating nor toxic (PBT).  
This substance is not considered to be very persistent nor very bioaccumulating (vPvB).

**Australia Classification**

*For the full text of the H-phrases mentioned in this Section, see Section 16*

<b>Classification</b>	Xi - Irritant.
<b>Risk Phrases</b>	R36 Irritating to eyes.

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Citric acid	77-92-9	60 - 100%	Eye Irrit. 2A (H319)

### 4. First aid measures

**Description of necessary first aid measures**

<b>Inhalation</b>	If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
<b>Eyes</b>	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
<b>Skin</b>	Wash with soap and water. Get medical attention if irritation persists.
<b>Ingestion</b>	Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

**Symptoms caused by exposure**

Causes eye irritation.

**Medical Attention and Special Treatment**

**Notes to Physician** Treat symptomatically

## 5. Fire Fighting Measures

**Suitable extinguishing equipment****Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical****Special Exposure Hazards**

Decomposition in fire may produce harmful gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

**Special protective equipment and precautions for fire fighters****Special Protective Equipment for Fire-Fighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## 6. Accidental release measures

**6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment. Avoid creating and breathing dust. Avoid contact with skin, eyes and clothing. Ensure adequate ventilation.

**6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas.

**6.3. Methods and material for containment and cleaning up**

Scoop up and remove.

## 7. Handling and storage

**7.1. Precautions for Safe Handling****Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust. Ensure adequate ventilation. Wash hands after use. Launder contaminated clothing before reuse. Use appropriate protective equipment.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Store away from alkalis. Store away from oxidizers. Store in a cool, dry location. Product has a shelf life of 60 months.

**Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

**Control parameters - exposure standards, biological monitoring****Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Citric acid	77-92-9	Not applicable	Not applicable

**Appropriate engineering controls**

**Engineering Controls** Use in a well ventilated area.

**Personal protective equipment (PPE)**

**Respiratory Protection** If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.

**Hand Protection**

Dust/mist respirator. (N95, P2/P3)  
Chemical-resistant protective gloves (EN 374) Suitable materials for longer, direct contact (recommended: protection index 6, corresponding to > 480 minutes permeation time as per EN 374): Nitrile gloves. (>= 0.35 mm thickness)

This information is based on literature references and on information provided by glove manufacturers, or is derived by analogy with similar substances. Please note that in practice the working life of chemical-resistant protective gloves may be considerably shorter than the permeation time determined in accordance with EN 374 as a result of the many influencing factors (e.g. temperature). If signs of wear and tear are noticed then the gloves should be replaced. Manufacturer's directions for use should be observed because of great diversity of types.

**Skin Protection**

Normal work coveralls.

**Eye Protection**

Chemical goggles; also wear a face shield if splashing hazard exists.

**Other Precautions**

None known.

**Environmental Exposure Controls**

Do not allow material to contaminate ground water system

## 9. Physical and Chemical Properties

**9.1. Information on basic physical and chemical properties**

**Physical State:** Solid  
**Odor:** Odorless

**Color:** White  
**Odor Threshold:** No information available

Property  
Remarks/ - Method

Values

<b>pH:</b>	2 - 2.2
<b>Freezing Point/Range</b>	No data available
<b>Melting Point/Range</b>	No data available
<b>Boiling Point/Range</b>	No data available
<b>Flash Point</b>	No data available
upper flammability limit	65
lower flammability limit	8
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	1.665
<b>Water Solubility</b>	Soluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	1000 °C / 1832 °F
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

**9.2. Other information**

**Molecular Weight** 192.13  
**VOC Content (%)** No data available

## 10. Stability and Reactivity

**10.1. Reactivity**

Not expected to be reactive.

**10.2. Chemical Stability**

Stable

**10.3. Possibility of Hazardous Reactions**

Will Not Occur

**10.4. Conditions to Avoid**

None anticipated

**10.5. Incompatible Materials**

Strong alkalis. Strong oxidizers.

**10.6. Hazardous Decomposition Products**

Carbon monoxide and carbon dioxide.

<b>11. Toxicological Information</b>
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**Information on routes of exposure****Principle Route of Exposure** Eye or skin contact, inhalation.**Symptoms related to exposure****Most Important Symptoms/Effects**

Causes eye irritation.

**Numerical measures of toxicity****Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Citric acid	77-92-9	5400 mg/kg (Rat) 5790 mg/kg (Mouse) 11,700 mg/kg (Rat)	> 2000 mg/kg	No data available

**Immediate, delayed and chronic health effects from exposure****Inhalation** May cause mild respiratory irritation.**Eye Contact** Causes eye irritation.**Skin Contact** May cause mild skin irritation.**Ingestion** Irritation of the mouth, throat, and stomach. May cause abdominal pain, vomiting, nausea, and diarrhea.**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.**Exposure Levels**

No data available

**Interactive effects**

None known.

**Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Citric acid	77-92-9	Not irritating to skin in rabbits.

Substances	CAS Number	Eye damage/irritation
Citric acid	77-92-9	Causes severe eye irritation.

Substances	CAS Number	Skin Sensitization
Citric acid	77-92-9	Patch test on human volunteers did not demonstrate sensitization properties

Substances	CAS Number	Respiratory Sensitization
Citric acid	77-92-9	No information available

Substances	CAS Number	Mutagenic Effects
Citric acid	77-92-9	Did not show mutagenic effects in animal experiments

Substances	CAS Number	Carcinogenic Effects
Citric acid	77-92-9	Did not show carcinogenic effects in animal experiments
Substances	CAS Number	Reproductive toxicity
Citric acid	77-92-9	Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments.
Substances	CAS Number	STOT - single exposure
Citric acid	77-92-9	No data of sufficient quality are available.
Substances	CAS Number	STOT - repeated exposure
Citric acid	77-92-9	No significant toxicity observed in animal studies at concentration requiring classification.
Substances	CAS Number	Aspiration hazard
Citric acid	77-92-9	No adverse health effects are expected from swallowing.

## 12. Ecological Information

### Ecotoxicity

#### Product Ecotoxicity Data

No data available

#### Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Citric acid	77-92-9	NOEC (8d) 425 mg/L (cell density) ( <i>Scenedesmus quadricauda</i> ) LOEC (8d) >80 mg/L ( <i>Microcystis aeruginosa</i> )	LC50 (96h) 1516 mg/L ( <i>Lepomis macrochirus</i> ) LC50 (48h) 440 mg/L ( <i>Leuciscus idus melanotus</i> ) LC50 (96h) >100 mg/L ( <i>Pimephales promelas</i> )	TT (72h) 485 mg/L ( <i>Entosiphon sulcatum</i> )	TLM96 100-330 ppm ( <i>Crangon crangon</i> ) EC50 (24h) 1535 mg/L ( <i>Daphnia magna</i> ) LC50 (48h) 160 mg/L ( <i>Daphnia magna</i> ) EC50 (48h) >50 mg/L ( <i>Daphnia magna</i> )

### 12.2. Persistence and degradability

Biodegradable.

Substances	CAS Number	Persistence and Degradability
Citric acid	77-92-9	Readily biodegradable (97% @ 28d)

### 12.3. Bioaccumulative potential

Does not bioaccumulate

Substances	CAS Number	Log Pow
Citric acid	77-92-9	-1.61 to -1.80

### 12.4. Mobility in soil

Substances	CAS Number	Mobility
Citric acid	77-92-9	No information available

### 12.6. Other adverse effects

#### Endocrine Disruptor Information

This product does not contain any known or suspected endocrine disruptors

## 13. Disposal Considerations

### Safe handling and disposal methods

Bury in a licensed landfill according to federal, state, and local regulations.

### Disposal of any contaminated packaging

Follow all applicable national or local regulations. Contaminated packaging may be disposed of by: rendering packaging incapable of containing any substance, or treating packaging to remove residual contents, or treating packaging to make sure the residual

contents are no longer hazardous, or by disposing of packaging into commercial waste collection.

**Environmental regulations**

Not applicable

**14. Transport Information****Transportation Information**

**UN Number:** Not restricted  
**UN Proper Shipping Name:** Not restricted  
**Transport Hazard Class(es):** Not applicable  
**Packing Group:** Not applicable  
**Environmental Hazards:** Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

**15. Regulatory Information****Safety, health and environmental regulations specific for the product****International Inventories**

**Australian AICS Inventory** All components listed on inventory or are exempt.  
**New Zealand Inventory of Chemicals** All components listed on inventory or are exempt.  
**EINECS Inventory** This product, and all its components, complies with EINECS  
**US TSCA Inventory** All components listed on inventory or are exempt.  
**Canadian DSL Inventory** All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

**16. Other information****Date of preparation or review**

**Revision Date:** 16-Apr-2015

**Revision Note** Revision Note  
SDS sections updated: 2

**Full text of R-phrases referred to under Sections 2 and 3**

R36 - Irritating to eyes

**Full text of H-Statements referred to under sections 2 and 3**

H319 - Causes serious eye irritation

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight CAS – Chemical Abstracts Service EC50 – Effective Concentration 50% LC50 – Lethal Concentration 50% LD50

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– Lethal Dose 50% LL50 – Lethal Loading 50% mg/kg – milligram/kilogram mg/L – milligram/liter NOEC – No Observed Effect Concentration OEL – Occupational Exposure Limit PBT – Persistent Bioaccumulative and Toxic ppm – parts per million STEL – Short Term Exposure Limit TWA – Time-Weighted Average vPvB – very Persistent and very Bioaccumulative h - hour mg/m<sup>3</sup> - milligram/cubic meter mm - millimeter mmHg - millimeter mercury w/w - weight/weight d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)  
NZ CCID

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**End of Safety Data Sheet**

## SAFETY DATA SHEET

### HC-2A

Revision Date: 12-Jun-2018

Revision Number: 2

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** HC-2A

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM008835

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Surfactant  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road, Jandakot, WA 6164  
Australia  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-mail Address** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951  
Global Incident Response Access Code: 334305  
Contract Number: 14012

##### Australian Poisons Information Centre

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Serious Eye Damage/Irritation	Category 1 - H318
Acute Aquatic Toxicity	Category 2 - H401
Chronic Aquatic Toxicity	Category 2 - H411

##### Label elements, including precautionary statements

##### Hazard Pictograms





**Signal Word**

DANGER

**Hazard Statements:**

H318 - Causes serious eye damage  
 H401 - Toxic to aquatic life  
 H411 - Toxic to aquatic life with long lasting effects

**Precautionary Statements**

**Prevention**

P273 - Avoid release to the environment  
 P280 - Wear eye protection/face protection

**Response**

P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
 P310 - Immediately call a POISON CENTER or doctor/physician  
 P391 - Collect spillage

**Storage**

None

**Disposal**

P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Contains**

**Substances**

Inner salt of alkyl amines

**CAS Number**

Proprietary

**Other hazards which do not result in classification**

None known

*For the full text of the H-phrases mentioned in this Section, see Section 16*

**3. Composition/information on Ingredients**

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Inner salt of alkyl amines	Proprietary	10 - 30%	Eye Corr. 1 (H318) Aquatic Acute 2 (H401) Aquatic Chronic 2 (H411)

**4. First aid measures**

**Description of necessary first aid measures**

**Inhalation**

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

**Eyes**

Immediately flush eyes with large amounts of water for at least 30 minutes. Seek prompt medical attention.

**Skin**

Wash with soap and water. Get medical attention if irritation persists.

**Ingestion**

Rinse mouth with water many times. Get medical attention if symptoms occur

**Symptoms caused by exposure**

Causes severe eye irritation which may damage tissue.

**Medical Attention and Special Treatment**

**Notes to Physician**

Treat symptomatically

**5. Fire Fighting Measures**

**Suitable extinguishing equipment**

**Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical**

**Special exposure hazards in a fire**

Use water spray to cool fire exposed surfaces. Decomposition in fire may produce harmful gases.

**Special protective equipment and precautions for fire fighters**

**Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

**6. Accidental release measures**

**6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment.

**6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas.

**6.3. Methods and material for containment and cleaning up**

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

**7. Handling and storage**

**7.1. Precautions for safe handling**

**Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid breathing vapors.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities**

**Storage Information**

Store away from oxidizers. Store in a cool well ventilated area. Keep container closed when not in use. Product has a shelf life of 60 months.

**Other Guidelines**

No information available

**8. Exposure Controls/Personal Protection**

**Control parameters - exposure standards, biological monitoring**

**Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Inner salt of alkyl amines	Proprietary	Not applicable	Not applicable

**Appropriate engineering controls**

**Engineering Controls**

Use in a well ventilated area.

**Personal protective equipment (PPE)**

**Personal Protective Equipment**

If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

<b>Respiratory Protection</b>	If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Dust/mist respirator. (N95, P2/P3)
<b>Hand Protection</b>	Use gloves which are suitable for the chemicals present in this product as well as other environmental factors in the workplace.
<b>Skin Protection</b>	Wear protective clothing appropriate for the work environment.
<b>Eye Protection</b>	Chemical goggles; also wear a face shield if splashing hazard exists.
<b>Other Precautions</b>	Eyewash fountains and safety showers must be easily accessible.
<b>Environmental Exposure Controls</b>	No information available

**9. Physical and Chemical Properties**

**9.1. Information on basic physical and chemical properties**

<b>Physical State:</b> Liquid	<b>Color</b> Clear light amber
<b>Odor:</b> Surfactant	<b>Odor Threshold:</b> No information available

<u>Property</u>	<u>Values</u>
<u>Remarks/ - Method</u>	
<b>pH:</b>	6.5-7.5
<b>Freezing Point / Range</b>	0 °C
<b>Melting Point / Range</b>	No data available
<b>Boiling Point / Range</b>	100 °C / 212 °F
<b>Flash Point</b>	> 100 °C / > 212 °F PMCC
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	< 17.5 mmHg
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	1.12
<b>Water Solubility</b>	Soluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

**9.2. Other information**

<b>VOC Content (%)</b>	No data available
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**10. Stability and Reactivity**

**10.1. Reactivity**

Not expected to be reactive.

**10.2. Chemical stability**

Stable

**10.3. Possibility of hazardous reactions**

Will Not Occur

**10.4. Conditions to avoid**

Keep away from heat, sparks and flame.

**10.5. Incompatible materials**

Strong oxidizers.

**10.6. Hazardous decomposition products**

Oxides of nitrogen. Carbon monoxide and carbon dioxide. Hydrogen chloride.

**11. Toxicological Information**

**Information on routes of exposure**

<b>Principle Route of Exposure</b>	Eye or skin contact, inhalation.
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**Symptoms related to exposure**

**Most Important Symptoms/Effects**

Causes severe eye irritation which may damage tissue.

**Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Inner salt of alkyl amines	Proprietary	>5000 mg/kg-bw (rat)	>2000 mg/kg-bw (rat)	No data available

**Immediate, delayed and chronic health effects from exposure**

<b>Inhalation</b>	May cause mild respiratory irritation.
<b>Eye Contact</b>	Causes severe eye irritation which may damage tissue. May cause corneal injury.
<b>Skin Contact</b>	May cause mild skin irritation.
<b>Ingestion</b>	May cause abdominal pain, vomiting, nausea, and diarrhea.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

**Exposure Levels**

No data available

**Interactive effects**

None known.

**Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Inner salt of alkyl amines		Not irritating to skin in rabbits.

Substances	CAS Number	Serious eye damage/irritation
Inner salt of alkyl amines		Causes severe eye irritation (Rabbit)

Substances	CAS Number	Skin Sensitization
Inner salt of alkyl amines		Did not cause sensitization on laboratory animals (guinea pig)

Substances	CAS Number	Respiratory Sensitization
Inner salt of alkyl amines		No information available

Substances	CAS Number	Mutagenic Effects
Inner salt of alkyl amines		In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects.

Substances	CAS Number	Carcinogenic Effects
Inner salt of alkyl amines		Did not show carcinogenic effects in animal experiments

Substances	CAS Number	Reproductive toxicity
Inner salt of alkyl amines		Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments.

Substances	CAS Number	STOT - single exposure
Inner salt of alkyl amines		No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	STOT - repeated exposure
Inner salt of alkyl amines		No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	Aspiration hazard
Inner salt of alkyl amines		Not applicable

## 12. Ecological Information

### Ecotoxicity

#### **Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Inner salt of alkyl amines	Proprietary	EC50 (96 h) 0.55 mg/L (Desmodesmus subspicatus) EC50 (72 h) 17.2 mg/L (Scenedesmus subspicatus) EC50 (72 h) 9.86 mg/L (Scenedesmus subspicatus) EC50 (72 h) 30 mg/L (Scenedesmus subspicatus)	LC50 (96 h) 2 mg/L (Brachydanio rerio) NOEC (28 d) 16 mg/L (Oncorhynchus mykiss)	No information available	EC50 (48 h) 6.5 mg/L (Daphnia magna) NOEC (21 d) 0.9 mg/L (Daphnia magna) NOEC (21 d) 0.932 mg/L (Daphnia magna) NOEC (21 d) 2.98 mg/L (Daphnia magna) NOEC (21 d) 0.03 mg/L (Daphnia magna) NOEC (21 d) 0.065 mg/L (Daphnia magna)

### 12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Inner salt of alkyl amines	Proprietary	Readily biodegradable (>90% @ 28d)

### 12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Inner salt of alkyl amines	Proprietary	Log Pow =0.9

### 12.4. Mobility in soil

Substances	CAS Number	Mobility
Inner salt of alkyl amines	Proprietary	No information available

### 12.6. Other adverse effects

#### **Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

## 13. Disposal Considerations

### Safe handling and disposal methods

Follow all applicable community, national or regional regulations regarding waste management methods.

### Disposal of any contaminated packaging

Follow all applicable national or local regulations.

### Environmental regulations

Not applicable

## 14. Transport Information

### Transportation Information

#### Australia ADG

<b>UN Number</b>	UN3082
<b>UN proper shipping name:</b>	Environmentally Hazardous Substance, Liquid, N.O.S. (Contains Inner salt of alkyl amines)
<b>Transport Hazard Class(es):</b>	9
<b>Packing Group:</b>	III
<b>Environmental Hazards:</b>	Marine Pollutant

### IMDG/IMO

**UN Number** UN3082  
**UN proper shipping name:** Environmentally Hazardous Substance, Liquid, N.O.S. (Contains Inner salt of alkyl amines)  
**Transport Hazard Class(es):** 9  
**Packing Group:** III  
**Environmental Hazards:** Marine Pollutant  
**EMS:** EmS F-A, S-F

**IATA/ICAO**

**UN Number** UN3082  
**UN proper shipping name:** Environmentally Hazardous Substance, Liquid, N.O.S. (Contains Inner salt of alkyl amines)  
**Transport Hazard Class(es):** 9  
**Packing Group:** III  
**Environmental Hazards:** Marine Pollutant

**Special precautions during transport**

None

**HazChem Code**

None Allocated

**15. Regulatory Information**

**Safety, health and environmental regulations specific for the product**

**International Inventories**

**Australian AICS Inventory** All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

**New Zealand Inventory of Chemicals** All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

**EINECS (European Inventory of Existing Chemical Substances)** This product does not comply with EINECS

**US TSCA Inventory** All components listed on inventory or are exempt.

**Canadian Domestic Substances List (DSL)** All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

**International Agreements**

**Montreal Protocol - Ozone Depleting Substances:** Does not apply.

**Stockholm Convention - Persistent Organic Pollutants:** Does not apply.

**Rotterdam Convention - Prior Informed Consent:** Does not apply.

**Basel Convention - Hazardous Waste:** Does not apply.

**16. Other information**

**Date of preparation or review**

**Revision Date:** 12-Jun-2018

**Revision Note**

SDS sections updated:  
2

**Full text of H-Statements referred to under sections 2 and 3**

H318 - Causes serious eye damage  
 H401 - Toxic to aquatic life  
 H411 - Toxic to aquatic life with long lasting effects

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

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For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight  
CAS – Chemical Abstracts Service  
EC50 – Effective Concentration 50%  
LC50 – Lethal Concentration 50%  
LD50 – Lethal Dose 50%  
LL50 – Lethal Loading 50%  
mg/kg – milligram/kilogram  
mg/L – milligram/liter  
NOEC – No Observed Effect Concentration  
OEL – Occupational Exposure Limit  
PBT – Persistent Bioaccumulative and Toxic  
ppm – parts per million  
STEL – Short Term Exposure Limit  
TWA – Time-Weighted Average  
vPvB – very Persistent and very Bioaccumulative  
h - hour  
mg/m<sup>3</sup> - milligram/cubic meter  
mm - millimeter  
mmHg - millimeter mercury  
w/w - weight/weight  
d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

**Disclaimer Statement**

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**End of Safety Data Sheet**

# SAFETY DATA SHEET

## HYDROCHLORIC ACID 32%

Revision Date: 01-Sep-2016

Revision Number: 2

### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

#### 1.1. Product Identifier

**Product Name** HYDROCHLORIC ACID 32%

#### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** MC600136

#### Recommended use of the chemical and restrictions on use

**Recommended Use** Solvent  
**Uses advised against** No information available

#### Supplier's name, address and phone number

**Manufacturer/Supplier** Multi-Chem Mintech  
1 Ward Road  
East Rockingham  
WA 6168  
Australia

Telephone Number: 61 (08) 9419 5300  
Fax Number: 61 (08) 9439 1055  
Emergency Telephone Number: + 61 1 800 686 951  
fdunexchem@halliburton.com

#### **E-mail Address**

#### Emergency phone number

+ 61 1 800 686 951

#### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

#### Classification of the hazardous chemical

Acute inhalation toxicity - vapor	Category 4 - H332
Skin Corrosion/Irritation	Category 1 - H314
Serious Eye Damage/Irritation	Category 1 - H318
Specific Target Organ Toxicity - (Single Exposure)	Category 3 - H335
Substances/mixtures corrosive to metal	Category 1 - H290

#### Label elements, including precautionary statements



**Hazard pictograms****Signal Word**

Danger

**Hazard Statements:**

H290 - May be corrosive to metals  
 H314 - Causes severe skin burns and eye damage  
 H318 - Causes serious eye damage  
 H331 - Toxic if inhaled  
 H335 - May cause respiratory irritation

**Precautionary Statements****Prevention**

P103 - Read label before use  
 P234 - Keep only in original container  
 P260 - Do not breathe dust/fume/gas/mist/vapors/spray  
 P271 - Use only outdoors or in a well-ventilated area

**Response**

P280 - Wear protective gloves/protective clothing/eye protection/face protection  
 P301 + P330 + P331 - IF SWALLOWED: rinse mouth. Do NOT induce vomiting  
 P303 + P361 + P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower  
 P363 - Wash contaminated clothing before reuse  
 P304 + P340 - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing  
 P310 - Immediately call a POISON CENTER or doctor/physician  
 P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing

**Storage**

P390 - Absorb spillage to prevent material damage  
 P403 + P233 - Store in a well-ventilated place. Keep container tightly closed  
 P405 - Store locked up

**Disposal**

P406 - Store in corrosive resistant container with a resistant inner liner.  
 P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Contains****Substances**

Hydrochloric acid

**CAS Number**

7647-01-0

**Other hazards which do not result in classification**

Chronic exposure to corrosive fumes/gases may cause erosion of the teeth followed by jaw necrosis. Bronchial irritation with chronic cough and frequent attacks of pneumonia are common. Gastrointestinal disturbances may also be seen

This mixture contains no substance considered to be persistent, bioaccumulating nor toxic (PBT).

This mixture contains no substance considered to be very persistent nor very bioaccumulating (vPvB).

*For the full text of the H-phrases mentioned in this Section, see Section 16*

<b>3. Composition/information on Ingredients</b>			
<b>Substances</b>	<b>CAS Number</b>	<b>PERCENT (w/w)</b>	<b>GHS Classification - Australia</b>
Hydrochloric acid	7647-01-0	30 - 60%	Acute Tox. 3 (H331) Skin Corr. 1A (H314)

			Eye Corr. 1 (H318) STOT SE 3 (H335) Met. Corr. 1 (H290)
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#### 4. First aid measures

##### Description of necessary first aid measures

**Inhalation** If inhaled, move victim to fresh air and seek medical attention.

**Eyes** In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

**Skin** In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.

**Ingestion** Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

##### Symptoms caused by exposure

Causes severe eye irritation which may damage tissue. Causes severe skin irritation with tissue destruction. May cause respiratory irritation. Harmful if inhaled.

##### Medical Attention and Special Treatment

**Notes to Physician** Treat symptomatically

#### 5. Fire Fighting Measures

##### Suitable extinguishing equipment

##### **Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

##### **Extinguishing media which must not be used for safety reasons**

None known.

##### Specific hazards arising from the chemical

##### **Special exposure hazards in a fire**

May form explosive mixtures with strong alkalis. Decomposition in fire may produce harmful gases. Reaction with steel and certain other metals generates flammable hydrogen gas. Do not allow runoff to enter waterways.

##### Special protective equipment and precautions for fire fighters

##### **Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

#### 6. Accidental release measures

##### 6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing. Avoid breathing vapors. Evacuate all persons from the area.

##### 6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas. Consult local authorities.

##### 6.3. Methods and material for containment and cleaning up

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Neutralize to pH of 6-8. Scoop up and remove.

#### 7. Handling and storage

##### 7.1. Precautions for safe handling

##### **Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Ensure adequate ventilation. Wash hands after use. Launder

contaminated clothing before reuse. Use appropriate protective equipment.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities**

**Storage Information**

Store away from alkalis. Store in a cool well ventilated area. Keep container closed when not in use. Store locked up. Product has a shelf life of 24 months.

**Other Guidelines**

No information available

**8. Exposure Controls/Personal Protection**

**Control parameters - exposure standards, biological monitoring**

**Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Hydrochloric acid	7647-01-0	5 ppm	TWA: 2 ppm (Ceiling)

**Appropriate engineering controls**

**Engineering Controls**

Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.

**Personal protective equipment (PPE)**

**Personal Protective Equipment**

If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

**Respiratory Protection**

If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.  
Acid gas respirator.

**Hand Protection**

Chemical-resistant protective gloves (EN 374) Suitable materials for longer, direct contact (recommended: protection index 6, corresponding to > 480 minutes permeation time as per EN 374): Butyl rubber gloves. (>= 0.7 mm thickness)  
This information is based on literature references and on information provided by glove manufacturers, or is derived by analogy with similar substances. Please note that in practice the working life of chemical-resistant protective gloves may be considerably shorter than the permeation time determined in accordance with EN 374 as a result of the many influencing factors (e.g. temperature). If signs of wear and tear are noticed then the gloves should be replaced. Manufacturer's directions for use should be observed because of great diversity of types.

**Skin Protection**

Full protective chemical resistant clothing. Rubber boots

**Eye Protection**

Chemical goggles; also wear a face shield if splashing hazard exists.

**Other Precautions**

Eyewash fountains and safety showers must be easily accessible.

**Environmental Exposure Controls**

Do not allow material to contaminate ground water system

**9. Physical and Chemical Properties**

**9.1. Information on basic physical and chemical properties**

<b>Physical State:</b> Liquid	<b>Color:</b> Clear colorless
<b>Odor:</b> Pungent acrid	<b>Odor Threshold:</b> No information available

Property	Values
Remarks/ - Method	
<b>pH:</b>	0.8
<b>Freezing Point / Range</b>	-46 °C
<b>Melting Point / Range</b>	No data available
<b>Boiling Point / Range</b>	110 °C / 230 °F

Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	26
Vapor Density	No data available
Specific Gravity	1.18
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

**9.2. Other information**

Molecular Weight	36.5
VOC Content (%)	No data available

## 10. Stability and Reactivity

**10.1. Reactivity**

Not expected to be reactive.

**10.2. Chemical stability**

Stable

**10.3. Possibility of hazardous reactions**

Will Not Occur

**10.4. Conditions to avoid**

None anticipated

**10.5. Incompatible materials**

Strong alkalis.

**10.6. Hazardous decomposition products**

Flammable hydrogen gas. Chlorine. Hydrogen sulfide.

## 11. Toxicological Information

**Information on routes of exposure**

**Principle Route of Exposure** Eye or skin contact, inhalation.

**Symptoms related to exposure****Most Important Symptoms/Effects**

Causes severe eye irritation which may damage tissue. Causes severe skin irritation with tissue destruction. May cause respiratory irritation. Harmful if inhaled.

**Numerical measures of toxicity****Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Hydrochloric acid	7647-01-0	No data available	No data available	No data available

**Immediate, delayed and chronic health effects from exposure**

<b>Inhalation</b>	Harmful if inhaled. Causes severe respiratory irritation.
<b>Eye Contact</b>	Causes eye burns
<b>Skin Contact</b>	Causes severe burns. Did not cause sensitization on laboratory animals (guinea pig)
<b>Ingestion</b>	Causes burns of the mouth, throat and stomach.

**Chronic Effects/Carcinogenicity** Prolonged, excessive exposure may cause erosion of the teeth.

**Exposure Levels**

No data available

**Interactive effects**

Skin disorders.

**Data limitations**

No data available

<b>Substances</b>	<b>CAS Number</b>	<b>Skin corrosion/irritation</b>
Hydrochloric acid	7647-01-0	Causes severe burns Causes severe skin irritation with tissue destruction.
<b>Substances</b>	<b>CAS Number</b>	<b>Serious eye damage/irritation</b>
Hydrochloric acid	7647-01-0	Causes severe burns Causes severe eye irritation. Will damage tissue.
<b>Substances</b>	<b>CAS Number</b>	<b>Skin Sensitization</b>
Hydrochloric acid	7647-01-0	Did not cause sensitization on laboratory animals (guinea pig)
<b>Substances</b>	<b>CAS Number</b>	<b>Respiratory Sensitization</b>
Hydrochloric acid	7647-01-0	No information available
<b>Substances</b>	<b>CAS Number</b>	<b>Mutagenic Effects</b>
Hydrochloric acid	7647-01-0	Not regarded as mutagenic. In vitro tests did not show mutagenic effects.
<b>Substances</b>	<b>CAS Number</b>	<b>Carcinogenic Effects</b>
Hydrochloric acid	7647-01-0	No data of sufficient quality are available.
<b>Substances</b>	<b>CAS Number</b>	<b>Reproductive toxicity</b>
Hydrochloric acid	7647-01-0	Embryo and fetotoxicity has been observed in female rats exposed to maternally toxic levels of hydrogen chloride (450 mg/m <sup>3</sup> , 1hr.). When tested at maternally toxic doses, no adverse effects on fertility, teratogenicity, or development were observed.
<b>Substances</b>	<b>CAS Number</b>	<b>STOT - single exposure</b>
Hydrochloric acid	7647-01-0	May cause respiratory irritation. No information available
<b>Substances</b>	<b>CAS Number</b>	<b>STOT - repeated exposure</b>
Hydrochloric acid	7647-01-0	No significant toxicity observed in animal studies at concentration requiring classification.
<b>Substances</b>	<b>CAS Number</b>	<b>Aspiration hazard</b>
Hydrochloric acid	7647-01-0	Not applicable

**12. Ecological Information**

**Ecotoxicity**

**Product Ecotoxicity Data**

No data available

**Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Hydrochloric acid	7647-01-0	No information available	LC50 282 mg/L (Gambusia affinis) LC50 20.5 mg/L (Lepomis macrochirus) LC50 (96h) 3.25 – 3.5 (pH) (Lepomis macrochirus)	EC50 (3h) >= 5 and <= 5.5 (pH) (Activated sludge, domestic)	EC50 (48 h) 4.92 mg/L (Daphnia magna)

**12.2. Persistence and degradability**

The methods for determining biodegradability are not applicable to inorganic substances.

Substances	CAS Number	Persistence and Degradability
Hydrochloric acid	7647-01-0	The methods for determining biodegradability are not applicable to inorganic substances.

**12.3. Bioaccumulative potential**

Does not bioaccumulate.

Substances	CAS Number	Log Pow
Hydrochloric acid	7647-01-0	LogKow -2.65

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Hydrochloric acid	7647-01-0	No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

**13. Disposal Considerations****Safe handling and disposal methods**

Disposal should be made in accordance with federal, state, and local regulations. Substance should NOT be deposited into a sewage facility.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

**14. Transport Information****Transportation Information****Australia ADG**

UN Number: UN1789  
 UN proper shipping name: Hydrochloric Acid Solution  
 Transport Hazard Class(es): 8  
 Packing Group: II  
 Environmental Hazards: Not applicable

**IMDG/IMO**

UN Number: UN1789  
 UN proper shipping name: Hydrochloric Acid Solution  
 Transport Hazard Class(es): 8  
 Packing Group: II  
 Environmental Hazards: Not applicable  
 EMS: EmS F-A, S-B

**IATA/CAO**

UN Number: UN1789  
 UN proper shipping name: Hydrochloric Acid Solution  
 Transport Hazard Class(es): 8  
 Packing Group: II  
 Environmental Hazards: Not applicable

**Special precautions during transport**

None

**HazChem Code**

2R

**15. Regulatory Information****Safety, health and environmental regulations specific for the product****International Inventories**

<b>Australian AICS Inventory</b>	All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.
<b>New Zealand Inventory of Chemicals</b>	All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.
<b>EINECS (European Inventory of Existing Chemical Substances)</b>	This product, and all its components, complies with EINECS
<b>US TSCA Inventory</b>	All components listed on inventory or are exempt.
<b>Canadian Domestic Substances List (DSL)</b>	All components listed on inventory or are exempt.

**Poisons Schedule number**

S6

**International Agreements**

<b>Montreal Protocol - Ozone Depleting Substances:</b>	Does not apply
<b>Stolkhom Convention - Persistent Organic Pollutants:</b>	Does not apply
<b>Rotterdam Convention - Prior Informed Consent:</b>	Does not apply
<b>Basel Convention - Hazardous Waste:</b>	Does not apply

**16. Other information****Date of preparation or review****Revision Date:** 01-Sep-2016**Revision Note**

SDS sections updated: 2

**Full text of H-Statements referred to under sections 2 and 3**

H290 - May be corrosive to metals  
H314 - Causes severe skin burns and eye damage  
H318 - Causes serious eye damage  
H331 - Toxic if inhaled  
H332 - Harmful if inhaled  
H335 - May cause respiratory irritation

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight  
CAS – Chemical Abstracts Service  
EC50 – Effective Concentration 50%  
LC50 – Lethal Concentration 50%  
LD50 – Lethal Dose 50%  
LL50 – Lethal Loading 50%  
mg/kg – milligram/kilogram  
mg/L – milligram/liter  
NOEC – No Observed Effect Concentration  
OEL – Occupational Exposure Limit  
PBT – Persistent Bioaccumulative and Toxic  
ppm – parts per million  
STEL – Short Term Exposure Limit  
TWA – Time-Weighted Average  
vPvB – very Persistent and very Bioaccumulative  
h - hour  
mg/m<sup>3</sup> - milligram/cubic meter  
mm - millimeter  
mmHg - millimeter mercury

w/w - weight/weight  
d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)  
NZ CCID

**Disclaimer Statement**

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

**End of Safety Data Sheet**



## SAFETY DATA SHEET

### MSA-III US

Revision Date: 25-Jan-2017

Revision Number: 14

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

**1.1. Product Identifier**

**Product Name** MSA-III US

**Other means of Identification**

**Synonyms** None  
**Hazardous Material Number:** HM005253

**Recommended use of the chemical and restrictions on use**

**Recommended Use** Corrosion Inhibitor  
**Uses advised against** Consumer use

**Supplier's name, address and phone number**

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
 15 Marriott Road, Jandakot, WA 6164  
 Australia  
 ACN Number: 009 000 775  
 Telephone Number: + 61 1 800 686 951  
 Fax Number: 61 (08) 9455 5300  
**E-mail Address** fdunexchem@halliburton.com

**Emergency phone number**

+ 61 1 800 686 951  
 Global Incident Response Access Code: 334305  
 Contract Number: 14012

**Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
 Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

**Classification of the hazardous chemical**

Acute Oral Toxicity	Category 4 - H302
Skin Corrosion/Irritation	Category 1 - H314
Serious Eye Damage/Irritation	Category 1 - H318
Specific Target Organ Toxicity - (Single Exposure)	Category 3 - H336
Acute Aquatic Toxicity	Category 3 - H402
Chronic Aquatic Toxicity	Category 3 - H412
Flammable liquids.	Category 2 - H225

**Label elements, including precautionary statements**

**Hazard Pictograms**

(Bad file name)

**Signal Word**

DANGER

**Hazard Statements:**

H225 - Highly flammable liquid and vapor  
 H302 - Harmful if swallowed  
 H314 - Causes severe skin burns and eye damage  
 H318 - Causes serious eye damage  
 H336 - May cause drowsiness or dizziness  
 H402 - Harmful to aquatic life  
 H412 - Harmful to aquatic life with long lasting effects

**Precautionary Statements****Prevention**

P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.  
 P233 - Keep container tightly closed  
 P240 - Ground and bond container and receiving equipment.  
 P241 - Use explosion-proof electrical/ventilating/lighting/equipment  
 P242 - Use only non-sparking tools  
 P243 - Take action to prevent static discharges.  
 P260 - Do not breathe dust/fume/gas/mist/vapors/spray  
 P264 - Wash face, hands and any exposed skin thoroughly after handling  
 P270 - Do not eat, drink or smoke when using this product  
 P271 - Use only outdoors or in a well-ventilated area

**Response**

P280 - Wear protective gloves/protective clothing/eye protection/face protection  
 P301 + P312 - IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell  
 P330 - Rinse mouth  
 P303 + P361 + P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower].  
 P363 - Wash contaminated clothing before reuse  
 P312 - Call a POISON CENTER or doctor/physician if you feel unwell  
 P310 - Immediately call a POISON CENTER or doctor/physician  
 P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
 P370 + P378 - In case of fire: Use water spray for extinction  
 P304 + P340 - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing

**Storage**

P403 + P233 - Store in a well-ventilated place. Keep container tightly closed  
 P403 + P235 - Store in a well-ventilated place. Keep cool  
 P405 - Store locked up

**Disposal**

P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Contains****Substances**

Isopropanol  
 Rosin amines  
 Thioglycolic acid  
 Ethoxylated alkyl amines

**CAS Number**

67-63-0  
 61790-47-4  
 68-11-1  
 Proprietary

**Other hazards which do not result in classification**

None known

For the full text of the H-phrases mentioned in this Section, see Section 16

### 3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Isopropanol	67-63-0	30 - 60%	Eye Irrit. 2 (H319) STOT SE 3 (H336) Flam. Liq. 2 (H225)
Rosin amines	61790-47-4	10 - 30%	Acute Tox. 4 (H302) Skin Corr. 1C (H314) Eye Corr. 1 (H318)
Thioglycolic acid	68-11-1	10 - 30%	Acute Tox. 3 (H301) Acute Tox. 3 (H311) Acute Tox. 2 (H330) Skin Corr. 1B (H314) Eye Corr. 1 (H318) Skin Sens. 1 (H317) STOT SE 3 (H335) STOT RE 2 (H373) Aquatic Acute 3 (H402)
Ethoxylated alkyl amines	Proprietary	5 - 10%	Acute Tox. 4 (H302) Skin Irrit. 2 (H315) Eye Corr. 1 (H318) Aquatic Acute 2 (H401) Aquatic Chronic 2 (H411)

### 4. First aid measures

#### Description of necessary first aid measures

#### **Inhalation**

If inhaled, move victim to fresh air and seek medical attention.

#### **Eyes**

In case of contact, immediately flush eyes with plenty of water for at least 30 minutes. Remove contact lenses after the first 5 minutes and continue washing. Seek immediate medical attention/advice. Suitable emergency eye wash facility should be immediately available

#### **Skin**

Remove contaminated clothing and launder before reuse. Remove contaminated shoes and discard. In case of contact, immediately flush skin with plenty of soap and water for at least 30 minutes and remove contaminated clothing, shoes and leather goods immediately. Get medical attention immediately.

#### **Ingestion**

Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

#### Symptoms caused by exposure

Causes severe eye irritation which may damage tissue. Causes severe skin irritation with tissue destruction. Harmful if swallowed. May cause headache, dizziness, and other central nervous system effects.

#### Medical Attention and Special Treatment

#### **Notes to Physician**

Treat symptomatically

### 5. Fire Fighting Measures

#### Suitable extinguishing equipment

#### **Suitable Extinguishing Media**

Water fog, carbon dioxide, foam, dry chemical.

#### **Extinguishing media which must not be used for safety reasons**

None known.

#### Specific hazards arising from the chemical

**Special exposure hazards in a fire**

May be ignited by heat, sparks or flames Use water spray to cool fire exposed surfaces. Closed containers may explode in fire. Decomposition in fire may produce harmful gases. Fight fire from a safe distance and from a protected location.

**Special protective equipment and precautions for fire fighters****Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

## 6. Accidental release measures

**6.1. Personal precautions, protective equipment and emergency procedures**

Remove sources of ignition. Evacuate all persons from the area. Use only competent persons for cleanup. Use appropriate protective equipment. Avoid contact with skin, eyes and clothing. Avoid breathing vapors. Ensure adequate ventilation.

**6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas. Prevent contamination of soil.

**6.3. Methods and material for containment and cleaning up**

Isolate spill and stop leak where safe. Remove ignition sources and work with non-sparking tools. Neutralize to pH of 6-8. Contain spill with sand or other inert materials. Scoop up and remove.

## 7. Handling and storage

**7.1. Precautions for safe handling****Handling Precautions**

Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse. Ground and bond containers when transferring from one container to another.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Store away from oxidizers. Store away from alkalis. Keep from heat, sparks, and open flames. Keep container closed when not in use. Product has a shelf life of 24 months.

**Other Guidelines**

No information available

## 8. Exposure Controls/Personal Protection

**Control parameters - exposure standards, biological monitoring****Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Isopropanol	67-63-0	TWA: 400 ppm TWA: 983 mg/m <sup>3</sup> STEL: 500 ppm STEL: 1230 mg/m <sup>3</sup>	TWA: 200 ppm STEL: 400 ppm
Rosin amines	61790-47-4	Not applicable	Not applicable
Thioglycolic acid	68-11-1	TWA: 1 ppm TWA: 3.8 mg/m <sup>3</sup>	TWA: 1 ppm
Ethoxylated alkyl amines	Proprietary	Not applicable	Not applicable

**Appropriate engineering controls****Engineering Controls**

Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.

**Personal protective equipment (PPE)****Personal Protective Equipment**

If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this

<b>Respiratory Protection</b>	product. Organic vapor/acid gas respirator. Positive pressure self-contained breathing apparatus in enclosed areas.
<b>Hand Protection</b>	Impervious rubber gloves.
<b>Skin Protection</b>	Rubber apron.
<b>Eye Protection</b>	Chemical goggles; also wear a face shield if splashing hazard exists.
<b>Other Precautions</b>	Eyewash fountains and safety showers must be easily accessible.
<b>Environmental Exposure Controls</b>	No information available

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

<b>Physical State:</b>	Liquid	<b>Color</b>	Light amber
<b>Odor:</b>	Strong	<b>Odor Threshold:</b>	No information available

<u>Property</u>	<u>Values</u>
<u>Remarks/ - Method</u>	
<b>pH:</b>	2.1-2.3
<b>Freezing Point / Range</b>	No data available
<b>Melting Point / Range</b>	No data available
<b>Boiling Point / Range</b>	No data available
<b>Flash Point</b>	6 °C / 43 °F Tag Closed Cup (TCC)
<b>Evaporation rate</b>	> 1
<b>Vapor Pressure</b>	83.8 - 102.4 mm Hg
<b>Vapor Density</b>	> 1
<b>Specific Gravity</b>	0.934 - 0.946
<b>Water Solubility</b>	Dispersible
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

### 9.2. Other information

<b>VOC Content (%)</b>	No data available
------------------------	-------------------

## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

### 10.2. Chemical stability

Stable

### 10.3. Possibility of hazardous reactions

Will Not Occur

### 10.4. Conditions to avoid

Keep away from heat, sparks and flame.

### 10.5. Incompatible materials

Strong oxidizers. Strong alkalis.

### 10.6. Hazardous decomposition products

Oxides of nitrogen. Oxides of sulfur. Hydrogen chloride. Carbon monoxide and carbon dioxide.

## 11. Toxicological Information

### Information on routes of exposure

**Principle Route of Exposure** Eye or skin contact, inhalation.

### Symptoms related to exposure

### Most Important Symptoms/Effects

Causes severe eye irritation which may damage tissue. Causes severe skin irritation with tissue destruction. Harmful

if swallowed. May cause headache, dizziness, and other central nervous system effects.

### Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Isopropanol	67-63-0	5840 mg/kg-bw (rat)	12870 mg/kg-bw (rabbit)	72.6 mg/L (Rat, 4h, vapor)
Rosin amines	61790-47-4	2500 mg/kg (rat) (similar substance) 700 mg/kg (guinea pig) (similar substance)	No data available	No data available
Thioglycolic acid	68-11-1	73 mg/kg-bw (rat)	848 mg/kg-bw (rabbit)	1.388 mg/L (rat, 4 hr, aerosol)
Ethoxylated alkyl amines	Proprietary	1200 mg/kg-bw (rat) (similar substance)	> 1260 mg/kg (rabbits) (similar substance)	No data available

### Immediate, delayed and chronic health effects from exposure

#### **Inhalation**

Massive inhalation immediately dangerous to life and health. Causes severe respiratory irritation. May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.

#### **Eye Contact**

Causes severe eye burns.

#### **Skin Contact**

Causes severe burns. May be absorbed through the skin and produce effects similar to those caused by inhalation and/or ingestion.

#### **Ingestion**

Harmful if swallowed. Causes burns of the mouth, throat and stomach. May cause headache, dizziness, nausea, vomiting, gastrointestinal irritation and central nervous system depression.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

### Exposure Levels

No data available

### Interactive effects

Skin disorders. Lung disorders.

### Data limitations

No data available

Substances	CAS Number	Skin corrosion/irritation
Isopropanol	67-63-0	Non-irritating to the skin (Rabbit)
Rosin amines	61790-47-4	Skin, rabbit: Causes burns
Thioglycolic acid	68-11-1	Corrosive to skin
Ethoxylated alkyl amines		Causes moderate skin irritation. (similar substances)

Substances	CAS Number	Serious eye damage/irritation
Isopropanol	67-63-0	Causes moderate eye irritation (Rabbit)
Rosin amines	61790-47-4	Causes eye burns
Thioglycolic acid	68-11-1	Corrosive to eyes
Ethoxylated alkyl amines		Causes severe eye irritation. Will damage tissue. (similar substances)

Substances	CAS Number	Skin Sensitization
Isopropanol	67-63-0	Did not cause sensitization on laboratory animals (guinea pig)
Rosin amines	61790-47-4	May cause sensitization by skin contact
Thioglycolic acid	68-11-1	Not regarded as a sensitizer.
Ethoxylated alkyl amines		No information available

Substances	CAS Number	Respiratory Sensitization
Isopropanol	67-63-0	No information available
Rosin amines	61790-47-4	No information available
Thioglycolic acid	68-11-1	No information available
Ethoxylated alkyl amines		No information available

Substances	CAS Number	Mutagenic Effects
Isopropanol	67-63-0	In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects.
Rosin amines	61790-47-4	No information available
Thioglycolic acid	68-11-1	In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects.
Ethoxylated alkyl amines		In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects. (similar substances)

Substances	CAS Number	Carcinogenic Effects
Isopropanol	67-63-0	Did not show carcinogenic effects in animal experiments
Rosin amines	61790-47-4	No information available
Thioglycolic acid	68-11-1	Did not show carcinogenic effects in animal experiments
Ethoxylated alkyl amines		No information available

Substances	CAS Number	Reproductive toxicity
Isopropanol	67-63-0	Animal testing did not show any effects on fertility.
Rosin amines	61790-47-4	No information available
Thioglycolic acid	68-11-1	Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments.
Ethoxylated alkyl amines		No data of sufficient quality are available.

Substances	CAS Number	STOT - single exposure
Isopropanol	67-63-0	May cause headache, dizziness, and other central nervous system effects.
Rosin amines	61790-47-4	May cause respiratory irritation.
Thioglycolic acid	68-11-1	May cause respiratory irritation.
Ethoxylated alkyl amines		No information available

Substances	CAS Number	STOT - repeated exposure
Isopropanol	67-63-0	No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)
Rosin amines	61790-47-4	No information available
Thioglycolic acid	68-11-1	Not applicable due to corrosivity of the substance.
Ethoxylated alkyl amines		No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	Aspiration hazard
Isopropanol	67-63-0	Not applicable
Rosin amines	61790-47-4	No information available
Thioglycolic acid	68-11-1	Not applicable
Ethoxylated alkyl amines		No information available

## 12. Ecological Information

### Ecotoxicity

#### Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Isopropanol	67-63-0	EC50 (72h) > 1000 mg/L (Desmodesmus subspicatus) EC50 (7d) 1800 mg/L (Scenedesmus quadricauda)	LC50 (96h) 9640 mg/L (Pimephales promelas) LC50 (7d) 7060 mg/L (Poecilia reticulata)	TT (16h) 1050 mg/L (Pseudomonas putida)	EC50 (48h) 13,299 mg/L (Daphnia magna) EC50 (24h) > 10,000 mg/L (Daphnia magna)
Rosin amines	61790-47-4	No information available	No information available	No information available	No information available
Thioglycolic acid	68-11-1	EC50 (72h) > 100 mg/L (Scenedesmus subspicatus) (similar substance)	LC50 (96h) > 100 mg/L (Oncorhynchus mykiss)	EC50 (3h) 530 mg/L (Activated sludge) (similar substance)	EC50 (48h) 38 mg/L (Daphnia magna)
Ethoxylated alkyl amines	Proprietary	No information available	LC50 (96h) 4.31 mg/L (Danio rerio)	No information available	LC50 (48h) 12.1 mg/L (Daphnia magna)

#### 12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Isopropanol	67-63-0	Readily biodegradable (53% @ 5d)

Rosin amines	61790-47-4	No information available
Thioglycolic acid	68-11-1	(67% @ 28d)
Ethoxylated alkyl amines	Proprietary	(27% @ 28d)

**12.3. Bioaccumulative potential**

Substances	CAS Number	Log Pow
Isopropanol	67-63-0	0.05
Rosin amines	61790-47-4	Log Kow = 6.29
Thioglycolic acid	68-11-1	Log Pow <0
Ethoxylated alkyl amines	Proprietary	No information available

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Isopropanol	67-63-0	No information available
Rosin amines	61790-47-4	No information available
Thioglycolic acid	68-11-1	No information available
Ethoxylated alkyl amines	Proprietary	No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

<b>13. Disposal Considerations</b>
------------------------------------

**Safe handling and disposal methods**

Follow all applicable community, national or regional regulations regarding waste management methods.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

<b>14. Transport Information</b>
----------------------------------

**Transportation Information****Australia ADG**

**UN Number:** UN2924  
**UN proper shipping name:** Flammable Liquid, Corrosive, N.O.S. (Contains Isopropanol, Thioglycolic Acid)  
**Transport Hazard Class(es):** 3 (8)  
**Packing Group:** II  
**Environmental Hazards:** Not applicable

**IMDG/IMO**

**UN Number:** UN2924  
**UN proper shipping name:** Flammable Liquid, Corrosive, N.O.S. (Contains Isopropanol, Thioglycolic Acid)  
**Transport Hazard Class(es):** 3 (8)  
**Packing Group:** II  
**Environmental Hazards:** Not applicable  
**EMS:** EmS F-E, S-C

**IATA/ICAO**

**UN Number:** UN2924  
**UN proper shipping name:** Flammable Liquid, Corrosive, N.O.S. (Contains Isopropanol, Thioglycolic Acid)  
**Transport Hazard Class(es):** 3 (8)  
**Packing Group:** II  
**Environmental Hazards:** Not applicable



**Special precautions during transport**

None

**HazChem Code**

•3W

**15. Regulatory Information****Safety, health and environmental regulations specific for the product****International Inventories****Australian AICS Inventory**

All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

**New Zealand Inventory of Chemicals**

All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

**EINECS (European Inventory of Existing Chemical Substances)**

This product, and all its components, complies with EINECS

**US TSCA Inventory**

All components listed on inventory or are exempt.

**Canadian Domestic Substances List (DSL)**

All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

**International Agreements****Montreal Protocol - Ozone Depleting Substances:**

Does not apply

**Stockholm Convention - Persistent Organic Pollutants:**

Does not apply

**Rotterdam Convention - Prior Informed Consent:**

Does not apply

**Basel Convention - Hazardous Waste:**

Does not apply

**16. Other information****Date of preparation or review****Revision Date:** 25-Jan-2017**Revision Note**

SDS sections updated:

2

**Full text of H-Statements referred to under sections 2 and 3**

H225 - Highly flammable liquid and vapor

H301 - Toxic if swallowed

H302 - Harmful if swallowed

H314 - Causes severe skin burns and eye damage

H318 - Causes serious eye damage

H319 - Causes serious eye irritation

H331 - Toxic if inhaled

H336 - May cause drowsiness or dizziness

H401 - Toxic to aquatic life

H411 - Toxic to aquatic life with long lasting effects

**Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

**Key abbreviations or acronyms used**

bw – body weight

CAS – Chemical Abstracts Service  
EC50 – Effective Concentration 50%  
LC50 – Lethal Concentration 50%  
LD50 – Lethal Dose 50%  
LL50 – Lethal Loading 50%  
mg/kg – milligram/kilogram  
mg/L – milligram/liter  
NOEC – No Observed Effect Concentration  
OEL – Occupational Exposure Limit  
PBT – Persistent Bioaccumulative and Toxic  
ppm – parts per million  
STEL – Short Term Exposure Limit  
TWA – Time-Weighted Average  
vPvB – very Persistent and very Bioaccumulative  
h - hour  
mg/m<sup>3</sup> - milligram/cubic meter  
mm - millimeter  
mmHg - millimeter mercury  
w/w - weight/weight  
d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)  
ECHA C&L  
OSHA  
NZ CCID

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**End of Safety Data Sheet**

## SAFETY DATA SHEET

### SAND - COMMON WHITE

Revision Date: 27-Jun-2016

Revision Number: 9

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### 1.1. Product Identifier

**Product Name** SAND - COMMON WHITE

##### Other means of Identification

**Synonyms** None  
**Hazardous Material Number:** HM005278

##### Recommended use of the chemical and restrictions on use

**Recommended Use** Proppant  
**Uses advised against** No information available

##### Supplier's name, address and phone number

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
15 Marriott Road  
Jandakot  
WA 6164  
Australia  
  
ACN Number: 009 000 775  
Telephone Number: + 61 1 800 686 951  
Fax Number: 61 (08) 9455 5300  
**E-mail Address** fdunexchem@halliburton.com

##### Emergency phone number

+ 61 1 800 686 951

##### **Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

##### Classification of the hazardous chemical

Carcinogenicity	Category 2 - H351
Specific Target Organ Toxicity - (Repeated Exposure)	Category 1 - H372

##### Label elements, including precautionary statements

**Hazard pictograms**



<b>Signal Word</b>	Danger
<b>Hazard Statements:</b>	H351 - Suspected of causing cancer H372 - Causes damage to organs through prolonged or repeated exposure
<b>Precautionary Statements</b>	
<b>Prevention</b>	P201 - Obtain special instructions before use P202 - Do not handle until all safety precautions have been read and understood P260 - Do not breathe dust/fume/gas/mist/vapors/spray P264 - Wash face, hands and any exposed skin thoroughly after handling P270 - Do not eat, drink or smoke when using this product P281 - Use personal protective equipment as required
<b>Response</b>	P308 + P313 - IF exposed or concerned: Get medical advice/attention P314 - Get medical attention/advice if you feel unwell
<b>Storage</b>	P405 - Store locked up
<b>Disposal</b>	P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

**Contains****Substances**

Crystalline silica, quartz

**CAS Number**

14808-60-7

**Other hazards which do not result in classification**

This substance is not considered to be persistent, bioaccumulating nor toxic (PBT).

This substance is not considered to be very persistent nor very bioaccumulating (vPvB).

*For the full text of the H-phrases mentioned in this Section, see Section 16*

<b>3. Composition/information on Ingredients</b>
--

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Crystalline silica, quartz	14808-60-7	60 - 100%	Carc. 2 (H351) STOT RE 1 (H372)

<b>4. First aid measures</b>
------------------------------

**Description of necessary first aid measures****Inhalation**

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

**Eyes**

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

**Skin**

Wash with soap and water.

**Ingestion**

Under normal conditions, first aid procedures are not required.

**Symptoms caused by exposure**

Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

**Medical Attention and Special Treatment****Notes to Physician** Treat symptomatically**5. Fire Fighting Measures****Suitable extinguishing equipment****Suitable Extinguishing Media**

None - does not burn.

**Extinguishing media which must not be used for safety reasons**

None known.

**Specific hazards arising from the chemical****Special exposure hazards in a fire**

None anticipated

**Special protective equipment and precautions for fire fighters****Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

**6. Accidental release measures****6.1. Personal precautions, protective equipment and emergency procedures**

Use appropriate protective equipment. Avoid creating and breathing dust. Avoid contact with skin, eyes and clothing. Ensure adequate ventilation.

**6.2. Environmental precautions**

Prevent from entering sewers, waterways, or low areas.

**6.3. Methods and material for containment and cleaning up**

Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

**7. Handling and storage****7.1. Precautions for safe handling****Handling Precautions**

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Product has a shelf life of 36 months.

**Other Guidelines**

No information available

**8. Exposure Controls/Personal Protection****Control parameters - exposure standards, biological monitoring****Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Crystalline silica, quartz	14808-60-7	TWA: 0.1 mg/m <sup>3</sup>	TWA: 0.025 mg/m <sup>3</sup>

**Appropriate engineering controls**

<b>Engineering Controls</b>	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits.
<b>Personal protective equipment (PPE)</b>	
<b>Personal Protective Equipment</b>	If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.
<b>Respiratory Protection</b>	Wear a NIOSH certified, European Standard EN 149 (FFP2/FFP3), AS/NZS 1715, or equivalent respirator when using this product.
<b>Hand Protection</b>	Normal work gloves.
<b>Skin Protection</b>	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
<b>Eye Protection</b>	Wear safety glasses or goggles to protect against exposure.
<b>Other Precautions</b>	None known.
<b>Environmental Exposure Controls</b>	No information available

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

<b>Physical State:</b>	Solid	<b>Color</b>	White
<b>Odor:</b>	Odorless	<b>Odor Threshold:</b>	No information available

Property	Values
Remarks/ - Method	
<b>pH:</b>	No data available
<b>Freezing Point / Range</b>	No data available
<b>Melting Point / Range</b>	No data available
<b>Boiling Point / Range</b>	No data available
<b>Flash Point</b>	No data available
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	2.63 - 2.67
<b>Water Solubility</b>	Insoluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

### 9.2. Other information

<b>Molecular Weight</b>	65 g/mol
<b>VOC Content (%)</b>	No data available

## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

### 10.2. Chemical stability

Stable

### 10.3. Possibility of hazardous reactions

Will Not Occur

### 10.4. Conditions to avoid

None anticipated

### 10.5. Incompatible materials

Hydrofluoric acid.

**10.6. Hazardous decomposition products**

Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).

**11. Toxicological Information****Information on routes of exposure**

**Principle Route of Exposure** Eye or skin contact, inhalation.

**Symptoms related to exposure****Most Important Symptoms/Effects**

Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

**Numerical measures of toxicity****Toxicology data for the components**

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Crystalline silica, quartz	14808-60-7	> 15000 mg/kg (human)	No information available	No data available

**Immediate, delayed and chronic health effects from exposure****Inhalation**

Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).

Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).

**Eye Contact**

May cause mechanical irritation to eye.

**Skin Contact**

None known.

**Ingestion**

None known.

**Chronic Effects/Carcinogenicity**

**Silicosis:** Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

**Cancer Status:** The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2). There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

**Exposure Levels**

No data available

**Interactive effects**

Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.

**Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Crystalline silica, quartz	14808-60-7	Non-irritating to the skin

Substances	CAS Number	Serious eye damage/irritation
Crystalline silica, quartz	14808-60-7	Mechanical irritation of the eyes is possible. No information available

Substances	CAS Number	Skin Sensitization
Crystalline silica, quartz	14808-60-7	No information available.

Substances	CAS Number	Respiratory Sensitization
Crystalline silica, quartz	14808-60-7	No information available

Substances	CAS Number	Mutagenic Effects
Crystalline silica, quartz	14808-60-7	Not regarded as mutagenic.

Substances	CAS Number	Carcinogenic Effects
Crystalline silica, quartz	14808-60-7	Contains crystalline silica which may cause silicosis, a delayed and progressive lung disease. The IARC and NTP have determined there is sufficient evidence in humans of the carcinogenicity of crystalline silica with repeated respiratory exposure. Based on available scientific evidence, this substance is a threshold carcinogen with a mode of action involving indirect genotoxicity secondary to lung injury.

Substances	CAS Number	Reproductive toxicity
Crystalline silica, quartz	14808-60-7	No information available

Substances	CAS Number	STOT - single exposure
Crystalline silica, quartz	14808-60-7	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	STOT - repeated exposure
Crystalline silica, quartz	14808-60-7	Causes damage to organs through prolonged or repeated exposure if inhaled: (Lungs)

Substances	CAS Number	Aspiration hazard
Crystalline silica, quartz	14808-60-7	Not applicable

## 12. Ecological Information

**Ecotoxicity****Product Ecotoxicity Data**

No data available

**Substance Ecotoxicity Data**

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Crystalline silica, quartz	14808-60-7	EC50 (72 h) =440 mg/L (Selenastrum capricornutum)	LL0 (96 h) =10000 mg/L (Danio rerio)	No information available	LL50 (24 h) >10000 mg/L (Daphnia magna)

**12.2. Persistence and degradability**

Substances	CAS Number	Persistence and Degradability
Crystalline silica, quartz	14808-60-7	The methods for determining biodegradability are not applicable to inorganic substances.



**12.3. Bioaccumulative potential**

Substances	CAS Number	Log Pow
Crystalline silica, quartz	14808-60-7	No information available

**12.4. Mobility in soil**

Substances	CAS Number	Mobility
Crystalline silica, quartz	14808-60-7	No information available

**12.6. Other adverse effects****Endocrine Disruptor Information**

This product does not contain any known or suspected endocrine disruptors

**13. Disposal Considerations****Safe handling and disposal methods**

Bury in a licensed landfill according to federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

**14. Transport Information****Transportation Information**

<b>UN Number</b>	Not restricted
<b>UN proper shipping name:</b>	Not restricted
<b>Transport Hazard Class(es):</b>	Not applicable
<b>Packing Group:</b>	Not applicable
<b>Environmental Hazards:</b>	Not applicable

**Special precautions during transport**

None

**HazChem Code**

None Allocated

**15. Regulatory Information****Safety, health and environmental regulations specific for the product****International Inventories**

**Australian AICS Inventory** All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.

**New Zealand Inventory of Chemicals** All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.

**EINECS (European Inventory of Existing Chemical Substances)** This product, and all its components, complies with EINECS

**US TSCA Inventory** All components listed on inventory or are exempt.

**Canadian Domestic Substances List (DSL)** All components listed on inventory or are exempt.

**Poisons Schedule number**

None Allocated

**International Agreements**

**Montreal Protocol - Ozone Depleting Substances:**

Does not apply

<b>Stolkhom Convention - Persistent Organic Pollutants:</b>	Does not apply
<b>Rotterdam Convention - Prior Informed Consent:</b>	Does not apply
<b>Basel Convention - Hazardous Waste:</b>	Does not apply

## 16. Other information

### Date of preparation or review

**Revision Date:** 27-Jun-2016

### **Revision Note**

SDS sections updated: 2

### **Full text of H-Statements referred to under sections 2 and 3**

H351 - Suspected of causing cancer if inhaled

H372 - Causes damage to organs through prolonged or repeated exposure if inhaled

### **Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

### **Key abbreviations or acronyms used**

bw – body weight

CAS – Chemical Abstracts Service

EC50 – Effective Concentration 50%

LC50 – Lethal Concentration 50%

LD50 – Lethal Dose 50%

LL50 – Lethal Loading 50%

mg/kg – milligram/kilogram

mg/L – milligram/liter

NOEC – No Observed Effect Concentration

OEL – Occupational Exposure Limit

PBT – Persistent Bioaccumulative and Toxic

ppm – parts per million

STEL – Short Term Exposure Limit

TWA – Time-Weighted Average

vPvB – very Persistent and very Bioaccumulative

h - hour

mg/m<sup>3</sup> - milligram/cubic meter

mm - millimeter

mmHg - millimeter mercury

w/w - weight/weight

d - day

### **Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

### **Disclaimer Statement**

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**End of Safety Data Sheet**

## SAFETY DATA SHEET

### SuperFlo 2000

Revision Date: 11-Apr-2017

Revision Number: 10

#### 1. Product Identifier & Identity for the Chemical

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

**1.1. Product Identifier**

**Product Name** SuperFlo 2000

**Other means of Identification**

**Synonyms** None  
**Hazardous Material Number:** HM006792

**Recommended use of the chemical and restrictions on use**

**Recommended Use** Surfactant  
**Uses advised against** No information available

**Supplier's name, address and phone number**

**Manufacturer/Supplier** Halliburton Australia Pty. Ltd.  
 15 Marriott Road, Jandakot, WA 6164  
 Australia  
 ACN Number: 009 000 775  
 Telephone Number: + 61 1 800 686 951  
 Fax Number: 61 (08) 9455 5300  
**E-mail Address** fdunexchem@halliburton.com

**Emergency phone number**

+ 61 1 800 686 951  
 Global Incident Response Access Code: 334305  
 Contract Number: 14012

**Australian Poisons Information Centre**

24 Hour Service: - 13 11 26  
 Police or Fire Brigade: - 000 (exchange): - 1100

#### 2. Hazard Identification

**Statement of Hazardous Nature** Hazardous according to the criteria of the 3rd Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Dangerous Goods according to the criteria of ADG.

**Classification of the hazardous chemical**

Aspiration Toxicity	Category 1 - H304
Acute Oral Toxicity	Category 4 - H302
Skin Corrosion/Irritation	Category 1 - H314
Serious Eye Damage/Irritation	Category 1 - H318
Skin Sensitization	Category 1 - H317
Reproductive Toxicity	Category 1 - H360
Specific Target Organ Toxicity - (Single Exposure)	Category 2 - H371
Flammable liquids.	Category 3 - H226

**Label elements, including precautionary statements****Hazard Pictograms**

(Bad file name)

**Signal Word**

DANGER

**Hazard Statements:**

H226 - Flammable liquid and vapor  
 H302 - Harmful if swallowed  
 H304 - May be fatal if swallowed and enters airways  
 H314 - Causes severe skin burns and eye damage  
 H317 - May cause an allergic skin reaction  
 H318 - Causes serious eye damage  
 H360 - May damage fertility or the unborn child  
 H371 - May cause damage to organs  
 H400 - Very toxic to aquatic life  
 H411 - Toxic to aquatic life with long lasting effects

**Precautionary Statements****Prevention**

P201 - Obtain special instructions before use  
 P202 - Do not handle until all safety precautions have been read and understood  
 P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.  
 P233 - Keep container tightly closed  
 P240 - Ground and bond container and receiving equipment.  
 P241 - Use explosion-proof electrical/ventilating/lighting/equipment  
 P243 - Take action to prevent static discharges.  
 P242 - Use only non-sparking tools  
 P260 - Do not breathe dust/fume/gas/mist/vapors/spray  
 P261 - Avoid breathing dust/fume/gas/mist/vapors/spray  
 P264 - Wash face, hands and any exposed skin thoroughly after handling  
 P270 - Do not eat, drink or smoke when using this product  
 P272 - Contaminated work clothing should not be allowed out of the workplace  
 P280 - Wear protective gloves/eye protection/face protection  
 P281 - Use personal protective equipment as required

**Response**

P301 + P312 - IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell  
 P330 - Rinse mouth  
 P303 + P361 + P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower].  
 P363 - Wash contaminated clothing before reuse  
 P310 - Immediately call a POISON CENTER or doctor/physician  
 P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
 P370 + P378 - In case of fire: Use water spray for extinction  
 P304 + P340 - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing  
 P308 + P313 - IF exposed or concerned: Get medical advice/attention  
 P403 + P235 - Store in a well-ventilated place. Keep cool  
 P405 - Store locked up  
 P501 - Dispose of contents/container to an approved incineration plant

**Storage****Disposal****Contains****Substances**

Terpene hydrocarbon by-products

**CAS Number**

68956-56-9

Methanol	67-56-1
Coco diethanolamide	Proprietary
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides	68391-01-5
Nonylphenol ethoxylate	Proprietary
Linanool	Proprietary
2,6-Octadien-1-ol, 3,7-dimethyl-, (2Z)-	106-25-2
2,6-Octadien-1-ol, 3,7-dimethyl-, (2E)-	106-24-1
Citronellol	106-22-9
Isopropanol	67-63-0

**Other hazards which do not result in classification**

None known

For the full text of the H-phrases mentioned in this Section, see Section 16

<b>3. Composition/information on Ingredients</b>
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Substances	CAS Number	PERCENT (w/w)	GHS Classification - Australia
Terpene hydrocarbon by-products	68956-56-9	10 - 30%	Skin Irrit. 2 (H315) Eye Irrit. 2 (H319) Skin Sens. 1 (H317) Asp. Tox. 1 (H304) Aquatic Acute 2 (H401) Aquatic Chronic 2 (H411) Flam. Liq. 3 (H226)
Methanol	67-56-1	5 - 10%	Acute Tox. 3 (H301) Acute Tox. 3 (H311) Acute Tox. 3 (H331) Repr. 1B (H360) STOT SE 1 (H370) Flam. Liq. 2 (H225)
Coco diethanolamide	Proprietary	5 - 10%	Skin Irrit. 2 (H315) Eye Corr. 1 (H318) Aquatic Acute 2 (H401) Aquatic Chronic 2 (H411)
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides	68391-01-5	5 - 10%	Acute Tox. 4 (H302) Acute Tox. 4 (H312) Skin Corr. 1 (H314) Eye Corr. 1 (H318) Aquatic Acute 1 (H400) Aquatic Chronic 1 (H410)
Nonylphenol ethoxylate	Proprietary	5 - 10%	Acute Tox. 4 (H302) Skin Irrit. 2 (H315) Eye Irrit. 2 (H319) Aquatic Acute 3 (H402) Aquatic Chronic 2 (H411)
Linanool	Proprietary	1 - 5%	Skin Irrit. 2 (H315) Eye Irrit. 2 (H319) Aquatic Acute 3 (H402) Flam. Liq. 4 (H227)
2,6-Octadien-1-ol, 3,7-dimethyl-, (2Z)-	106-25-2	1 - 5%	Skin Irrit. 2 (H315) Eye Irrit. 2A (H319) Skin Sens. 1 (H317) STOT SE 3 (H335) Aquatic Acute 2 (H401)
2,6-Octadien-1-ol, 3,7-dimethyl-, (2E)-	106-24-1	1 - 5%	Skin Irrit. 2 (H315) Eye Corr. 1 (H318) Skin Sens. 1 (H317) STOT SE 3 (H335) Aquatic Acute 3 (H402)
Citronellol	106-22-9	1 - 5%	Skin Irrit. 2 (H315) Eye Irrit. 2 (H319) Skin Sens. 1 (H317)

Isopropanol	67-63-0	1 - 5%	Aquatic Acute 2 (H401) Eye Irrit. 2 (H319) STOT SE 3 (H336) Flam. Liq. 2 (H225)
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#### 4. First aid measures

##### Description of necessary first aid measures

<b>Inhalation</b>	If inhaled, move victim to fresh air and seek medical attention.
<b>Eyes</b>	Immediately flush eyes with large amounts of water for at least 30 minutes. Seek prompt medical attention.
<b>Skin</b>	In case of contact, immediately flush skin with plenty of soap and water for at least 30 minutes and remove contaminated clothing, shoes and leather goods immediately. Get medical attention immediately.
<b>Ingestion</b>	Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention. Get medical attention! If vomiting occurs, keep head lower than hips to prevent aspiration. Rinse mouth. Never give anything by mouth to an unconscious person.

##### Symptoms caused by exposure

Causes severe eye irritation which may damage tissue. Causes severe skin irritation with tissue destruction. May cause allergic skin reaction. Harmful if swallowed. Potential reproductive hazard. May cause birth defects. May cause damage to internal organs.

##### Medical Attention and Special Treatment

**Notes to Physician** Treat symptomatically

#### 5. Fire Fighting Measures

##### Suitable extinguishing equipment

##### **Suitable Extinguishing Media**

Carbon dioxide, dry chemical, foam.

##### **Extinguishing media which must not be used for safety reasons**

None known.

##### Specific hazards arising from the chemical

##### **Special exposure hazards in a fire**

May be ignited by heat, sparks or flames Use water spray to cool fire exposed surfaces. Closed containers may explode in fire. Decomposition in fire may produce harmful gases. Runoff to sewer may cause fire or explosion hazard.

##### Special protective equipment and precautions for fire fighters

##### **Special protective equipment for firefighters**

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

#### 6. Accidental release measures

##### 6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment. Wear self-contained breathing apparatus in enclosed areas.

##### 6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

##### 6.3. Methods and material for containment and cleaning up

Isolate spill and stop leak where safe. Remove ignition sources and work with non-sparking tools. Contain spill with sand or other inert materials. Scoop up and remove.

#### 7. Handling and storage

**7.1. Precautions for safe handling****Handling Precautions**

Wash hands after use. Launder contaminated clothing before reuse. Ground and bond containers when transferring from one container to another. Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Avoid breathing mist.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

**7.2. Conditions for safe storage, including any incompatibilities****Storage Information**

Store away from oxidizers. Keep from heat, sparks, and open flames. Keep container closed when not in use.

**Other Guidelines**

No information available

<b>8. Exposure Controls/Personal Protection</b>
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**Control parameters - exposure standards, biological monitoring****Exposure Limits**

Substances	CAS Number	Australia NOHSC	ACGIH TLV-TWA
Terpene hydrocarbon by-products	68956-56-9	Not applicable	Not applicable
Methanol	67-56-1	TWA: 200 ppm TWA: 262 mg/m <sup>3</sup> STEL: 250 ppm STEL: 328 mg/m <sup>3</sup>	TWA: 200 ppm STEL: 250 ppm
Coco diethanolamide	Proprietary	Not applicable	Not applicable
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides	68391-01-5	Not applicable	Not applicable
Nonylphenol ethoxylate	Proprietary	Not applicable	Not applicable
Linanool	Proprietary	Not applicable	Not applicable
2,6-Octadien-1-ol, 3,7-dimethyl-, (2Z)-	106-25-2	Not applicable	Not applicable
2,6-Octadien-1-ol, 3,7-dimethyl-, (2E)-	106-24-1	Not applicable	Not applicable
Citronellol	106-22-9	Not applicable	Not applicable
Isopropanol	67-63-0	TWA: 400 ppm TWA: 983 mg/m <sup>3</sup> STEL: 500 ppm STEL: 1230 mg/m <sup>3</sup>	TWA: 200 ppm STEL: 400 ppm

**Appropriate engineering controls****Engineering Controls**

Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.

**Personal protective equipment (PPE)****Personal Protective Equipment**

If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

**Respiratory Protection**

If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Positive pressure self-contained breathing apparatus if methanol is released.

**Hand Protection**

Use gloves which are suitable for the chemicals present in this product as well as other environmental factors in the workplace. Manufacturer's directions for use should be observed because of great diversity of types.

**Skin Protection**

Rubber apron.

**Eye Protection**

Chemical goggles; also wear a face shield if splashing hazard exists.

**Other Precautions**

Eyewash fountains and safety showers must be easily accessible.

**Environmental Exposure Controls**

No information available

## 9. Physical and Chemical Properties

### 9.1. Information on basic physical and chemical properties

**Physical State:** Liquid  
**Odor:** Alcohol  
**Color:** Straw  
**Odor Threshold:** No information available

<u>Property</u>	<u>Values</u>
<u>Remarks/ - Method</u>	
<b>pH:</b>	No data available
<b>Freezing Point / Range</b>	-29 °C
<b>Melting Point / Range</b>	No data available
<b>Boiling Point / Range</b>	No data available
<b>Flash Point</b>	30 °C / 86 °F PMCC
<b>Evaporation rate</b>	No data available
<b>Vapor Pressure</b>	No data available
<b>Vapor Density</b>	No data available
<b>Specific Gravity</b>	0.99
<b>Water Solubility</b>	Soluble in water
<b>Solubility in other solvents</b>	No data available
<b>Partition coefficient: n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	No data available
<b>Decomposition Temperature</b>	No data available
<b>Viscosity</b>	No data available
<b>Explosive Properties</b>	No information available
<b>Oxidizing Properties</b>	No information available

### 9.2. Other information

**VOC Content (%)** No data available

## 10. Stability and Reactivity

### 10.1. Reactivity

Not expected to be reactive.

### 10.2. Chemical stability

Stable

### 10.3. Possibility of hazardous reactions

Will Not Occur

### 10.4. Conditions to avoid

Keep away from heat, sparks and flame.

### 10.5. Incompatible materials

Strong oxidizers.

### 10.6. Hazardous decomposition products

Carbon monoxide and carbon dioxide.

## 11. Toxicological Information

### Information on routes of exposure

**Principle Route of Exposure** Eye or skin contact, inhalation.

### Symptoms related to exposure

#### Most Important Symptoms/Effects

Causes severe eye irritation which may damage tissue. Causes severe skin irritation with tissue destruction. May cause allergic skin reaction. Harmful if swallowed. Potential reproductive hazard. May cause birth defects. May cause damage to internal organs.

### Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Terpene hydrocarbon by-products	68956-56-9	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rat)	No data available



Methanol	67-56-1	300 mg/kg-bw (human) < 790 to 13,000 mg/kg (rat)	1000 mg/kg-bw (human) 17,100 mg/kg (rabbit)	10 mg/L (human, 4h, vapor)
Coco diethanolamide	Proprietary	>5000 mg/kg-bw (rat)	>2000 mg/kg-bw (rabbit)	No data available
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides	68391-01-5	340.5 mg/kg-bw (Rat)	1420 mg/kg-bw (Rat)	No data available
Nonylphenol ethoxylate	Proprietary	1310 mg/kg (Rat)	> 2000 mg/kg (Rabbit) (similar substance)	No data available
Linanol	Proprietary	2790 mg/kg ( Rat )	5610 mg/kg ( Rat )	> 3.2 mg/L (Rat, 4 h, aerosol)
2,6-Octadien-1-ol, 3,7-dimethyl-, (2Z)-	106-25-2	4500 mg/kg ( Rat )	> 5000 mg/kg (Rabbit)	No data available
2,6-Octadien-1-ol, 3,7-dimethyl-, (2E)-	106-24-1	3600 mg/kg (Rat)	> 5000 mg/kg (Rabbit)	No data available
Citronellol	106-22-9	3450 mg/kg (rat)	2650 mg/kg (rabbits)	No information available
Isopropanol	67-63-0	5840 mg/kg-bw (rat)	12870 mg/kg-bw (rabbit)	72.6 mg/L (Rat, 4h, vapor)

**Immediate, delayed and chronic health effects from exposure****Inhalation**

May cause respiratory irritation. May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.

**Eye Contact**

Causes severe eye irritation

**Skin Contact**

Causes severe skin irritation with tissue destruction. May cause an allergic skin reaction.

**Ingestion**

Harmful if swallowed. May cause headache, dizziness, nausea, vomiting, gastrointestinal irritation and central nervous system depression. Ingestion may result in blindness. Aspiration can be a hazard if this material is swallowed.

**Chronic Effects/Carcinogenicity** No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

**Exposure Levels**

No data available

**Interactive effects**

Eye ailments. Skin disorders.

**Data limitations**

No data available

Substances	CAS Number	Skin corrosion/irritation
Terpene hydrocarbon by-products	68956-56-9	Causes moderate skin irritation. (Rabbit)
Methanol	67-56-1	Non-irritating to the skin (Rabbit)
Coco diethanolamide		Irritating to skin. (Rabbit)
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides	68391-01-5	Causes severe skin irritation with tissue destruction. (Rabbit)
Nonylphenol ethoxylate		Irritating to skin. (similar substances)
Linanol		Causes moderate skin irritation. (Rabbit)
2,6-Octadien-1-ol, 3,7-dimethyl-, (2Z)-	106-25-2	Causes skin irritation.
2,6-Octadien-1-ol, 3,7-dimethyl-, (2E)-	106-24-1	Causes moderate skin irritation.
Citronellol	106-22-9	Causes moderate skin irritation. (Rabbit)
Isopropanol	67-63-0	Non-irritating to the skin (Rabbit)

Substances	CAS Number	Serious eye damage/irritation
Terpene hydrocarbon by-products	68956-56-9	Causes moderate eye irritation (Rabbit) (similar substances)
Methanol	67-56-1	Non-irritating to the eye (Rabbit)
Coco diethanolamide		Causes severe eye irritation (Rabbit) (similar substances)
Quaternary ammonium compounds,	68391-01-5	Causes severe eye irritation which may damage tissue. (Rabbit)

benzyl-C12-18-alkyldimethyl, chlorides		
Nonylphenol ethoxylate		Irritating to eyes (similar substances)
Linanool		Causes moderate eye irritation (Rabbit)
2,6-Octadien-1-ol, 3,7-dimethyl-, (2Z)-	106-25-2	Causes severe eye irritation
2,6-Octadien-1-ol, 3,7-dimethyl-, (2E)-	106-24-1	Causes severe eye irritation which may damage tissue.
Citronellol	106-22-9	Causes moderate eye irritation (Rabbit)
Isopropanol	67-63-0	Causes moderate eye irritation (Rabbit)

Substances	CAS Number	Skin Sensitization
Terpene hydrocarbon by-products	68956-56-9	May cause an allergic skin reaction. (mouse) (similar substances)
Methanol	67-56-1	Did not cause sensitization on laboratory animals (guinea pig)
Coco diethanolamide		Did not cause sensitization on laboratory animals (guinea pig)
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides	68391-01-5	Did not cause sensitization on laboratory animals (guinea pig) (similar substances)
Nonylphenol ethoxylate		Did not cause sensitization on laboratory animals (guinea pig) (similar substances)
Linanool		Patch test on human volunteers did not demonstrate irritating properties
2,6-Octadien-1-ol, 3,7-dimethyl-, (2Z)-	106-25-2	May cause sensitization by skin contact (guinea pig) (mouse)
2,6-Octadien-1-ol, 3,7-dimethyl-, (2E)-	106-24-1	May cause sensitization by skin contact (mouse)
Citronellol	106-22-9	May cause sensitization by skin contact (mouse)
Isopropanol	67-63-0	Did not cause sensitization on laboratory animals (guinea pig)

Substances	CAS Number	Respiratory Sensitization
Terpene hydrocarbon by-products	68956-56-9	No information available
Methanol	67-56-1	No information available
Coco diethanolamide		No information available
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides	68391-01-5	No information available
Nonylphenol ethoxylate		No information available
Linanool		No information available
2,6-Octadien-1-ol, 3,7-dimethyl-, (2Z)-	106-25-2	No information available
2,6-Octadien-1-ol, 3,7-dimethyl-, (2E)-	106-24-1	No information available
Citronellol	106-22-9	No information available
Isopropanol	67-63-0	No information available

Substances	CAS Number	Mutagenic Effects
Terpene hydrocarbon by-products	68956-56-9	In vitro tests did not show mutagenic effects
Methanol	67-56-1	The weight of evidence from available in vitro and in vivo studies indicates that this substance is not expected to be mutagenic.
Coco diethanolamide		In vitro tests did not show mutagenic effects Some in vivo tests have shown mutagenic effects.
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides	68391-01-5	In vitro tests did not show mutagenic effects (similar substances)
Nonylphenol ethoxylate		In vitro tests did not show mutagenic effects (similar substances)
Linanool		In vitro tests did not show mutagenic effects In vivo tests did not show mutagenic effects.
2,6-Octadien-1-ol, 3,7-dimethyl-, (2Z)-	106-25-2	In vitro tests did not show mutagenic effects In vivo tests did not show mutagenic effects. (similar substances)
2,6-Octadien-1-ol, 3,7-dimethyl-, (2E)-	106-24-1	In vitro tests did not show mutagenic effects In vivo tests did not show mutagenic effects.
Citronellol	106-22-9	In vitro tests did not show mutagenic effects In vivo tests did not show mutagenic effects.
Isopropanol	67-63-0	In vitro tests did not show mutagenic effects. In vivo tests did not show mutagenic effects.

Substances	CAS Number	Carcinogenic Effects
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Terpene hydrocarbon by-products	68956-56-9	Did not show carcinogenic effects in animal experiments (similar substances)
Methanol	67-56-1	No data of sufficient quality are available.
Coco diethanolamide		No data of sufficient quality are available.
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides	68391-01-5	Did not show carcinogenic effects in animal experiments (similar substances)
Nonylphenol ethoxylate		Did not show carcinogenic effects in animal experiments (similar substances)
Linanool		No data of sufficient quality are available.
2,6-Octadien-1-ol, 3,7-dimethyl-, (2Z)-	106-25-2	Did not show carcinogenic effects in animal experiments (similar substances)
2,6-Octadien-1-ol, 3,7-dimethyl-, (2E)-	106-24-1	Did not show carcinogenic effects in animal experiments (similar substances)
Citronellol	106-22-9	Did not show carcinogenic effects in animal experiments (similar substances)
Isopropanol	67-63-0	Did not show carcinogenic effects in animal experiments

Substances	CAS Number	Reproductive toxicity
Terpene hydrocarbon by-products	68956-56-9	Did not show teratogenic effects in animal experiments. (similar substances)
Methanol	67-56-1	Experiments have shown reproductive toxicity effects on laboratory animals
Coco diethanolamide		Did not show teratogenic effects in animal experiments.
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides	68391-01-5	Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments. (similar substances)
Nonylphenol ethoxylate		Not a confirmed teratogen or embryotoxin. (similar substances)
Linanool		Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments.
2,6-Octadien-1-ol, 3,7-dimethyl-, (2Z)-	106-25-2	Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments. (similar substances)
2,6-Octadien-1-ol, 3,7-dimethyl-, (2E)-	106-24-1	Animal testing did not show any effects on fertility.
Citronellol	106-22-9	Animal testing did not show any effects on fertility. Did not show teratogenic effects in animal experiments.
Isopropanol	67-63-0	Animal testing did not show any effects on fertility.

Substances	CAS Number	STOT - single exposure
Terpene hydrocarbon by-products	68956-56-9	No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)
Methanol	67-56-1	May cause disorder and damage to the Central Nervous System (CNS)
Coco diethanolamide		No significant toxicity observed in animal studies at concentration requiring classification.
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides	68391-01-5	No data of sufficient quality are available.
Nonylphenol ethoxylate		No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)
Linanool		No data of sufficient quality are available.
2,6-Octadien-1-ol, 3,7-dimethyl-, (2Z)-	106-25-2	May cause respiratory irritation.
2,6-Octadien-1-ol, 3,7-dimethyl-, (2E)-	106-24-1	May cause respiratory irritation.
Citronellol	106-22-9	No information available
Isopropanol	67-63-0	May cause headache, dizziness, and other central nervous system effects.

Substances	CAS Number	STOT - repeated exposure
Terpene hydrocarbon by-products	68956-56-9	No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)
Methanol	67-56-1	No data of sufficient quality are available.
Coco diethanolamide		No data of sufficient quality are available.
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides	68391-01-5	No data of sufficient quality are available.
Nonylphenol ethoxylate		No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)

Linanool		No significant toxicity observed in animal studies at concentration requiring classification.
2,6-Octadien-1-ol, 3,7-dimethyl-, (2Z)-	106-25-2	No significant toxicity observed in animal studies at concentration requiring classification.
2,6-Octadien-1-ol, 3,7-dimethyl-, (2E)-	106-24-1	No significant toxicity observed in animal studies at concentration requiring classification.
Citronellol	106-22-9	No significant toxicity observed in animal studies at concentration requiring classification.
Isopropanol	67-63-0	No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)

Substances	CAS Number	Aspiration hazard
Terpene hydrocarbon by-products	68956-56-9	Aspiration into the lungs may cause chemical pneumonitis including coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal.
Methanol	67-56-1	Not applicable
Coco diethanolamide		Not applicable
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides	68391-01-5	Not applicable
Nonylphenol ethoxylate		Not applicable
Linanool		Not applicable
2,6-Octadien-1-ol, 3,7-dimethyl-, (2Z)-	106-25-2	Not applicable
2,6-Octadien-1-ol, 3,7-dimethyl-, (2E)-	106-24-1	Not applicable
Citronellol	106-22-9	Not applicable
Isopropanol	67-63-0	Not applicable

## 12. Ecological Information

### Ecotoxicity

#### Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Terpene hydrocarbon by-products	68956-56-9	ErC50 (72h) 4.779 mg/L (Pseudokirchnerella subcapitata) EC50 (72h) 63.59 mg/L (Skeletonema costatum)	LC50 (96h) 5.07 mg/L (Danio rerio) LC50 (96h) > 65 mg/L (Cyprinodon variegatus)	No information available	EL50 (48h) 1.4 - 2.7 mg/L (Daphnia magna) EC50 (48h) 155 mg/L (Acartia tonsa)
Methanol	67-56-1	EC50 (96 h) =22000 mg/L (Pseudokirchnerella subcapitata) NOEC (8 d) =8000 mg/L (Scenedesmus quadricauda)	LC50 (96 h) =15400 mg/L (Lepomis macrochirus) EC50 (200 h) =14536 mg/L (Oryzias latipes)	IC50 (3h) > 1000 mg/L (activated sludge)	EC50 (96 h) =18260 mg/L (Daphnia magna) NOEC (21 d) =208 mg/L (Daphnia magna)
Coco diethanolamide	Proprietary	EC50(72h) 2.2 mg/L (Scenedesmus subspicatus)	LC50(96h) 3.6 mg/L (Brachydanio rerio) NOEC(28d)=0.32 mg/L (Oncorhynchus mykiss)	No information available	EC50(48h) 2.25 mg/L (Ceriodaphnia dubia) NOEC(21d) 0.07 mg/L (Daphnia magna)
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides	68391-01-5	No information available	LC50 (96 h) 0.515 mg/L (Lepomis macrochirus)	No information available	EC50 (48 h) 0.092 mg/L (Mysidopsis bahia) NOEC (34 d) 0.032 mg/L (Daphnia magna)
Nonylphenol ethoxylate	Proprietary	EC50 (48h) 15 mg/L (Lemna minor) EC50 (48h) 17 mg/L (Scenedesmus quadricauda)	LC50 (48h) 16.4 mg/L (Poecilia reticulata)	No information available	LC50 (48h) 18.2 mg/L (Daphnia magna)
Linanool	Proprietary	EC50(96h): 88.3 mg/L (Desmodesmus subspicatus)	LC50(96h): 27.8 mg/L (Oncorhynchus mykiss)	EC50(3h): > 100 mg/L (activated sludge, domestic)	No information available
2,6-Octadien-1-ol, 3,7-dimethyl-, (2Z)-	106-25-2	ErC50(72h): 9.54 mg/L (Pseudokirchnerella subcapitata)	LC50(96h): 20.3 mg/L (Danio rerio)	EC50(3h): 241 mg/L (activated sludge)	EC50(48h): 32.4 mg/L (Daphnia magna)
2,6-Octadien-1-ol, 3,7-dimethyl-, (2E)-	106-24-1	EC50(72h): 13.1 mg/L (Desmodesmus subspicatus)	LC50(96h): 22 mg/L (Danio rerio)	EC50(30m): 70 mg/L (Activated sludge)	EC50(48h): 10.8 mg/L (Daphnia magna)

Citronellol	106-22-9	EC50 (72 h) 2.4 mg/L (Scenedesmus subspicatus)	LC50 (96 h) 14.66 mg/L (Leuciscus idus)	No information available	EC50 (48 h) 17.48 mg/L (Daphnia magna)
Isopropanol	67-63-0	EC50 (72h) > 1000 mg/L (Desmodesmus subspicatus) EC50 (7d) 1800 mg/L (Scenedesmus quadricauda)	LC50 (96h) 9640 mg/L (Pimephales promelas) LC50 (7d) 7060 mg/L (Poecilia reticulata)	TT (16h) 1050 mg/L (Pseudomonas putida)	EC50 (48h) 13,299 mg/L (Daphnia magna) EC50 (24h) > 10,000 mg/L (Daphnia magna)

### 12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Terpene hydrocarbon by-products	68956-56-9	Readily biodegradable (83% @ 28d)
Methanol	67-56-1	Readily biodegradable (95% @ 20d)
Coco diethanolamide	Proprietary	Readily biodegradable (92.5% @ 28d)
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides	68391-01-5	Readily biodegradable (60% @ 15d)
Nonylphenol ethoxylate	Proprietary	No information available
Linanol	Proprietary	Readily biodegradable (62.4% @ 28d)
2,6-Octadien-1-ol, 3,7-dimethyl-, (2Z)-	106-25-2	Readily biodegradable (90% @ 28d)
2,6-Octadien-1-ol, 3,7-dimethyl-, (2E)-	106-24-1	Readily biodegradable (94% @ 28d)
Citronellol	106-22-9	Readily biodegradable (80 - 90% @ 28d)
Isopropanol	67-63-0	Readily biodegradable (53% @ 5d)

### 12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Terpene hydrocarbon by-products	68956-56-9	5.7
Methanol	67-56-1	Not Bioaccumulative; BCF=1
Coco diethanolamide	Proprietary	Not Bioaccumulative; BCF=65.4 L/kg (similar substance)
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides	68391-01-5	LogKow 3.91
Nonylphenol ethoxylate	Proprietary	3.93 BCF: 7.6 - 16 (Oryzias latipes)
Linanol	Proprietary	2.84
2,6-Octadien-1-ol, 3,7-dimethyl-, (2Z)-	106-25-2	2.76
2,6-Octadien-1-ol, 3,7-dimethyl-, (2E)-	106-24-1	2.6
Citronellol	106-22-9	log Kow =3.55
Isopropanol	67-63-0	0.05

### 12.4. Mobility in soil

Substances	CAS Number	Mobility
Terpene hydrocarbon by-products	68956-56-9	No information available
Methanol	67-56-1	No information available
Coco diethanolamide	Proprietary	No information available
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides	68391-01-5	No information available
Nonylphenol ethoxylate	Proprietary	No information available
Linanol	Proprietary	No information available
2,6-Octadien-1-ol, 3,7-dimethyl-, (2Z)-	106-25-2	KOC = 94.15 L/kg
2,6-Octadien-1-ol, 3,7-dimethyl-, (2E)-	106-24-1	KOC = 70.79
Citronellol	106-22-9	KOC = 70.79
Isopropanol	67-63-0	No information available

### 12.6. Other adverse effects

#### Endocrine Disruptor Information

This product contains ethoxylated nonylphenols

## 13. Disposal Considerations

**Safe handling and disposal methods**

Disposal should be made in accordance with federal, state, and local regulations.

**Disposal of any contaminated packaging**

Follow all applicable national or local regulations.

**Environmental regulations**

Not applicable

## 14. Transport Information

**Transportation Information****Australia ADG**

<b>UN Number</b>	UN1993
<b>UN proper shipping name:</b>	Flammable Liquid, N.O.S. (Contains Methanol, Terpenes)
<b>Transport Hazard Class(es):</b>	3
<b>Packing Group:</b>	III
<b>Environmental Hazards:</b>	Marine Pollutant

**IMDG/IMO**

<b>UN Number</b>	UN1993
<b>UN proper shipping name:</b>	Flammable Liquid, N.O.S. (Contains Methanol, Terpenes)
<b>Transport Hazard Class(es):</b>	3
<b>Packing Group:</b>	III
<b>Environmental Hazards:</b>	Marine Pollutant
<b>EMS:</b>	EmS F-E, S-E

**IATA/ICAO**

<b>UN Number</b>	UN1993
<b>UN proper shipping name:</b>	Flammable Liquid, N.O.S. (Contains Methanol, Terpenes)
<b>Transport Hazard Class(es):</b>	3
<b>Packing Group:</b>	III
<b>Environmental Hazards:</b>	Marine Pollutant

**Special precautions during transport**

None

**HazChem Code**

•3Y

## 15. Regulatory Information

**Safety, health and environmental regulations specific for the product****International Inventories**

<b>Australian AICS Inventory</b>	All components are listed on the AICS or are subject to a relevant exemption, permit, or assessment certificate.
<b>New Zealand Inventory of Chemicals</b>	All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.
<b>EINECS (European Inventory of Existing Chemical Substances)</b>	This product, and all its components, complies with EINECS
<b>US TSCA Inventory</b>	All components listed on inventory or are exempt.
<b>Canadian Domestic Substances List (DSL)</b>	All components listed on inventory or are exempt.

**Poisons Schedule number**

S6

**International Agreements**

<b>Montreal Protocol - Ozone Depleting Substances:</b>	Does not apply
<b>Stockholm Convention - Persistent Organic Pollutants:</b>	Does not apply

**Rotterdam Convention - Prior Informed Consent:**  
**Basel Convention - Hazardous Waste:**

Does not apply  
Does not apply

## 16. Other information

### Date of preparation or review

**Revision Date:** 11-Apr-2017

### **Revision Note**

Update to Format

SECTION:

2

### **Full text of H-Statements referred to under sections 2 and 3**

H225 - Highly flammable liquid and vapor

H226 - Flammable liquid and vapor

H301 - Toxic if swallowed

H302 - Harmful if swallowed

H304 - May be fatal if swallowed and enters airways

H311 - Toxic in contact with skin

H312 - Harmful in contact with skin

H314 - Causes severe skin burns and eye damage

H315 - Causes skin irritation

H317 - May cause an allergic skin reaction

H318 - Causes serious eye damage

H319 - Causes serious eye irritation

H331 - Toxic if inhaled

H335 - May cause respiratory irritation

H336 - May cause drowsiness or dizziness

H360 - May damage fertility or the unborn child

H370 - Causes damage to organs

H371 - May cause damage to organs

H400 - Very toxic to aquatic life

H410 - Very toxic to aquatic life with long lasting effects

H411 - Toxic to aquatic life with long lasting effects

### **Additional information**

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

### **Key abbreviations or acronyms used**

bw – body weight

CAS – Chemical Abstracts Service

EC50 – Effective Concentration 50%

LC50 – Lethal Concentration 50%

LD50 – Lethal Dose 50%

LL50 – Lethal Loading 50%

mg/kg – milligram/kilogram

mg/L – milligram/liter

NOEC – No Observed Effect Concentration

OEL – Occupational Exposure Limit

PBT – Persistent Bioaccumulative and Toxic

ppm – parts per million

STEL – Short Term Exposure Limit

TWA – Time-Weighted Average

vPvB – very Persistent and very Bioaccumulative

h - hour

mg/m<sup>3</sup> - milligram/cubic meter

mm - millimeter

mmHg - millimeter mercury

w/w - weight/weight

d - day

**Key literature references and sources for data**

[www.ChemADVISOR.com/](http://www.ChemADVISOR.com/)

**Disclaimer Statement**

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

**End of Safety Data Sheet**



**APPENDIX C**

**Tables**





Table C1. Chemical mass balance and estimated concentrations in typical hydraulic fracturing fluids

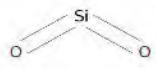


Name For Report	CAS Number	HighTempAcid				DFS-BCG (H)				DFS-BCG				Deltafrac (H)			
		Constituent Weight in Fluid (lbs)	Additive mass percent (ignores Proppant and Makeup Water)	Additive Mass Percent (total)	Equivalent Concentration (mg/L) **50,000gal**	Constituent Weight in Fluid (lbs)	Additive mass percent (ignores Proppant and Makeup Water)	Additive Mass Percent (total)	Equivalent Concentration (mg/L) **50,000gal**	Constituent Weight in Fluid (lbs)	Additive mass percent (ignores Proppant and Makeup Water)	Additive Mass Percent (total)	Equivalent Concentration (mg/L) **50,000gal**	Constituent Weight in Fluid (lbs)	Additive mass percent (ignores Proppant and Makeup Water)	Additive Mass Percent (total)	Equivalent Concentration (mg/L) **50,000gal**
Polyethylene Glycol	23322-68-3																
<b>Proppants</b>																	
Aluminum silicate	1302-76-7				70000	0.0000%	13.05286%		70000	0.0000%	13.06251%		70000	0.0000%	29.44439%		
Aluminum oxide	1344-28-1				20000	0.0000%	3.72939%		20000	0.0000%	3.73215%		20000	0.0000%	8.41268%		
Crystalline silica, quartz	14808-60-7				10000	0.0000%	1.86469%		10000	0.0000%	1.86607%		10000	0.0000%	4.20634%		
Iron oxide	1309-37-1				5000	0.0000%	0.92235%		5000	0.0000%	0.93304%		5000	0.0000%	2.10317%		
Titanium dioxide	13463-07-7				3000	0.0000%	0.55941%		3000	0.0000%	0.55982%		3000	0.0000%	1.26190%		
Crystalline silica, cristobalite	14464-46-1				2000	0.0000%	0.37294%		2000	0.0000%	0.37321%		2000	0.0000%	0.84127%		
<b>Water</b>																	
Water in additives	7732-18-5	1191.123095	63.77932%	0.361669552	2907.10740	38.98566%	0.54209%		2861.57598	40.53186%	0.53399%		974.56017	43.85064%	0.40993%		
Make Up water	No Cas Number	1425.832073		42.1480%	418824.17550		78.09789%		418824.73147		78.15574%		125513.83314		52.79540%		
<b>Total Mass Additives</b>	lbs	676.446475			4549.7567				4198.490144				1247.893695				
Total Mass Proppant		0			110000				110000				110000				
Total Mass Water (in additives)		1191.123095			2907.10740				2861.57598				974.56017				
Total Mass Make Up Water		1425.832073			418824.17550				418824.7315				125513.83314				
<b>Total Mass Additives</b>	kg	307			2064				1904				566				
Total Mass Proppant		0			49895				49895				49895				
Total Mass Water (in additives)		540			1319				1298				442				
Total Mass Make Up Water		647			189975				189976				56932				
<b>Total Mass Additives</b>	%	20.5%			0.8%				0.8%				0.5%				
Total Mass Proppant		0.0%			20.5%				20.5%				46.3%				
Total Mass Water (in additives)		36.2%			0.5%				0.5%				0.4%				
Total Mass Make Up Water		43.3%			78.1%				78.2%				52.8%				
		1840.985759			12382.40955				11426.41857				3396.210352				
		122.7323839			825.4939698				761.7612379				226.4140235				
		736.3943035			4952.963819				4570.567427				1358.484141				



**APPENDIX D**

# Human Health Hazard Summary

Name	Silica gel
Synonyms	Precipitated silica; amorphous silica
CAS number	112926-00-8
Molecular formula	O <sub>2</sub> -Si
Molecular structure	

Overview	References
<p>Silica gel is part of a larger group of chemicals referred to as synthetic amorphous silica (SAS) registered under the overarching CAS No 7631-86-9.</p> <p>SAS (including silica gels) are white, fluffy and/or powdery amorphous forms of silicon dioxide (silica, SiO<sub>2</sub>). It has a molecular weight of 60.08g/mol, a density of 2.2 at 20°C and a melting point of approximately 1700 °C.</p> <p>Commercialised since the 1950s, SAS are used in a wide variety of industrial applications and they are usually tailor-made to meet the users' requirements. Main uses of SAS include reinforcement and thickening agent in various systems such as elastomers, resins, inks and water for instance. Due to their high porosity, SAS is also used as an adsorbing agent. SAS is also used in consumers' products such as cosmetics, pharmaceuticals and foods.</p> <p>SAS have been studied less than crystalline silica. They are generally less toxic than crystalline silica and are cleared more rapidly from the lung. Furthermore, amorphous silica is chemically and biologically inert when ingested in any of its many physical forms such as amorphous siliceous earth (diatomaceous earth, diatomite, kieselguhr) or colloidal <b>silica gels</b>. This explains why overall it is not considered as hazardous to humans. The human health toxicity information discussed below is based on SAS.</p>	<p>ECETOC (2006);</p> <p>IARC (1997);</p> <p>SIDS (2004);</p> <p>Gosselin <i>et al.</i>(1984)</p>

Human Health Toxicity Summary	Reference
<p><b>Carcinogenicity</b></p> <p>IARC rating for silica, amorphous (CAS No 7631-86-9): Group 3 (<i>Amorphous silica is not classifiable as to its carcinogenicity to humans</i>)</p> <p>The evaluations for amorphous silica pertain to inhalation resulting from workplace exposures. Very little epidemiological evidence was available to the Working Group. No association was detected for mesothelioma with biogenic amorphous silica fibres in the three community-based case-control studies. Separate analyses were not performed for cancer risks among a subset of diatomaceous earth industry workers exposed predominantly to amorphous silica.</p> <p>There is inadequate evidence in humans for the carcinogenicity of amorphous silica.</p>	IARC (2018)
<p><b>Mutagenicity/Genotoxicity</b></p> <p>No mutations were observed when SAS was tested in <i>in vitro</i> and <i>in vivo</i> standard methods. No evidence for mutagenic activity was found in an ex-vivo gene-mutation assays on isolated alveolar type-II cells after long-term inhalation exposure of rats to a distinctly noxious/inflammatory SAS concentration of 50 mg/m<sup>3</sup> (13 weeks).</p>	SIDS (2004)
<p><b>Reproductive Toxicity</b></p> <p>The reproductive toxicity properties of SAS were assessed with a one-generation on rats where animals were fed SAS at a dose of 500 mg/kg bw/day for a premating period of 4.5 months with continued exposure up to 6 months. While no adverse effects were observed, however, it was reported that the study had some shortcomings regarding the low number of pregnant animals used and that the mating ratio was too low according to current standards.</p>	SIDS (2004)
<p><b>Developmental Toxicity/Teratogenicity</b></p> <p>The potential for developmental effects of SAS were assessed in a comprehensive and reliable testing programme where various animal species (rat, mouse, rabbit, and hamster) were administered SAS orally at doses up to 1600 mg/kg bw/day. No significant signs of maternal or developmental toxic effects were observed in any species tested. Abnormalities noted in soft or skeletal tissues of the test groups were comparable to the frequencies occurring in the control groups. The NOEL for maternal and developmental toxicity was reported as the highest tested dose of 1600 mg/kg bw/d.</p>	FDA (1972, 1973a,b) as cited in SIDS (2004)
<p><b>Endocrine Disruption</b></p> <p>Not listed as an endocrine disruptor.</p>	EC (2000)
<p><b>Neurotoxicity</b></p> <p>NDF</p>	



<p><b>Acute Toxicity (oral, dermal or inhalation)</b></p> <p>SAS (aqueous suspension or gel) administered orally (gavage or in diet) and dermally did not cause mortality at the highest doses tested. LD<sub>50</sub> values ranged from &gt; 3100 to &gt; 20000 mg/kg in rats and mice. One study established an oral LD<sub>50</sub> for rats to be &gt; 10000 mg/kg bw. Based on a rabbit study, a dermal LD<sub>50</sub> &gt; 5000 mg/kg bw was established for rabbits.</p> <p>No clinically or pathologically meaningful effects were observed after 4-hour exposure of rats to either pyrogenic or precipitated SAS. However, in the study where animals were exposed to precipitated SAS, signs of some discomfort and stress were observed and body weight of females was retarded for two days post-exposure.</p>	<p>SIDS (2004)</p>
<p><b>Chronic/repeat dose toxicity (oral, dermal, inhalation)</b></p> <p><i>Oral</i></p> <p>The chronic toxic effects of silica gel were assessed in a rat study. In this study, animals received an amorphous silica gel (Syloid 244) at dietary levels of 3.2 and 10% for 6 months, corresponding to average doses of 2170 to 2420 mg/kg bw/day and 7950 to 8980 mg/kg bw/day respectively. No adverse effects were observed. Isolated pathological findings were assessed to be unrelated to dosing and common in untreated rats. The microscopic examination did not show any changes in the kidneys or reproductive organs.</p> <p><i>Dermal</i></p> <p>No information was found regarding the chronic toxicity of silica gel or SAS via the dermal route.</p> <p><i>Inhalation</i></p> <p>No evidence of pneumoconiosis or silicosis was observed in occupational exposures to SAS. Other disorders of the respiratory tract could not be correlated to exposure to SAS alone. However, it is noted that the available epidemiological data base on workers is too limited to be able to draw firm conclusions.</p>	<p>Grace (1975) as cited in SIDS (2004);  SIDS (2004)</p>
<p><b>Sensitisation of the skin or respiratory system</b></p> <p>There are no experimental data available on sensitisation. There is no evidence of skin sensitisation in workers over decades of practical experience.</p>	<p>SIDS (2004)</p>
<p><b>Corrosion (irreversible)/irritation (reversible) effects on the skin or eye</b></p> <p><b>Effects on skin</b></p> <p>Based on experimental data, SAS is not irritating to rabbit skin. However, it is noted that cases of dryness or degenerative eczema of the skin in workers with chronic contact have been reported by occupational physicians.</p> <p>When tested on the rabbit eye as a powder, SAS showed no or only weak and non-permanent irritating effects on the conjunctivae but neither the iris nor the cornea were affected.</p>	<p>SIDS (2004)</p>

Physical Hazards	Reference
<b>Flammable Potential</b> Non flammable solid.	SIDS (2004)
<b>Explosive Potential</b> Not classified as an explosive substance.	SIDS (2004)

Toxicity Values	Value	Reference
<b>Human Toxicity Data</b>		
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEC	NDF	
LOAEL	NDF	
<b>Animal Toxicity Data</b>		
<i>Acute Toxicity</i>		
<i>LD<sub>50</sub></i>		
Rat, oral (gavage)	> 3100 to > 20000 mg/kg (aqueous suspension and gel SAS)	SIDS (2004)
Mouse, oral	> 3100 to > 20000 mg/kg (aqueous suspension and gel SAS)	SIDS (2004)
Rabbit, oral	NDF	
Rat, dermal	NDF	
Rabbit, dermal	> 5000 mg/kg (precipitated SAS)	SIDS (2004)
Mouse, dermal	NDF	
<i>LC<sub>50</sub></i>		
Rat	>0.14 - >2.0 mg/l (pyrogenic and precipitated SAS)	SIDS (2004)

<b>High Chronic/Repeat Dose Toxicity</b>		
LOAEL	NDF	
LOAEC	5 mg/m <sup>3</sup> (precipitated and gel SAS)	SIDS (2004)

Footnotes:

- LD<sub>50</sub> – lethal dose for 50% of experimental population
- LC<sub>50</sub> – lethal air concentration for 50% of experimental population
- LOAEL – Lowest Observed Adverse Effect Level
- LOAEC – Lowest Observed Adverse Effect Concentration
- NDF – No data found within the limits of the search strategy

Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Band 4</b>		
Carcinogenicity (IARC Group 1 or 2A)	No	IARC Group 3 – inadequate evidence to classify
Mutagenicity/Genotoxicity (GHS Category 1A and 1B)	No	SIDS, 2004
Reproductive Toxicity/Developmental toxicity (GHS Category 1, 1A and 1B)	No	Based on a study with some limitations (SIDS, 2004)
Endocrine Disruption <sup>1</sup>	No	EC, 2000
<b>Hazard Band 3</b>		
Carcinogenicity (IARC Group 2B)	No	
Mutagenicity/Genotoxicity (GHS Category 2)	No	SIDS, 2004
Reproductive Toxicity/Developmental toxicity (GHS Category 2)	No	Based on a study with some limitations (SIDS, 2004)
Acute Toxicity (oral, dermal or inhalation)  Very Toxic/Toxic <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> ≤ 300 mg/kg<sup>2</sup></li> <li>• dermal LD<sub>50</sub> ≤ 1000 mg/kg</li> <li>• inhalation LC<sub>50</sub> ≤ 10 mg/L<sup>3</sup> (or mg/m<sup>3</sup>) (vapour)</li> </ul>	No	SIDS, 2004
High Chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL ≤ 10 mg/kg/d<sup>2</sup>;</li> <li>• dermal LOAEL ≤ 20 mg/kg/d;</li> <li>• inhalation LOAEC (6 h/d) ≤ 50 ppm/d for gases, ≤ 0.2 mg/L/d for vapours or ≤ 0.02 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	No	SIDS (2004)
Corrosive (irreversible effect)	No	SIDS (2004)

Human Health Toxicity Ranking		
	Hazard data	Comment
Respiratory sensitiser	No	Based on widespread exposure and few reports of allergic responses.
<b>Hazard Band 2</b>		
Harmful chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL &gt; 10 mg/kg/d and ≤ 100 mg/kg/d</li> <li>• dermal LOAEL &gt; 20 mg/kg/d and ≤ 200 mg/kg/d</li> <li>• inhalation (6-h/d) LOAEC               <ul style="list-style-type: none"> <li>&gt; 50 mg/L ≤ 250 mg/L/d for gases,</li> <li>&gt; 0.2 mg/L ≤ 1.0 mg/L/d for vapours or</li> <li>&gt; 0.02 mg/L ≤ 0.2 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul> </li> </ul>	No	SIDS (2004)
Skin Sensitiser	No	Based on widespread exposure and few reports of allergic responses.
<b>Hazard Band 1</b>		
Acute Toxicity-Harmful <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> &gt; 300 mg/kg ≤ 2000 mg/kg</li> <li>• dermal LD<sub>50</sub> &gt; 1 000 mg/kg ≤ 2000 mg/kg;</li> <li>• inhalation LC<sub>50</sub> (6 h/d) &gt; 10 mg/L ≤ 20 mg/L for vapours)<sup>3</sup></li> </ul>	No	SIDS (2004)
Irritant (reversible effect)	No	SIDS (2004)
<b>Hazard Band 0</b>		
<b>All indicators outside criteria listed in Hazards 1-4</b>		
<b>Physical Hazards</b>		
Flammable potential	No	SIDS (2004)
Explosive potential	No	SIDS (2004)
<b>Hazard Evaluation (highest band) not including physical hazards</b>	<b>0</b>	

Human Health Toxicity Ranking		
	Hazard data	Comment
Data confidence (available points out of 12 parameters)	12/12	83%

\* Based on IMAP Framework [NICNAS (2013) Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework. National Industrial Chemicals Notification and Assessment Scheme. Department of Health and Aging, Canberra].

<sup>1</sup> Based on list of endocrine disrupting chemicals from the European Commission's Endocrine Disruptors website.

<sup>2</sup> milligrams per kilogram body mass (mg/kg) or milligrams per kilogram body mass per day (mg/kg/d)

<sup>3</sup> Based on GHS cut-offs for hazard classification. For chronic/repeat dose toxicity, GHS cut-offs are provided as guidance values (i.e. the dose/concentration at or below which significant health effects are observed)". (p 18, NICNAS 2013).

Human Health Guidelines		
Media	Concentration (mg/m <sup>3</sup> ; mg/L; mg/kg)	Reference
<b>Occupational Exposure Limits</b>		
<b>Air (OEL)</b>		
8-h TWA	10 mg/m <sup>3</sup>	Work Safe Australia (2020)
STEL	NDF	
Peak Limitation	NDF	
<b>Environmental Exposure</b>		
<b>Air</b> , ambient, residential	NDF	
<b>Air</b> , commercial/industrial	NDF	
<b>Water</b> , potable	NDF	
<b>Water</b> , recreational	NDF	

<b>Soil, residential</b>	NDF	
<b>Soil, commercial/industrial</b>	NDF	
<b>Soil, protection of groundwater</b>	NDF	

Footnotes:

OEL = Occupational Exposure Limit

TWA = 8 h Time-Weighted Average

STEL = (15 min) Short-term Exposure Limit

## Qualifying Summary Comments

Silica gel is a type of synthetic amorphous silica (SAS). Amorphous silica has been studied less than crystalline silica as they are generally less toxic than crystalline silica and are cleared more rapidly removed from the lung. It is noted that although effects on the lung have been observed at high concentrations these have been reversible following cessation of exposure. Amorphous silica is chemically and biologically inert when ingested in any of its many physical forms such as amorphous siliceous earth (diatomaceous earth, diatomite, kieselguhr) or colloidal silica gels and is not classifiable as to its carcinogenicity to humans. SAS is not considered as having acute or chronic health effects when administered via oral, dermal and inhalation exposure pathways nor as having any reproductive, development/teratogenicity and mutagenicity/genotoxicity effects. SAS is not classified as a skin sensitiser nor does it cause irreversible irritation of the skin or eye. For this reason it is categorized as Hazard Band 0. WorkSafe Australia has listed amorphous silica as a hazardous substance under the respective legislation and developed an exposure standard for amorphous silica dust which is the generic standard for dusts. Due to its low solubility, amorphous silica in aqueous solution and as introduced during chemical stimulation activities would settle into soils and sediments and become indistinguishable from those materials. The principle hazard is subsequently the generation of dusts under occupational settings which require management.

## References

EC (2000) Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption, preparation of a candidate list of substances as a basis for priority setting, Final Report. European Commission. (Incorporating corrigenda to final report dated 21 June 2000).

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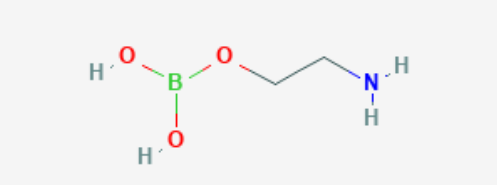
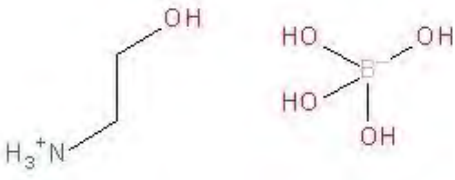
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SIDS (2004) Organization for Economic Cooperation and Development (OECD) Screening Information Dataset (SIDS) Initial Assessment Report as maintained by United Nations Environment Programme (UNEP) Chemicals . Available at [https://hpvchemicals.oecd.org/UI/SIDS\\_Details.aspx?key=7dc69270-2300-4a87-af67-8962ad98a749&idx=0](https://hpvchemicals.oecd.org/UI/SIDS_Details.aspx?key=7dc69270-2300-4a87-af67-8962ad98a749&idx=0). [Accessed 7 January 2020].

Created by:	LPA	Date: 18/12/2019
Reviewed by:	CLB	Date and Revision: 23/01/2020



Name	Monoethanolamine borate
Synonyms	Ethanolamine borate; boric acid, 2-aminoethyl ether; 2-Aminoethanol, monoester with boric acid; MEA borate; MEA polyborate
CAS number	26038-87-9
Molecular formula	C <sub>2</sub> H <sub>8</sub> BNO <sub>3</sub>
Molecular structure	 <p>(Source: U.S. NLM, 2020)</p>
Surrogate	<p>Limited data was found for monoethanolamine borate. Therefore, Reaction products of monoethanolamine and boric acid (1:1) (CAS RN: 94095-04-2) has been adopted as a surrogate.</p> <p>Molecular formula: C<sub>2</sub>H<sub>7</sub>NO.xBH<sub>3</sub>O<sub>3</sub></p>  <p>(Source: ECHA, 2020)</p> <p>In addition, NICNAS provides a group assessment for 'Salts of boric acid'. This group assessment considered 28 different salts of boric acid (metals, ammoniums and amines) of which CAS RN 26038-87-9 is one (NICNAS, 2017). The basis for this grouping outlined by NICNAS is that boric acid is expected to drive the toxicity of these chemicals, even though the individual cations, anions and organic acids may vary in toxicological properties.</p>

Overview	References
<p>Reaction products of monoethanolamine and boric acid (1:1) is a clear, pale yellow solution (at 20°C and 1013 hPa), that only exists in aqueous solution. The freezing/melting point and boiling point are likely to be similar to that of water, noting the presence of the compound in solution would slightly depress the melting point and elevate the boiling point. The relative density was measured to be 1.270 g/cm<sup>3</sup> (at 20°C) and it is considered to be infinitely soluble in water. The vapour pressure is reported to</p>	<p>ECHA, 2020 and NICNAS, 2017</p>

<p>be &lt; 0 Pa at 20°C and 25°C. Reaction products of monoethanolamine and boric acid (1:1) is used in chemical manufacturing and is found in liquid and granular fertilisers, lubricant additives, lubricants and greases, in metal working fluids and hydraulic fluids. NICNAS report uses from CAS RN. 26038-87-9 internationally include cosmetic uses as a buffering agent and commercial uses in metal working fluids.</p> <p>Reaction products of monoethanolamine and boric acid (1:1) is considered readily biodegradable and is considered to have a low potential for adsorb to soil. Based on a logKow of &lt;3, it is also considered to have a low potential for bioaccumulation. Following oral exposure, simple inorganic borates are readily and completely absorbed in humans and animals. Absorption via the dermal route is expected to be very low. As the substance is a liquid and has a negligible vapour pressure, the potential for inhalation exposure of vapours is considered low. However, inhalation absorption is assumed to be high, as a worst-case scenario. If absorbed, the substance will likely be circulated by the blood to the liver and other tissues. Being hydrophilic, it is unlikely to be absorbed by cells of the organs and tissues, except for the kidney. NICNAS outlines that for compounds within the salts of boric acid group, undissociated boric acid is the main species likely present in mammalian blood following exposure. This is based on studies for simple inorganic borates, such as boric acid and borax. Once absorbed, it is likely the substance will be excreted rapidly via the kidneys and non-absorbed substance will be excreted in faeces. Boric acid has a half-life of &lt;24 hours in humans and animals.</p>	
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Human Health Toxicity Summary	Reference
<p><b>Carcinogenicity</b></p> <p>Monoethanolamine borate or reaction products of monoethanolamine and boric acid (1:1) have not been evaluated by the International Agency for Research on Cancer (IARC) as to their carcinogenicity.</p> <p>Although there is limited data to assess carcinogenicity, NICNAS conclude that chemicals in this group are not likely to be carcinogenic based on data for surrogate compounds,</p>	<p>ECHA, 2020</p> <p>NICNAS, 2017</p>
<p><b>Mutagenicity/Genotoxicity</b></p> <p>Reaction products of monoethanolamine and boric acid (1:1) is not classifiable as mutagenic, based on available data.</p> <p>The key study cited by ECHA is an <i>in vitro</i> gene mutation study in bacteria, undertaken in accordance with OECD Guideline 471 and GLP compliant. The test system included Salmonella typhimurium bacteria and Escherichia coli bacteria. Results of this study were negative, and the substance was found to be not mutagenic to the cells tested.</p> <p>NICNAS also conclude that chemicals in this group are not likely to have mutagenic or genotoxic potential, based on available information for surrogate compounds.</p>	<p>ECHA, 2020</p>
<p><b>Reproductive Toxicity</b></p> <p>Data is currently not available to assess reproductive toxicity of Reaction products of monoethanolamine and boric acid (1:1) (or Reaction products of monoethanolamine and boric acid (1:3) as a read-across compound).</p>	<p>ECHA, 2020</p>

<p>Safe Work Australia (2020) has classified Monoethanolamine borate as Category 1B for reproductive and developmental toxicity (H360FD May damage fertility. May damage the unborn child). This is based on the classification of sodium borate, anhydrous (CAS No. 1330-43-4), tetraboron disodium heptaoxide, hydrate (CAS No. 12267-73-1) and orthoboric acid, sodium salt (CAS No. 13840-56-7) as Category 1B and the recommendation by NICNAS to extent this classification to the group ('salts of boric acid').</p> <p>NICNAS outline that the testes and the developing foetus have been identified as the most sensitive targets of boron toxicity in animal studies. Testicular effects reported include reduced organ weight and organ:body ratio, atrophy and degeneration of the spermatogenic epithelium, impaired spermatogenesis and reduced fertility. Two-year and three-year generational studies in rats, determined the NOAEL for fertility of 100 mg/kg bw/day of boric acid (equivalent to 17.5 mg boron/kg bw/day), based on testicular effects.</p>	<p>Safe Work Australia (2020) and NICNAS, 2017.</p>
<p><b>Developmental Toxicity/Teratogenicity</b></p> <p>Data is currently not available to assess developmental toxicity of Reaction products of monoethanolaimne and boric acid (1:1) (or Reaction products of monoethanolaimne and boric acid (1:3) as a read-across compound).</p> <p>As discussed above, Safe Work Australia (2020) has classified Monoethanolamine borate as Category 1B for reproductive and developmental toxicity (H360FD May damage fertility. May damage the unborn child).</p> <p>NICNAS outline that the testes and the developing foetus have been identified as the most sensitive targets of boron toxicity in animal studies. Developmental effects reported include high prenatal mortality, reduced foetal body weight and malformations and variations of the eyes, CNS, cardiovascular system and axial skeleton. A NOAEL for developmental effects of 55 mg/kg bw/day of boric acid (equivalent to 9.6 mg boron/kg bw/day) was reported for rats.</p>	<p>ECHA, 2020</p> <p>Safe Work Australia (2020)</p>
<p><b>Endocrine Disruption</b></p> <p>Monoethanolamine borate or Reaction products of monoethanolaimne and boric acid (1:1) are not identified in the European Commission (EC)'s report, "Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption" as a substance of interest.</p>	<p>EC, 2000</p>
<p><b>Acute Toxicity (oral, dermal, inhalation)</b></p> <p>Reaction products of monoethanolaimne and boric acid (1:1) is not classifiable based on its acute oral or dermal toxicity, based on the available data.</p> <p>The key acute <b>oral</b> toxicity study referenced found a LD<sub>50</sub> (female) of &gt; 2000 mg/kg bw for rats. The study was undertaken in accordance with OECD Guideline 423 and was GLP compliant. The study involved female rats being administered a single dose of the test item via gavage, with dose being 5, 50, 300 and 2000 mg/kg body weight.</p> <p>The key acute <b>dermal</b> study referenced found a LD<sub>50</sub> of &gt;2000 mg/kg bw. The study was undertaken in accordance with OECD Guideline 402 and was GLP compliant. The study involved male and female rats being exposure to a single dose of 2000 mg/kg bw, via occlusive coverage.</p>	<p>ECHA, 2020</p>

<p>No study was available to assess acute toxicity via the inhalation route of exposure.</p> <p>NICNAS outlines that these compounds are expected to have low acute oral, dermal and inhalation toxicity. However, this is based on read-across substances due to limited data. NICNAS outlines that free amines (as in compounds with 2-aminoethanol) may be acutely toxic. This is based on studies which suggests free amines can induce acute toxicity by way of their strong alkalinity, which causes corrosive effects such as severe local damage to the gastrointestinal tract. However, the cations of these amines are not basic and do not have corrosive potential, or corresponding acute toxicity.</p>	<p>NICNAS, 2017</p>
<p><b>Chronic/repeat dose toxicity (oral, dermal, inhalation)</b></p> <p>Data is currently not available to assess chronic/ repeat dose toxicity of Reaction products of monoethanolamine and boric acid (1:1) (or Reaction products of monoethanolamine and boric acid (1:3) as a read-across compound).</p> <p>NICNAS also outline that there is no data available to assess the oral, dermal or inhalation repeat dose toxicity of these chemicals. However, based on surrogate compounds, it is considered that chemical in this group are not likely to cause serious damage to health from repeated oral exposure.</p>	<p>ECHA, 2020</p> <p>NICNAS, 2017</p>
<p><b>Sensitisation of the skin or respiratory system</b></p> <p>Reaction products of monoethanolamine and boric acid (1:1) is not classifiable based on skin sensitisation, based on a read-across approach and a study available for reaction products of monoethanolamine and boric acid (1:3).</p> <p>The key study references concluded that reaction products of monoethanolamine and boric acid (1:3) was practically devoid of potential to cause sensitisation in a guinea pig skin sensitisation study undertaken in accordance with OECD Guideline 406.</p> <p>No data is available to assess the respiratory system sensitisation.</p> <p>NICNAS concludes that based on the available information for surrogates, chemicals in this group are not likely to be skin sensitisers.</p>	<p>ECHA, 2020</p> <p>NICNAS, 2017</p>
<p><b>Corrosion (irreversible)/irritation (reversible) effects on the skin or eye</b></p> <p>Reaction products of monoethanolamine and boric acid (1:1) is not classifiable based on <b>skin</b> irritation, as the substance is considered not irritating to the skin, as outline by ECHA.</p> <p>The key skin irritation/corrosion study referenced is a study on rabbits, where the rabbits were exposed to for 4 hours with semiocclusive coverage and observed for 72 hours after patch removal. The substance was found to be not irritating.</p> <p>Reaction products of monoethanolamine and boric acid (1:1) is not classifiable based on <b>eye</b> irritation, as the substance is considered not irritating or corrosive to the eyes, as outlined by ECHA.</p> <p>The key eye irritation study presented is a Bovine Corneal Opacity and Permeability test. The substance was tested by topical application for approximately 10 minutes and study concluded that the substance did not induce ocular irritation under the experimental conditions.</p> <p>NICNAS considered this group unlikely to be specific <b>skin</b> or <b>respiratory</b> irritants, based on the limited data available, Slight <b>eye</b> irritant effects were reported in animal studies for surrogate compounds,</p>	<p>ECHA, 2020</p>

however, the effects were not sufficient to warrant a hazard classification for the chemicals in this group.	NICNAS, 2017.
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Physical Hazards	Reference
<b>Flammable Potential</b> Non flammable. A study reports that the substance did not flash below the boiling temperature of water.	ECHA, 2020
<b>Explosive Potential</b> Non explosive. Reaction products of monoethanolamine and boric acid (1:1) does not contain functional groups associated with explosive properties.	ECHA, 2020

Toxicity Values	Value	Reference
<b>Human Toxicity Data</b>		
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEC	NDF	
LOAEL	NDF	
<b>Animal Toxicity Data</b>		
<i>Acute Toxicity</i>		
<i>LD<sub>50</sub></i>		
Rat, oral	LD <sub>50</sub> (female) > 2000 mg/kg bw	Cited by ECHA, 2020
Rat, dermal	LD <sub>50</sub> >2000 mg/kg bw	Cited by ECHA, 2020
<i>LC<sub>50</sub></i>		
Rat	NDF	
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEL	NDF	
LOAEC	NDF	

Toxicity Values	Value	Reference
NOAEL	Developmental effects (rats): 55 mg/kg bw/day boric acid (equivalent to 9.6 mg boron/kg bw/day)  Fertility, testicular effects (rats): 100 mg/kg bw/day boric acid (equivalent to 17.5 mg boron/kg bw/day)	Cited by NICNAS, 2017

Footnotes:

LD<sub>50</sub> – lethal dose for 50% of experimental population

LC<sub>50</sub> – lethal air concentration for 50% of experimental population

LOAEL – Lowest Observed Adverse Effect Level

LOAEC – Lowest Observed Adverse Effect Concentration

NDF – No data found within the limits of the search strategy

Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Band 4</b>		
Carcinogenicity (IARC Group 1 or 2A)	No	
Mutagenicity/Genotoxicity (GHS Category 1A and 1B)	No	
Reproductive Toxicity/Developmental toxicity (GHS Category 1, 1A and 1B)	Yes	Category 1B for reproductive and developmental toxicity (H360FD May damage fertility. May damage the unborn child).
Endocrine Disruption <sup>1</sup>	No	
<b>Hazard Band 3</b>		
Carcinogenicity (IARC Group 2B)	No	
Mutagenicity/Genotoxicity (GHS Category 2)	No	
Reproductive Toxicity/Developmental toxicity (GHS Category 2)	-	See above
Acute Toxicity (oral, dermal or inhalation)  Very Toxic/Toxic <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> ≤ 300 mg/kg<sup>2</sup></li> <li>• dermal LD<sub>50</sub> ≤ 1000 mg/kg</li> <li>• inhalation LC<sub>50</sub> ≤ 10 mg/L<sup>3</sup> (or mg/m<sup>3</sup>) (vapour)</li> </ul>	No	

Human Health Toxicity Ranking		
	Hazard data	Comment
High Chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL <math>\leq 10</math> mg/kg/d<sup>2</sup>;</li> <li>• dermal LOAEL <math>\leq 20</math> mg/kg/d;</li> <li>• inhalation LOAEC (6 h/d) <math>\leq 50</math> ppm/d for gases, <math>\leq 0.2</math> mg/L/d for vapours or <math>\leq 0.02</math> mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	NDF	
Corrosive (irreversible effect)	No	
Respiratory sensitiser	NDF	
<b>Hazard Band 2</b>		
Harmful chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL <math>&gt; 10</math> mg/kg/d and <math>\leq 100</math> mg/kg/d</li> <li>• dermal LOAEL <math>&gt; 20</math> mg/kg/d and <math>\leq 200</math> mg/kg/d</li> <li>• inhalation (6-h/d) LOAEC <math>&gt; 50</math> mg/L <math>\leq 250</math> mg/L/d for gases, <math>&gt; 0.2</math> mg/L <math>\leq 1.0</math> mg/L/d for vapours or <math>&gt; 0.02</math> mg/L <math>\leq 0.2</math> mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	NDF	
Skin Sensitiser	No	
<b>Hazard Band 1</b>		
Acute Toxicity-Harmful <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> <math>&gt; 300</math> mg/kg <math>\leq 2000</math> mg/kg</li> <li>• dermal LD<sub>50</sub> <math>&gt; 1000</math> mg/kg <math>\leq 2000</math> mg/kg;</li> <li>• inhalation LC<sub>50</sub> (6 h/d) <math>&gt; 10</math> mg/L <math>\leq 20</math> mg/L for vapours)<sup>3</sup></li> </ul>	No	
Irritant (reversible effect)	No	
<b>Hazard Band 0</b> <b>All indicators outside criteria listed in Hazards 1-4</b>		
<b>Physical Hazards</b>		
Flammable potential	No	

Human Health Toxicity Ranking		
	Hazard data	Comment
Explosive potential	No	
<b>Hazard Evaluation (highest band) not including physical hazards</b>	4	Based on potential reproductive and developmental toxicity of salts of boric acid.
<b>Data confidence (available points out of 12 parameters)</b>	10/12	83%

\* Based on IMAP Framework [NICNAS (2013) Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework. National Industrial Chemicals Notification and Assessment Scheme. Department of Health and Aging, Canberra].

<sup>1</sup> Based on list of endocrine disrupting chemicals from the European Commission's Endocrine Disruptors website.

<sup>2</sup> milligrams per kilogram body mass (mg/kg) or milligrams per kilogram body mass per day (mg/kg/d)

<sup>3</sup> Based on GHS cut-offs for hazard classification. For chronic/repeat dose toxicity, GHS cut-offs are provided as guidance values (i.e. the dose/concentration at or below which significant health effects are observed)". (p 18, NICNAS 2013).

Human Health Guidelines		
Media	Concentration (mg/m <sup>3</sup> ; mg/L; mg/kg)	Reference
<b>Occupational Exposure Limits</b>		
<b>Air (OEL)</b>		
8-h TWA	NDF	
STEL	NDF	
Peak Limitation	NDF	
<b>Environmental Exposure</b>		
<b>Air, ambient, residential</b>	NDF	
<b>Air, commercial/industrial</b>	NDF	



Human Health Guidelines		
Water, potable	NDF	
Water, recreational	NDF	
Soil, residential	NDF	
Soil, commercial/industrial	NDF	
Soil, protection of groundwater	NDF	

Footnotes:

OEL = Occupational Exposure Limit

TWA = 8 h Time-Weighted Average

STEL = (15 min) Short-term Exposure Limit

### Qualifying Summary Comments

Reaction products of monoethanolamine and boric acid is a clear, pale yellow solution. It is expected to have similar freezing points and boiling points of water. The substance is used in chemical manufacturing and is found in cosmetics, liquid and granular fertilisers, lubricant additives, lubricants and greases, in metal working fluids and hydraulic fluids. It is readily biodegradable and considered to have a low potential for bioaccumulation. Following oral exposure, simple inorganic borates are readily and completely absorbed in humans and animals. Once absorbed, undissociated boric acid is the main species likely present in mammalian blood and it is likely the substance will be excreted rapidly via the kidneys. Boric acid has a half-life of <24 hours in humans and animals.

Reaction products of monoethanolamine and boric acid has been ranked as Hazard Band 4, based on potential reproductive and developmental toxicity, Safe Work Australia (2020) has classified Monoethanolamine borate as Category 1B for reproductive and developmental toxicity (H360FD May damage fertility. May damage the unborn child). This is based on the classification of sodium borate, anhydrous (CAS No. 1330-43-4), tetraboron disodium heptaoxide, hydrate (CAS No. 12267-73-1) and orthoboric acid, sodium salt (CAS No. 13840-56-7) as Category 1B and the recommendation by NICNAS to extend this classification to the group ('salts of boric acid'). Reaction products of monoethanolamine and boric acid are considered to have low acute and repeat dose toxicity, are unlikely to be carcinogenic or mutagenic, and do not appear to be irritating to the skin or eyes.

### References

European Chemicals Agency (ECHA), 2019. *Registration Dossier for Reaction products of monoethanolamine and boric acid (1:1)*. Available at <https://echa.europa.eu/registration-dossier/-/registered-dossier/14325/1>. Last modified 11/12/2019, accessed January 2020.

European Commission (EC), 2000. *Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption, preparation of a candidate list of substances as a basis for priority setting, Final Report* (Incorporating corrigenda to final report dated 21 June 2000).

International Agency for Research on Cancer (IARC), 2019. Agents Classified by the IARC Monographs, Volumes 1–125, last updated 29 November, 2019. Available at <https://monographs.iarc.fr/agents-classified-by-the-iarc/>, accessed December 2019.

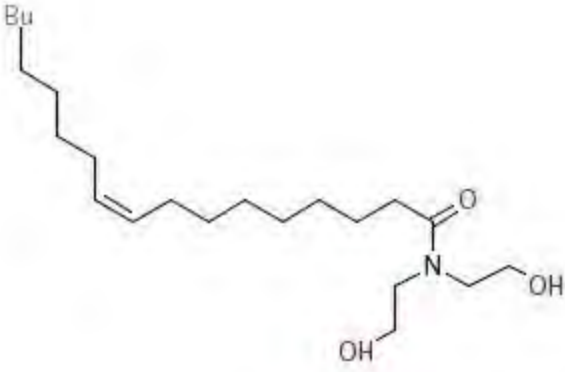
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Safe Work Australia. HCIS (Hazardous Chemical Information System) 2020. *Hazardous Chemical Information System: MEA polyborate*. <http://hcis.safeworkaustralia.gov.au/HazardousChemical/Details?chemicalID=4838>, accessed January 2020.

U.S. National Library of Medicine (U.S. NLM), 2020. PubChem Compound Summary dossier for Monoethanolamine borate. Available at <https://pubchem.ncbi.nlm.nih.gov/compound/Monoethanolamine-borate>, accessed January 2020.

Created by:	MGT	Date: 03 February 2020
Reviewed by:	CLB	Date and Revision: 13 February 2020

[https://golderassociates.sharepoint.com/sites/117999/project files/6 deliverables/report 014/appendix e - human health summaries/19133367 hh\\_26038-87-9\\_monoethanolamine borate.docx](https://golderassociates.sharepoint.com/sites/117999/project%20files/6%20deliverables/report%20014/appendix%20e%20-%20human%20health%20summaries/19133367%20hh_26038-87-9_monoethanolamine_borate.docx)

Name	Amides, tall-oil fatty, N,N-bis(hydroxyethyl)
Synonyms	Diethanolamine tall oil acid amide; Tall oil fatty acid diethanolamide; Tallamide DEA; N,N-Bis(2-hydroxyethyl)tall oil fatty amides
CAS number	68155-20-4
Molecular formula	Unspecified
Molecular structure	Unspecified
Surrogate	<p>Name: Oleamide, N,N-bis(2-hydroxyethyl)-; Amides, C18-unsatd., N,N-bis(hydroxyethyl). CAS RN: 93-83-4</p> <p>Basis for adoption: Limited information available for CAS RN: 68155-20-4. U.S. EPA's Analog Identification Methodology (AIM) Tool software program identified CAS RN: 93-83-4 as an exact chemical match (U.S. EPA, 2019).</p>
Molecular formula (surrogate)	C <sub>22</sub> H <sub>43</sub> NO <sub>3</sub>
Molecular structure (surrogate)	 <p>(Source: ECHA, 2019)</p>

Overview	References
<p>Amides, C18-unsatd., N,N-bis(hydroxyethyl) is a brown liquid (at 20°C and 1013 hPa) with a density of 0.967 g/cm<sup>3</sup> (at 20°C). It has a freezing point of &lt;-80°C and is reported to decomposes before boiling at &gt; 300°C. Modelling suggests a water solubility between 0.12 mg/L and 2.17 mg/L at 25°C.</p>	ECHA, 2019

Overview	References
<p>Amides, C18-unsatd., N,N-bis(hydroxyethyl) has numerous industrial and consumer uses, including in washing and cleaning products, in polymer manufacturing, textile treatment products and dyes, adhesives and sealants, lubricants and grease, pH regulators and water treatment products, and plant protection products. Household use of products containing this compound include machine wash liquids/detergents, automotive care products, paints and coating or adhesives, fragrances and air fresheners.</p> <p>The ECHA dossier identifies amides, C18-unsatd., N,N-bis(hydroxyethyl) as having low bioaccumulation potential. Studies on a surrogate compound, N,N-bis(2-hydroxyethyl)dodecanamide (C12 DEA) report that the substance is well absorbed via the oral route (approximately 50% oral absorption), then metabolised to polar metabolites and excreted principally in urine. A toxicokinetic study on a surrogate compound, N,N-bis(2-hydroxyethyl)dodecanamide (C12 DEA), reported that this substance was rapidly converted into 11- and 12- hydroxy derivatives in rat liver and kidney microsomes. The ECHA dossier also outlines dermal absorption of approximately 10% and inhalation of as 100% (data lacking).</p>	<p>ECHA, 2019</p>

Human Health Toxicity Summary	Reference
<p><b>Carcinogenicity</b></p> <p>Amides, C18-unsatd., N,N-bis(hydroxyethyl) (both CAS RN 93-83-4 and 68155-20-4) has not been evaluated by the International Agency for Research on Cancer (IARC) as to its carcinogenicity.</p> <p>The ECHA dossier outlines that no carcinogenic classification is warranted, according to CLP (EC 1272/2008) criteria. This is based on the results of a chronic dermal study in rats, where the absence of neoplastic lesions or carcinogenic activity in a chronic bioassay in rodents suggested that the test substance does not have carcinogenic potential.</p>	<p>IARC, 2019</p> <p>ECHA, 2019</p>
<p><b>Mutagenicity/Genotoxicity</b></p> <p>The ECHA dossier did not classify amides, C18-unsatd., N,N-bis(hydroxyethyl) (and a surrogate compound) as genotoxic, based on negative results in short-term <i>in vitro</i> and <i>in vivo</i> genotoxicity test.</p> <p>An <i>in vitro</i> gene mutation study in mammalian cells cited on the ECHA dossier was performed in compliance with GLP. The study investigated the potential of the test substance to induce mutations at the mouse lymphoma thymidine kinase locus using the cell line L5178Y. The substance was tested under several conditions and the assess was performed both with and without rat liver microsomal (S9) activation. The results reported no increase in the frequency of mutant colonies of the cells after exposure to the test substance, based on the conditions of the study. Two <i>in vitro</i> gene mutation studies in bacteria were also cited on the ECHA dossier. Both studies report negative results, indicating the test substance is not mutagenic in the Salmonella typhimurium reverse mutation assay and the E.coli reverse mutation assay. An <i>in vivo</i> mammalian germ cell study cited in the ECHA dossier also reported negative results, with the test substance not increasing the frequency of micronucleated normochromatic erythrocytes (NCE) in peripheral blood of both male and female mice at the end of 13 weeks.</p>	<p>ECHA, 2019</p>

<p><b>Reproductive Toxicity</b></p> <p>The ECHA dossier outlines that there were no studies available to assess effects on fertility for exposure to amides, C18-unsatd., N,N-bis(hydroxyethyl) via the oral, dermal, and inhalation routes.</p>	ECHA, 2019
<p><b>Developmental Toxicity/Teratogenicity</b></p> <p>The ECHA dossier does not provide a developmental toxicity classification for amides, C18-unsatd., N,N-bis(hydroxyethyl). The ECHA dossier does cite a developmental toxicity study undertaken on a surrogate substance, being amides, C12-18 and C18-unsatd. N,N-bis (hydroxyethyl). The study assessed embryonic and foetal development in pregnant Sprague-Dawley CD rats according to OECD Guideline 414. During gestation days 6 to 15 inclusive, the substance was administered to groups of 30 female rats by gavage at does levels of 0, 100, 300 and 1,000 mg/kg bw/day. Observations were made on days 0, 6, 16 and 20, with all surviving females sacrificed on gestation day 20 and the fetuses removed by caesarean section. The NOAELs for parental toxicity and developmental toxicity were considered to be 1,000 mg/kg bw/day (the highest dose level), under the study conditions.</p>	ECHA, 2019
<p><b>Endocrine Disruption</b></p> <p>Amides, C18-unsatd., N,N-bis(hydroxyethyl) (both CAS RN 93-83-4 and 68155-20-4) is not identified in the European Commission (EC)'s report, "Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption" as a substance of interest.</p>	EC, 2000
<p><b>Acute Toxicity (oral, dermal, inhalation)</b></p> <p>Amides, C18-unsatd., N,N-bis(hydroxyethyl) is reported to have low acute <b>oral</b> toxicity, with a LD<sub>50</sub> reported as 10 000 mg/kg/bw in a rat study. Groups of 6 male rats were administered 0, 5 000, 10 000 and 20 000 mg/kg/bw of the test substance by gavage and the animals were observed for 14 d. The ECHA dossier outlines that GHS criteria were not met by the study.</p> <p>An acute <b>dermal</b> exposure LD<sub>50</sub> of &gt; 2 000 mg/kg/bw was established in a study of male and female rabbits. Information provided by ECHA outlines a 24 h exposure duration, exposure at one dose of 2 000 mg/kg/bw and that 3 animals with abraded skin and 3 animals with intact skin were exposed.</p> <p>No data available for exposure via the <b>inhalation</b> pathway.</p>	ECHA, 2019
<p><b>Chronic/repeat dose toxicity (oral, dermal, inhalation)</b></p> <p>The ECHA dossier concludes that amides, C18-unsatd., N,N-bis(hydroxyethyl) does not meet the requirement for repeated dose toxicity classification according to CLP (EC1272/2008) criteria. This was based on the NOAEL of &gt; 750 mg/kg bw/day derived from an oral sub-acute study in rats and observed effected in a chronic dermal study in rats, where the NOAEL was 50 mg/kg bw/day for systemic effects and LOAEL of 50 mg/kg bw/day for local effects.</p> <p>The oral 28-day sub-acute study in groups of 10 male and 10 female rats was undertaken with a surrogate substance, amides, C12-18 (even numbered) and C18-unsaturated, N,N-bis(hydroxyethyl). No treatment-related effects were reported at any of the dose levels tested. The dermal 2-year chronic study in groups of 50 male and 50 female rats was undertaken on the test substance.</p>	ECHA, 2019

<p><b>Sensitisation of the skin or respiratory system</b></p> <p>A skin sensitising potential test undertaken on a surrogate compound, amides, C16-18 and C18-unsatd., N,N-bis(hydroxyethyl), cited by the ECHA dossier, found the test substance to not be sensitising to the skin. The test comprised at guinea-pig maximisation test, according to OECD Guideline 406.</p> <p>There was no study available to assess the respiratory sensitisation of the substance.</p>	<p>ECHA, 2019</p>
<p><b>Corrosion (irreversible)/irritation (reversible) effects on the skin or eye</b></p> <p>The ECHA dossier concludes that, based on the available data, amides, C18-unsatd., N,N-bis(hydroxyethyl) is considered irritating to both skin and eyes. ECHA classifies the substance as Skin Irrit. 2 H315 (causes skin irritation) and Eye Irrit. 2 H319 (causes serious eye irritation).</p> <p>A skin irritation study is cited, where 0.5 mL of undiluted substance was applied to 6 rabbits (with one abraded area and one area of intact skin), with the exposure period being 24 hours. Observations were made at 24h and 72 h, with moderate to severe erythema and defined edema observed at 24 h and moderate to severe erythema and moderate edema observed at 72 h on the abraded and intact rabbit skin.</p> <p>An eye irritation study is cited, where 0.1 mL of the undiluted substance was applied in a single instillation into one eye of each of the six rabbits, with the other eye acting as the control. Observations were made at 24 hr, 48 hr, 72 hr, 7 d and 14 d. The study cites that irritation (chemosis and discharge) reduced to almost 0 by day 14, with the exception of conjunctival redness, which was the most prominent response and was present in 3/6 animals.</p>	<p>ECHA, 2019</p>

Physical Hazards	Reference
<b>Flammable Potential</b> Flash point of 218°C at 1019 hPa.	ECHA, 2019
<b>Explosive Potential</b> No data available. No chemical groups present in the molecule that are associated with explosive properties.	ECHA, 2019

Toxicity Values	Value	Reference
<b>Human Toxicity Data</b>		
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEC	NDF	
LOAEL	NDF	
<b>Animal Toxicity Data</b>		
<i>Acute Toxicity</i>		
<i>LD<sub>50</sub></i>		
Rat, oral	LD <sub>50</sub> : 10 000 mg/kg/bw	Cited by ECHA, 2019
Rabbit, dermal	LD <sub>50</sub> : > 2 000 mg/kg/bw	Cited by ECHA, 2019
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEL	LOAEL (dermal, rats, local effects): 50 mg/kg bw/day	Cited by ECHA, 2019
NOAEL	NOAEL (oral, sub-acute, rats): > 750 mg/kg bw/day NOAEL (dermal, rats, systemic effects): 50 mg/kg bw/day NOAEL (oral, rat, developmental and parental toxicity): 1,000 mg/kg bw/day	Cited by ECHA, 2019

**Footnotes:**

LD<sub>50</sub> – lethal dose for 50% of experimental population

LOAEL – Lowest Observed Adverse Effect Level

NOAEL – No Observed Adverse Effect Level

NDF – No data found within the limits of the search strategy

Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Band 4</b>		
Carcinogenicity (IARC Group 1 or 2A)	No	
Mutagenicity/Genotoxicity (GHS Category 1A and 1B)	No	
Reproductive Toxicity/Developmental toxicity (GHS Category 1, 1A and 1B)	No	
Endocrine Disruption <sup>1</sup>	No	
<b>Hazard Band 3</b>		
Carcinogenicity (IARC Group 2B)	No	
Mutagenicity/Genotoxicity (GHS Category 2)	No	
Reproductive Toxicity/Developmental toxicity (GHS Category 2)	No	
Acute Toxicity (oral, dermal or inhalation)  Very Toxic/Toxic <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> ≤ 300 mg/kg<sup>2</sup></li> <li>• dermal LD<sub>50</sub> ≤ 1000 mg/kg</li> <li>• inhalation LC<sub>50</sub> ≤ 10 mg/L<sup>3</sup> (or mg/m<sup>3</sup>) (vapour)</li> </ul>	No	
High Chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL ≤ 10 mg/kg/d<sup>2</sup>;</li> <li>• dermal LOAEL ≤ 20 mg/kg/d;</li> <li>• inhalation LOAEC (6 h/d) ≤ 50 ppm/d for gases, ≤ 0.2 mg/L/d for vapours or ≤ 0.02 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	No	
Corrosive (irreversible effect)	No	
Respiratory sensitiser	-	
<b>Hazard Band 2</b>		



Human Health Toxicity Ranking		
	Hazard data	Comment
Harmful chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>oral LOAEL &gt; 10 mg/kg/d and ≤ 100 mg/kg/d</li> <li>dermal LOAEL &gt; 20 mg/kg/d and ≤ 200 mg/kg/d</li> <li>inhalation (6-h/d) LOAEC &gt; 50 mg/L ≤ 250 mg/L/d for gases, &gt; 0.2 mg/L ≤ 1.0 mg/L/d for vapours or &gt; 0.02 mg/L ≤ 0.2 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	Yes	LOAEL (dermal): 50 mg/kg bw/day
Skin Sensitiser	No	
<b>Hazard Band 1</b>		
Acute Toxicity-Harmful <ul style="list-style-type: none"> <li>oral LD<sub>50</sub> &gt; 300 mg/kg ≤ 2000 mg/kg</li> <li>dermal LD<sub>50</sub> &gt; 1 000 mg/kg ≤ 2000 mg/kg;</li> <li>inhalation LC<sub>50</sub> (6 h/d) &gt; 10 mg/L ≤ 20 mg/L for vapours)<sup>3</sup></li> </ul>	No	
Irritant (reversible effect)	Yes	Irritating to skin and eyes.
<b>Hazard Band 0</b> All indicators outside criteria listed in Hazards 1-4	-	
<b>Physical Hazards</b>		
Flammable potential	No	
Explosive potential	No	
<b>Hazard Evaluation (highest band) not including physical hazards</b>	2	Based on chronic dermal toxicity.
<b>Data confidence (available points out of 12 parameters)</b>	11/12	92%

\* Based on IMAP Framework [NICNAS (2013) Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework. National Industrial Chemicals Notification and Assessment Scheme. Department of Health and Aging, Canberra].

<sup>1</sup>Based on list of endocrine disrupting chemicals from the European Commission's Endocrine Disruptors website.

<sup>2</sup> milligrams per kilogram body mass (mg/kg) or milligrams per kilogram body mass per day (mg/kg/d)

<sup>3</sup> Based on GHS cut-offs for hazard classification. For chronic/repeat dose toxicity, GHS cut-offs are provided as guidance values (i.e. the dose/concentration at or below which significant health effects are observed)". (p 18, NICNAS 2013).

Human Health Guidelines		
Media	Concentration (mg/m <sup>3</sup> ; mg/L; mg/kg)	Reference
<b>Occupational Exposure Limits</b>		
<b>Air (OEL)</b>		
8-h TWA	NDF	
STEL	NDF	
Peak Limitation	NDF	
<b>Environmental Exposure</b>		
<b>Air</b> , ambient, residential	NDF	
<b>Air</b> , commercial/industrial	NDF	
<b>Water</b> , potable	NDF	
<b>Water</b> , recreational	NDF	
<b>Soil</b> , residential	NDF	
<b>Soil</b> , commercial/industrial	NDF	
<b>Soil</b> , protection of groundwater	NDF	

Footnotes:

OEL = Occupational Exposure Limit

TWA = 8 h Time-Weighted Average

STEL = (15 min) Short-term Exposure Limit

NDF – No data found within the limits of the search strategy

## Qualifying Summary Comments

Limited information was available for Amides, tall-oil fatty, N,N-bis(hydroxyethyl) (CAS RN: 68155-20-4). Therefore, a surrogate compound of amides, C18-unsatd., N,N-bis(hydroxyethyl) (CAS RN: 93-83-4) has been adopted for this assessment. The U.S. EPA's Analog Identification Methodology (AIM) Tool software program identified CAS RN: 93-83-4 as an exact chemical match to CAS RN: 68155-20-4 (U.S. EPA, 2019). Amides, C18-unsatd., N,N-bis(hydroxyethyl) is a brown liquid (at 20°C and 1013 hPa) with a density of 0.967 g/cm<sup>3</sup> (at 20°C). It has a freezing point of <-80°C and is reported to decomposes before boiling at > 300°C. Modelling suggests a water solubility between 0.12 mg/L and 2.17 mg/L at 25°C. Studies on a surrogate compound suggest that it will be absorbed readily via the oral route, then metabolised to polar metabolites and excreted principally in urine. Dermal absorption is likely low. Amides, C18-unsatd., N,N-bis(hydroxyethyl) has numerous industrial and consumer uses.

Amides, C18-unsatd., N,N-bis(hydroxyethyl) was ranked in Hazard Band 2, based on chronic dermal exposure and observed LOAEL (dermal) of 50 mg/kg bw/day. Amides, C18-unsatd., N,N-bis(hydroxyethyl) is an eye and skin irritant.

## References

European Chemicals Agency (ECHA), 2019. *Registration Dossier for Amides, C18-unsatd., N,N-bis(hydroxyethyl)*. Available at <https://echa.europa.eu/registration-dossier/-/registered-dossier/13417/1>. Last modified 9 December 2019, accessed December 2019.


European Commission (EC), 2000. Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption, preparation of a candidate list of substances as a basis for priority setting, Final Report (Incorporating corrigenda to final report dated 21 June 2000).

International Agency for Research on Cancer (IARC), 2019. Agents Classified by the IARC Monographs, Volumes 1–125, last updated 29 November, 2019. Available at <https://monographs.iarc.fr/agents-classified-by-the-iarc/>, accessed December 2019.

U.S. Environmental Protection Agency (U.S. EPA), 2019. *Analog Identification Methodology (AIM) Tool software program*. Available at <https://www.epa.gov/tsca-screening-tools/analog-identification-methodology-aim-tool>, accessed December 2019.

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Reviewed by:	CLB	Date and Revision: 21/01/20

[https://golderassociates.sharepoint.com/sites/117999/project\\_files/6\\_deliverables/report\\_014/appendix\\_e\\_-\\_human\\_health\\_summaries/19133367\\_hh\\_68155-20-4\\_tall\\_oil\\_acid\\_diethanolamide\\_dec2019.docx](https://golderassociates.sharepoint.com/sites/117999/project_files/6_deliverables/report_014/appendix_e_-_human_health_summaries/19133367_hh_68155-20-4_tall_oil_acid_diethanolamide_dec2019.docx)

Name	Ethanol
Synonyms	Ethyl alcohol; alcohol
CAS number	64-17-5
Molecular formula	C <sub>2</sub> H <sub>6</sub> O
Molecular structure	 <p>(Source: ECHA, 2020)</p>

Overview	References
<p>Ethanol is a simple alcohol. It is a colourless liquid (at 20°C and 1013 hPa), with a mild but typical alcoholic odour. Ethanol is fully soluble in water (at relevant environmental temperature). The melting/freezing point of ethanol is approximately - 114°C and the boiling point is approximately 78°C. Ethanol is highly flammable, with auto flammability at 363 to 425°C. Ethanol is considered non-explosive. Ethanol has a variety of uses. It is found in alcoholic beverages, is a fuel source, is found in cosmetics and various household products, and it has various industrial uses including as a cleaning solvent, a processing aid and a chemical intermediate in industrial processes such as the protective coating of metal compartments of vehicles, rubber production/processing and chemical production. This review focuses on the use of and potential human exposure to ethanol in industrial uses such as hydraulic fracturing activities. Exposures via consumer products will not be considered further.</p> <p>When released to the environment, modelling indicates that at static equilibrium alcohols will likely be distributed mainly to water and air, with adsorption to soil and sediment being weak. Ethanol is not expected to undergo direct photolysis, but experimental data supported by modelling data predicts that it will likely undergo indirect photolysis through hydroxyl radical reactions at a slow to moderate rate. Based on indirect photolysis, the half-life of ethanol is estimated to be 38 hours. Ethanol is considered readily biodegradable, but resistant to hydrolysis. Ethanol is considered to have a low bioaccumulation potential.</p> <p>Upon human exposure, ethanol is absorbed across the surface of the gastrointestinal tract, the lungs and the skin, due to its low molecular weight and being highly soluble in both water and lipids. Greater than 90% of the ingested dose is absorbed by the GI tract, with absorption beginning immediately following ingestion. Following absorption into the bloodstream, irrespective of the route of exposure, ethanol is distributed throughout the body. Ethanol is metabolised primarily by the liver, in three steps, (i) oxidation of ethanol to acetaldehyde (AcH) (ii) conversion of AcH to acetate and (iii) oxidation of acetate to carbon dioxide and water. The maximum amount of ethanol that can be metabolised per</p>	<p>ECHA, 2020</p>



<p>ECHA identifies the key reproductive studies as a two-generation drinking-water study in mice and an inhalation study on rats. The two-generation study in mice investigated the effects of 5%, 10% and 15% ethanol in drinking water in reproduction and fertility. This study reported a NOAEL of 13 800 mg/kg for effects on fertility. The inhalation study identifying a NOAEC of 30 400 mg/m<sup>3</sup> for effects on fertility (values close to or exceeding 50% of the lower explosive limit).</p>	
<p><b>Developmental Toxicity/Teratogenicity</b></p> <p>Classification of ethanol for developmental toxicity was considered not warranted in the context of a chemical substance, because adverse reproductive responses were only observed for repeat dose oral consumption of large amounts of ethanol, at doses normally only associated with problem drinking.</p> <p>Several toxicity studies are presented on the ECHA dossier, with the overall conclusion being that ethanol can clearly cause developmental toxicity. However, the doses required are exceedingly high compared to doses normally use to assess chemical substance hazards. These doses are also associated with maternal toxicity.</p> <p><i>Oral</i></p> <p>In an oral study, pregnant female mice were exposed to ethanol at several doses by gavage. No teratogenic effects were seen even at the highest dose tested (7 800 mg/kg bw/day).</p> <p><i>Inhalation</i></p> <p>An inhalation study assessing pregnant female rats exposed to ethanol reported a NOAEL for teratogenicity of 38 000 mg/m<sup>3</sup> ethanol. The study also reported clear maternal toxicity (necrosis and food intake reduction) at the highest dose and a NOAEL for maternal toxicity of 30 400 mg/m<sup>3</sup> of ethanol was established.</p>	<p>ECHA, 2020</p>
<p><b>Endocrine Disruption</b></p> <p>Ethanol is not identified in the European Commission (EC)'s report, "<i>Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption</i>" as a substance of interest.</p>	<p>EC, 2000</p>
<p><b>Acute Toxicity (oral, dermal, inhalation)</b></p> <p>Ethanol is not classified as acutely toxic by ECHA (based on LD<sub>50</sub> and LC<sub>50</sub> values being above thresholds for classification for acute toxicity).</p> <p>Numerous studies are provided for assessment of the acute oral, dermal and inhalation toxicity of ethanol. ECHA summarises the toxicity references values as:</p> <p><i>Oral</i></p> <p>Human: LD<sub>50</sub> ~ 2000 mg/kg  Rat: LD<sub>50</sub> of 15 010 mg/kg (female), 10 600 mg/kg (male, young adult), 7 060 mg/kg (male, old adult), 11 500 mg/kg (old adult), 17 750 mg/kg (young adult), 6 160 mg/kg (immature animal), 10 470 mg/kg (male/female), &gt;7 692 mg/kg (female).  Mouse: 8 350 mg/kg.</p> <p><i>Inhalation</i></p> <p>Rat (4 hr): LC<sub>50</sub> 51 mg/L (male) and 55 mg/L (female).</p>	<p>ECHA, 2020</p>

<p><i>Dermal</i></p> <p>No reliable data. Information indicates LD<sub>50</sub> &gt; 15 800 mg/kg.</p>	
<p><b>Chronic/repeat dose toxicity (oral, dermal, inhalation)</b></p> <p>Adverse effects in repeated dose toxicity studies were seen only at extremely high doses, which are well above the concentrations that would trigger classification for repeat dose effects.</p> <p><i>Oral</i></p> <p>Toxicity references values outlined for the oral route of exposure included the following:</p> <p><i>Key study identified by ECHA</i></p> <p>Rat NOAEL (90 day): 1 730 mg/kg bw/day  Rat LOAEL (90 day): 3 160 mg/kg bw/day.</p> <p>The primary study referenced is a 90 day study in rats, fed a mixture containing 16.25% USP ethanol at 3 dose levels. The NOAEL was determined to be 10 mL/kg for the mixture for increased kidney weight and renal tubular epithelial hyperplasia in males (which is equivalent to 1 730 mg/kg bw). The LOAEL was determined to be 4 mL/kg of 100% USP ethanol for the same end points (equivalent to 3 160 mg/kg bw)</p> <p><i>Other studies</i></p> <p>Rat NOAEL (90 day): 3 250 mg/kg bw/day (male), 3900 mg/kg bw/day (male/female), &lt;4 400 mg/kg bw/day (female)</p> <p>Mouse NOAEL (90 day): &gt; 9 400 mg/kg bw/day (female), &lt; 9 700 mg/kg bw/day (male)</p> <p>Monkey NOEL (chronic): &lt; 6 200 mg/kg bw/day.</p> <p><i>Dermal</i></p> <p>Repeat dose toxicity data for the dermal route was not available. However, under non-occlusive conditions, there is sufficient evidence to conclude that dermal exposure would be negligible based on rapid evaporation of ethanol. In addition, skin absorption under practical conditions is considered negligible based on available data.</p> <p><i>Inhalation</i></p> <p>For the inhalation route, there is limited repeat dose toxicity data. The information that is available (sub-acute studies, supplemented by reproductive toxicity data by the inhalation route) indicate that toxicity by the inhalation route is not likely to be of concern.</p>	<p>ECHA, 2020</p>
<p><b>Sensitisation of the skin or respiratory system</b></p> <p>In an ear swelling study, ethanol was found to be not sensitising to the skin.</p> <p>No data is available for assessment of respiratory sensitisation. However, with lacking data on respiratory sensitisation, considering that there are no alerts for respiratory sensitisation and ethanol is not a skin sensitiser, ECHA outlines that no classification for respiratory sensitisation is warranted.</p>	<p>ECHA, 2020</p>
<p><b>Corrosion (irreversible)/irritation (reversible) effects on the skin or eye</b></p> <p>Ethanol is not classified as a skin irritant by ECHA (based on available data reviewed as a whole). This classification was based on slight responses seen in animal studies and the lack of response in a human study, indicating the substance had minimal acute skin irritation potential. In the human</p>	<p>ECHA, 2020</p>

volunteer study, there was some evidence to suggest the potential for chronic irritation from repeated application under extreme occlusive conditions.

Ethanol is considered an eye irritant by ECHA (based on available data), classified as reversible eye irritant (Category 2) under the EU regulation 1272/2008. Studies indicate that irritancy effect diminishes rapidly with dilution. Results of studies undertaken for ethanol concentrations of 50% or less do not warrant classification. Considering this and the fact that results at 100% only just trigger classification, dilutions up to 70-80% are unlikely to warrant classification.



Physical Hazards	Reference
<b>Flammable Potential</b> Highly flammable.	ECHA, 2020
<b>Explosive Potential</b> Non explosive (based on the composition and no chemical structures being associated with explosive properties).	ECHA, 2020

Toxicity Values	Value	Reference
<b>Human Toxicity Data</b>		
<b>Acute Toxicity</b>		
LD <sub>50</sub>	~ 2000 mg/kg	Cited by ECHA, 2020
<b>High Chronic/Repeat Dose Toxicity</b>		
LOAEC	NDF	
LOAEL	NDF	
<b>Animal Toxicity Data</b>		
<b>Acute Toxicity</b>		
<b>LD<sub>50</sub></b>		
Rat, oral	15 010 mg/kg (female) 10 600 mg/kg (male, young adult) 7 060 mg/kg (male, old adult) 11 500 mg/kg (old adult) 17 750 mg/kg (young adult) 6 160 mg/kg (immature animal) 10 470 mg/kg (male/female) >7 692 mg/kg (female).	Cited by ECHA, 2020
Mouse, oral	8 350 mg/kg	Cited by ECHA, 2020
<b>LC<sub>50</sub></b>		

Rat	51 mg/L (male, 4 hr) 55 mg/L (female, 4 hr)	Cited by ECHA, 2020
<b>High Chronic/Repeat Dose Toxicity</b>		
LOAEL	Oral (rat, male, increased kidney weight and renal tubular epithelial hyperplasia): 3 160 mg/kg bw/day	Cited by ECHA, 2020
NOAEL	Oral (rat, male, increased kidney weight and renal tubular epithelial hyperplasia): 1 730 mg/kg bw/day  Oral (mice, 2-generation, fertility): 13 800 mg/kg	Cited by ECHA, 2020
NOAEC	Inhalation (rats, fertility): 30 400 mg/m <sup>3</sup>  Inhalation (rats, teratogenicity): 38 000 mg/m <sup>3</sup>	Cited by ECHA, 2020

Footnotes:

LD<sub>50</sub> – lethal dose for 50% of experimental population  
 LC<sub>50</sub> – lethal air concentration for 50% of experimental population  
 LOAEL – Lowest Observed Adverse Effect Level  
 LOAEC – Lowest Observed Adverse Effect Concentration  
 NDF – No data found within the limits of the search strategy  
 NOAEL – No Observed Adverse Effect Level  
 NOAEC – No Observed Adverse Effect Concentration

Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Band 4</b>		
Carcinogenicity (IARC Group 1 or 2A)	No <sup>^</sup>	
Mutagenicity/Genotoxicity (GHS Category 1A and 1B)	No <sup>^</sup>	
Reproductive Toxicity/Developmental toxicity (GHS Category 1, 1A and 1B)	No <sup>^</sup>	
Endocrine Disruption <sup>1</sup>	No <sup>^</sup>	
<b>Hazard Band 3</b>		
Carcinogenicity (IARC Group 2B)	No <sup>^</sup>	
Mutagenicity/Genotoxicity (GHS Category 2)	No <sup>^</sup>	
Reproductive Toxicity/Developmental toxicity (GHS Category 2)	No <sup>^</sup>	
Acute Toxicity (oral, dermal or inhalation)  Very Toxic/Toxic <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> ≤ 300 mg/kg<sup>2</sup></li> <li>• dermal LD<sub>50</sub> ≤ 1000 mg/kg</li> <li>• inhalation LC<sub>50</sub> ≤ 10 mg/L<sup>3</sup> (or mg/m<sup>3</sup>) (vapour)</li> </ul>	No <sup>^</sup>	
High Chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL ≤ 10 mg/kg/d<sup>2</sup>;</li> <li>• dermal LOAEL ≤ 20 mg/kg/d;</li> <li>• inhalation LOAEC (6 h/d) ≤ 50 ppm/d for gases, ≤ 0.2 mg/L/d for vapours or ≤ 0.02 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	No <sup>^</sup>	
Corrosive (irreversible effect)	No	
Respiratory sensitiser	No	
<b>Hazard Band 2</b>		

Human Health Toxicity Ranking		
	Hazard data	Comment
Harmful chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>oral LOAEL &gt; 10 mg/kg/d and ≤ 100 mg/kg/d</li> <li>dermal LOAEL &gt; 20 mg/kg/d and ≤ 200 mg/kg/d</li> <li>inhalation (6-h/d) LOAEC               <ul style="list-style-type: none"> <li>&gt; 50 mg/L ≤ 250 mg/L/d for gases,</li> <li>&gt; 0.2 mg/L ≤ 1.0 mg/L/d for vapours or</li> <li>&gt; 0.02 mg/L ≤ 0.2 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul> </li> </ul>	No <sup>^</sup>	
Skin Sensitiser	No	
<b>Hazard Band 1</b>		
Acute Toxicity-Harmful <ul style="list-style-type: none"> <li>oral LD<sub>50</sub> &gt; 300 mg/kg ≤ 2000 mg/kg</li> <li>dermal LD<sub>50</sub> &gt; 1 000 mg/kg ≤ 2000 mg/kg;</li> <li>inhalation LC<sub>50</sub> (6 h/d) &gt; 10 mg/L ≤ 20 mg/L for vapours)<sup>3</sup></li> </ul>	No <sup>^</sup>	Human, oral: LD <sub>50</sub> ~ 2000 mg/kg  Rat, inhalation: LD <sub>50</sub> 51 mg/L
Irritant (reversible effect)	Yes	Eye irritant (Category 2)
<b>Hazard Band 0</b> All indicators outside criteria listed in Hazards 1-4	-	
<b>Physical Hazards</b>		
Flammable potential	Yes	Highly flammable.
Explosive potential	No	
<b>Hazard Evaluation (highest band) not including physical hazards</b>	1	Based on eye irritancy
<b>Data confidence (available points out of 12 parameters)</b>	12/12	100%

<sup>^</sup> Hazard Bank Ranking, when excluding data from human consumption of alcohol.

\* Based on IMAP Framework [NICNAS (2013) Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework. National Industrial Chemicals Notification and Assessment Scheme. Department of Health and Aging, Canberra].

<sup>1</sup> Based on list of endocrine disrupting chemicals from the European Commission's Endocrine Disruptors website.

<sup>2</sup> milligrams per kilogram body mass (mg/kg) or milligrams per kilogram body mass per day (mg/kg/d)

<sup>3</sup> Based on GHS cut-offs for hazard classification. For chronic/repeat dose toxicity, GHS cut-offs are provided as guidance values (i.e. the dose/concentration at or below which significant health effects are observed)". (p 18, NICNAS 2013).

Human Health Guidelines		
Media	Concentration (mg/m <sup>3</sup> ; mg/L; mg/kg)	Reference
<b>Occupational Exposure Limits</b>		
<b>Air (OEL)</b>		
8-h TWA	1880 mg/m <sup>3</sup>	Safe Work Australia, 2020
STEL	NDF	-
Peak Limitation	NDF	-
<b>Environmental Exposure</b>		
<b>Air</b> , ambient, residential	NDF	
<b>Air</b> , commercial/industrial	NDF	
<b>Water</b> , potable		
<b>Water</b> , recreational	NDF	
<b>Water</b> , fresh waters	1 400 µg/L	NEPC, 2013
<b>Soil</b> , residential		
<b>Soil</b> , commercial/industrial	NDF	
<b>Soil</b> , protection of groundwater	NDF	

Footnotes:

OEL = Occupational Exposure Limit

TWA = 8 h Time-Weighted Average

STEL = (15 min) Short-term Exposure Limit

### Qualifying Summary Comments

Ethanol is a simple alcohol, that is found as a highly flammable, colourless liquid (at 20°C and 1013 hPa) and is fully soluble in water. Ethanol is a component of alcoholic beverages, is used as a fuel source, is found in cosmetics and other household products, and has various industrial uses. Upon release to the environment, ethanol will likely distribute to water and air. Ethanol is considered readily biodegradable and has a low potential to bioaccumulate.

Ethanol has been ranked in Hazard Band 1, based on being an eye irritant. This ranking is based on the exclusion of data specific to extremely high exposure to ethanol, as observed for consumption of alcoholic beverages. Adverse effects for several endpoints (carcinogenicity, mutagenicity/genotoxicity, reproductive/developmental toxicity and chronic toxicity) were observed at high dose rate. However, these dose rates are not considered relevant when considering industrial uses and potential occupational exposure.

### References

European Commission (EC), 2000. Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption, preparation of a candidate list of substances as a basis for priority setting, Final Report (Incorporating corrigenda to final report dated 21 June 2000).

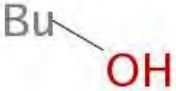
European Chemicals Agency (ECHA), 2020. Registration Dossier for ethanol. Available at <https://echa.europa.eu/registration-dossier/-/registered-dossier/16105>. Last modified 04 January 2020, accessed January 2020.

International Agency for Research on Cancer (IARC), 2019. Agents Classified by the IARC Monographs, Volumes 1–125, last updated 29 November, 2019. Available at <https://monographs.iarc.fr/agents-classified-by-the-iarc/>, accessed December 2019.

National Environment Protection Council (NEPC), 2013. National Environment Protection (Assessment of Site Contamination) Amended Measure 2013 (No.1). Schedule B1: Guidelines on Investigation Levels for soil and groundwater. National Environment Protection Council, Commonwealth Government of Australia.

Safe Work Australia, 2020. Hazardous Chemical Information System (HCIS): Exposure Standard Details for Ethyl alcohol. Available at: <http://hcis.safeworkaustralia.gov.au/ExposureStandards/Details?exposureStandardID=259>, accessed January 2020.

Created by:	MGT	Date: 08/01/2020
Reviewed by:	CLB	Date and Revision: 14/01/20

Name	Butyl alcohol
Synonyms	Butan-1-ol, 1-butanol, butanol, n-butanol
CAS number	71-36-3
Molecular formula	C <sub>4</sub> H <sub>10</sub> O
Molecular structure	 <p>(Source: ECHA, 2020)</p>

Overview	References
<p>Butyl alcohol is a liquid (at 20°C and 1012 hPa), that has a freezing point of -90°C and a boiling point of 119 °C. Its solubility in water is 66 g/L at 20°C, its relative density is 0.81 g/cm<sup>3</sup> at 20°C and it has a vapour pressure of &lt;10 hPa at 20°C. Butyl alcohol is a flammable liquid, with a flash point of 35°C and an auto-flammability temperature of 355°C (at 1013 hPa). Butyl alcohol has many uses including in coatings (paints, inks, toners, adhesives), in lubricants, in metal working fluids and rolling oils, in cleaning agents and as a laboratory agent and a process chemical.</p> <p>Following human exposure, butyl alcohol is rapidly taken up and distributed throughout the body, followed by a fast and complete elimination. Studies have shown butyl alcohol is readily absorbed through the skin, intestinal tract and lungs. Once absorbed, it is distributed almost uniformly through the body. Following metabolism primarily by alcohol and aldehyde dehydrogenases, butyl alcohol is rapidly eliminated. The majority of butyl alcohol is excreted as carbon dioxide.</p> <p>Upon release to the environment, butyl alcohol is most likely to be found in water. It is unlikely to undergo hydrolysis and photochemical degradation in air will likely be slow. Butyl alcohol is readily biodegraded, resulting in a short retention time under natural conditions. Bioaccumulation is not expected.</p>	ECHA, 2020

Human Health Toxicity Summary	Reference
<p><b>Carcinogenicity</b> Butyl alcohol has not been evaluated by the International Agency for Research on Cancer (IARC) as to its carcinogenicity.</p>	IARC, 2019

<p>Butyl alcohol is considered by ECHA to be not classified for carcinogenicity under CLP Regulation (EC) No 1272/2008, as amended for the ninth time in Regulation (EC) No 2016/1179. ECHA considered that there was no evidence of carcinogenic potential due to lack of mutagenicity, and because no structural fragments were found in a structure-activity-relationship model (CASE) indicating a carcinogenic potential.</p>	<p>ECHA, 2020</p>
<p><b>Mutagenicity/Genotoxicity</b></p> <p>Butyl alcohol is not considered classifiable for genetic toxicity by ECHA under CLP Regulation (EC) No 1272/2008, as amended for the eighth time in Regulation (EU) No. 2016/218, based on the available data.</p> <p>ECHA cites several <i>in vitro</i> studies including a gene mutation study in mammalian cells, a cytogenicity/micronucleus study and gene mutation studies in bacteria, and an <i>in vivo</i> mammalian somatic cell study. The results of these studies were all reported to be negative.</p>	<p>ECHA, 2020</p>
<p><b>Reproductive Toxicity</b></p> <p>Butyl alcohol is not considered classifiable for fertility or reproductive toxicity by ECHA under CLP Regulations (EC) No 1272/2008, as amended for the eighth time in Regulation (EU) No. 2016/218, based on the available data.</p> <p>They key <b>oral</b> studies cited by ECHA include:</p> <ul style="list-style-type: none"> <li>- A study on female fertility and prenatal development in rats. The NOAEL for maternal toxicity, including fertility was reported as 5 000 mg/kg bw/d.</li> <li>- A 90-day, repeated dose toxicity study (comparable to guideline study under GLP conditions) in rats reported a NOEL for reproductive organs of 500 mg/kg bw.</li> </ul> <p>The key <b>inhalation</b> study cited by ECHA was a behavioural peri-, postnatal developmental (neuro)toxicity rat study. The reported parental NOAEC, including fertility was 18.5 mg/L. An inhalation study for n-Butyl acetate is also provided, as this is considered a read across substance. The two-generation reproduction study in rats involved whole body exposure to vapours. The NOAEC for fertility was reported as 9.7 mg/L butyl acetate (converted to 6.189 mg/L for butyl alcohol). No studies were available to assess effects on fertility via the dermal route of exposure.</p>	<p>ECHA, 2020</p>
<p><b>Developmental Toxicity/Teratogenicity</b></p> <p>Butyl alcohol is not considered classifiable for teratogenicity or developmental toxicity by ECHA under CLP Regulations (EC) No 1272/2008, as amended for the eighth time in Regulation (EU) No. 2016/218, based on the available data.</p> <p>They key <b>oral</b> studies cited by ECHA include:</p> <ul style="list-style-type: none"> <li>- A prenatal developmental toxicity study in rats. The NOAEL for maternal and developmental toxicity was reported as 1 454 mg/kg bw/d. The study also reported no teratogenicity observed up to the highest dose tested, being 5 654 mg/kg bw/d.</li> <li>- A study on female fertility and prenatal development in rats. The NOAEL for teratogenicity was reported as 5 000 mg/kg bw/d. A NOEL for developmental effects was not established by the study.</li> </ul> <p>The key <b>inhalation</b> studies cited by ECHA include:</p> <ul style="list-style-type: none"> <li>- A prenatal developmental toxicity study in rats. The NOAEC for developmental toxicity including</li> </ul>	<p>ECHA, 2020</p>



<p>morphological fetal alterations was 10.8 mg/L.</p> <ul style="list-style-type: none"> <li>- A behavioural peri-, postnatal developmental (neuro)toxicity rat study. The reported parental NOAEC, including behavioural or teratogenic effects was 18.5 mg/L.</li> </ul> <p>Inhalation studies for n-Butyl acetate are also provided, as this is considered a read across substance.</p> <ul style="list-style-type: none"> <li>- A prenatal developmental toxicity study in rabbits reported a NOAEC for developmental toxicity of 7.2 mg/L.</li> <li>- A prenatal developmental toxicity study in rats reported a LOAEC for maternal and developmental toxicity of 7.2 mg/L. However, it was noted that the developmental effects were associated with clear maternal toxicity and were not considered to be an independent effect.</li> <li>- A prenatal developmental study in rats reported a NOAEC for developmental toxicity of 9.6 mg/L.</li> </ul>	
<p><b>Endocrine Disruption</b></p> <p>Butyl alcohol is not identified in the European Commission (EC)'s report, "<i>Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption</i>" as a substance of interest.</p>	<p>EC, 2000</p>
<p><b>Acute Toxicity (oral, dermal, inhalation)</b></p> <p>Butyl alcohol is classified for acute <b>oral</b> toxicity as Category 4 (H302: Harmful if swallowed). The key study reference was a rat study, with a LD<sub>50</sub> of approximately 2 290 mg/kg bw (study similar to OECD TG 401).</p> <p>Other Oral LD<sub>50</sub> cited by ECHA include:</p> <ul style="list-style-type: none"> <li>- Rat 2 510 mg/kg bw</li> <li>- Rat (female) 4 360 mg/kg bw</li> <li>- Mouse 2 680 mg/kg bw</li> <li>- Rabbits 3 500 mg/kg bw</li> <li>- Golden hamsters 1 200 mg/kg bw</li> <li>- Dogs, minimum lethal dose 1 782 mg/kg bw</li> </ul> <p>Butyl alcohol was not classifiable for acute <b>dermal</b> toxicity under CLP Regulation (EC) No. 1272/2008, as amended for the ninth time in Regulation (EC) No 2016/1179, based on only slight dermal toxicity. The key study referenced was a rabbit study, with a LD<sub>50</sub> of approximately 3 430 mg/kg bw (study similar to OECD TG 402).</p> <p>Butyl alcohol was not classifiable for acute <b>inhalation</b> toxicity under CLP Regulation (EC) No. 1272/2008, as amended for the ninth time in Regulation (EC) No 2016/1179, based on very low inhalation toxicity. The key study referenced was a rat study, with 4h exposure, and a LC<sub>0</sub> of &gt; 17.76 mg/L (similar to OECD 403).</p> <p>Other toxicity reference doses cited by ECHA include:</p> <ul style="list-style-type: none"> <li>- Rats Inhalation Hazard Test (IHT), LT<sub>0</sub> 21.48 mg/L: no mortality within 7 hrs (similar OECD 403).</li> <li>- Rats LC<sub>0</sub> &gt;24 mg/L, with 4 hr exposure; IHT: No mortality within 8 h (similar to OECD 403).</li> </ul> <p>Butyl alcohol is classified by ECHA for <b>inhalation</b> exposure as specific target organ toxicity (STOT) Single Exposure Category 3 (H335: May cause respiratory irritation/ H336: May cause drowsiness or dizziness) according to CLP Regulations (EC) 1272/2008 requirements. This classification was due to observed local irritant effects on the respiratory system in an inhalation hazard test and transient effects on the central nervous system (CNS) (drowsiness and dizziness).</p> <p>Studies cited by ECHA include:</p>	<p>ECHA, 2020</p>

<p>- Human study (3-5 minute exposure): sensory irritating effects on nose and throat.</p> <p>- Rat inhalation hazard test (7 hour exposure): irritating effects on the respiratory system.</p> <p>- Human study (10 year study on workers): No sign of irritation in human at concentrations <math>\leq</math> 310 mg/m<sup>3</sup>.</p> <p>The ECHA profile provides additional information as follows: The weight of evidence of all data indicated that there is no evidence that butyl alcohol has to be considered as neurotoxic or developmental neurotoxicant as it did not lead to adverse and/or persistent damage to the CNS or peripheral nervous system. Exposure to butyl alcohol led only to transient effects or impairment of neurological functions (drowsiness and dizziness) typical for short chain alcohols.</p>	
<p><b>Chronic/repeat dose toxicity (oral, dermal, inhalation)</b></p> <p>Butyl alcohol is not classified by ECHA for repeated dose systemic toxicity via oral, inhalation or dermal route under CLP Regulation (EC) No 1272/2008, as amended for the ninth time in Regulation (EU) No 2016/1179, based on the data available. ECHA does provide clarifying comments as follows: The CNS effects observed in the repeated dose studies were not centred on a specific organ but considered as general impairments of neurological and behavioural functions (Drowsiness and dizziness) which are classified accordingly (STOT SE 3, H336). Those observations typically occur for alcohols and there is currently no need for classification of butyl alcohol for repeated dose systemic toxicity.</p> <p>For <b>oral</b> exposure, the key study cited by ECHA is a sub-chronic 90-day rat study, which reports a NOEL of 125 mg/kg bw/d. Four groups of male and female rats (30/sex/group) were administered by gavage daily 0, 30, 125 or 500 mg/kg bw/d for either 6 or 13 weeks. General effects on neurological and behavioural functions as typically observed for alcohols were reported at the highest concentration, 500 mg/kg bw/d.</p> <p>For <b>dermal</b> exposure, the key study cited by ECHA is a short-term repeated dose rabbit study where butyl alcohol was applied occlusive to rabbit skin 12 times in 21 days for 5 hours (each exposure). Drying of the skin was observed and slight erythema but effects reversible. From continuous exposure, cracking, furrowing and exfoliation of the epidermis was observed but effects were reversible. No systemic toxicity observed. A NOAEL/LOAEL was not reported.</p> <p>For <b>inhalation</b>, the key study cited by ECHA was a sub-chronic 90-day rat study, with rats exposed to vapours 5 day/week for 5 h per day. The observed effect level was 320 mg/m<sup>3</sup>, but the study was not considered suitable for NOAEL/LOAEL derivation.</p>	ECHA, 2020
<p><b>Sensitisation of the skin or respiratory system</b></p> <p>Butyl alcohol is not classified by ECHA as a skin sensitizer, under CLP Regulation (EC) No 1272/2008, as amended for the ninth time in Regulation (EU) No 2016/1179, based on the available data being suitable for classification purposes. The key study cited by ECHA is a mouse Local Lymph Node Assay study (in vivo) (undertaken similar to OECD guideline 429) that showed that the test item does not have a sensitising effect on the skin under the test conditions.</p> <p>No data is available to assess respiratory sensitisation.</p>	ECHA, 2020
<p><b>Corrosion (irreversible)/irritation (reversible) effects on the skin or eye</b></p>	ECHA, 2020

Butyl alcohol is classified by ECHA as a **skin** irritant (Category 2, H315: Causes skin irritation), under Regulation (EC) No 1272/2008, as amended for the ninth time in CLP Regulation (EU) No. 2016/1179, based on studies undertaken with a typical mixture containing butyl alcohol..

It is noted that pure butyl alcohol reportedly causes only slight and reversible skin irritation. For typically produced mixtures, however, the effects on the skin are more distinct.

The key study cited by ECHA is a rabbit study, where two rabbits were exposed to the butyl alcohol (purity unknown; taken directly from the production) for 5 minutes, 1 hour and 2 hours under occlusive conditions, and then observed for 8 days. The study concluded the substance with irritating to the skin. For the exposure duration of 5 minutes effects were completely reversible within 8 days, but for the exposure duration of 1 hour and 2 hours, the effects were not fully reversible within 8 d.

Butyl alcohol is classified by ECHA as a risk for serious **eye** damage (Category 1, H318: "Causes serious eye irritation") according to CLP Regulations (EC) 1272/2008 requirements, as amended for the ninth time in Regulation (EU) No 2016/21179. This classification was due to the irreversible and sever effects on corneal opacity, iritis, conjunctivae redness and chemosis within 7 days.

The key study cited by ECHA is a rabbit study, where three rabbits were exposure for 24 h to 0.1 mL of the test substance (study in according to OECD guideline 405). This study reported observed corneal opacity, iritis, conjunctivae redness and chemosis, with effects not fully reversible within 7 days. An additional study was cited where the same effects were observed to be fully reversible within at least 21 days.

Physical Hazards	Reference
<b>Flammable Potential</b> Flammable liquid	ECHA, 2020
<b>Explosive Potential</b> Non-explosive	ECHA, 2020

Toxicity Values	Value	Reference
<b>Human Toxicity Data</b>		
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEC	NDF	
LOAEL	NDF	
<b>Animal Toxicity Data</b>		
<i>Acute Toxicity</i>		
<i>LD<sub>50</sub></i>		
Rat, oral	LD <sub>50</sub> ~ 2 290 mg/kg bw	Cited by ECHA, 2020
Rat, dermal	LD <sub>50</sub> ~ 3 430 mg/kg bw	Cited by ECHA, 2020
<i>LC<sub>50</sub></i>		
Rat	LC <sub>0</sub> of > 17.76 mg/L	Cited by ECHA, 2020
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEL	NDF	
LOAEC	NDF	
NOAEL	Rat (oral, systemic effects): 125 mg/kg bw/d	Cited by ECHA, 2020

	<p>Rat (oral, reproductive organs): 500 mg/kg bw</p> <p>Rat (oral, maternal and developmental toxicity): 1 454 mg/kg bw/d</p>	
NOAEC	<p>Rat (inhalation, fertility): 6.189 mg/L</p> <p>Rat (inhalation, developmental toxicity including morphological fetal alterations): 10.8 mg/L</p>	Cited by ECHA, 2020

Footnotes:

LD<sub>50</sub> – lethal dose for 50% of experimental population

LC<sub>50</sub> – lethal air concentration for 50% of experimental population

LOAEL – Lowest Observed Adverse Effect Level

LOAEC – Lowest Observed Adverse Effect Concentration

NDF – No data found within the limits of the search strategy

Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Band 4</b>		
Carcinogenicity (IARC Group 1 or 2A)	No	
Mutagenicity/Genotoxicity (GHS Category 1A and 1B)	No	
Reproductive Toxicity/Developmental toxicity (GHS Category 1, 1A and 1B)	No	
Endocrine Disruption <sup>1</sup>	No	
<b>Hazard Band 3</b>		
Carcinogenicity (IARC Group 2B)	No	
Mutagenicity/Genotoxicity (GHS Category 2)	No	
Reproductive Toxicity/Developmental toxicity (GHS Category 2)	No	
Acute Toxicity (oral, dermal or inhalation)  Very Toxic/Toxic <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> ≤ 300 mg/kg<sup>2</sup></li> <li>• dermal LD<sub>50</sub> ≤ 1000 mg/kg</li> <li>• inhalation LC<sub>50</sub> ≤ 10 mg/L<sup>3</sup> (or mg/m<sup>3</sup>) (vapour)</li> </ul>	No	
High Chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL ≤ 10 mg/kg/d<sup>2</sup>;</li> <li>• dermal LOAEL ≤ 20 mg/kg/d;</li> <li>• inhalation LOAEC (6 h/d) ≤ 50 ppm/d for gases, ≤ 0.2 mg/L/d for vapours or ≤ 0.02 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	No	
Corrosive (irreversible effect)	Yes	Irreversible and severe effects on the eyes
Respiratory sensitiser	NDF	
<b>Hazard Band 2</b>		

Human Health Toxicity Ranking		
	Hazard data	Comment
Harmful chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL &gt; 10 mg/kg/d and ≤ 100 mg/kg/d</li> <li>• dermal LOAEL &gt; 20 mg/kg/d and ≤ 200 mg/kg/d</li> <li>• inhalation (6-h/d) LOAEC &gt; 50 mg/L ≤ 250 mg/L/d for gases, &gt; 0.2 mg/L ≤ 1.0 mg/L/d for vapours or &gt; 0.02 mg/L ≤ 0.2 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	No	
Skin Sensitiser	No	
<b>Hazard Band 1</b>		
Acute Toxicity-Harmful <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> &gt; 300 mg/kg ≤ 2000 mg/kg</li> <li>• dermal LD<sub>50</sub> &gt; 1 000 mg/kg ≤ 2000 mg/kg;</li> <li>• inhalation LC<sub>50</sub> (6 h/d) &gt; 10 mg/L ≤ 20 mg/L for vapours)<sup>3</sup></li> </ul>	No	
Irritant (reversible effect)	Yes	Skin irritant
<b>Hazard Band 0</b> All indicators outside criteria listed in Hazards 1-4		
<b>Physical Hazards</b>		
Flammable potential	Yes	
Explosive potential	No	
<b>Hazard Evaluation (highest band) not including physical hazards</b>	3	Corrosive to the eyes
<b>Data confidence (available points out of 12 parameters)</b>	11/12	92%

\* Based on IMAP Framework [NICNAS (2013) Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework. National Industrial Chemicals Notification and Assessment Scheme. Department of Health and Aging, Canberra].

<sup>1</sup>Based on list of endocrine disrupting chemicals from the European Commission's Endocrine Disruptors website.

<sup>2</sup> milligrams per kilogram body mass (mg/kg) or milligrams per kilogram body mass per day (mg/kg/d)

<sup>3</sup> Based on GHS cut-offs for hazard classification. For chronic/repeat dose toxicity, GHS cut-offs are provided as guidance values (i.e. the dose/concentration at or below which significant health effects are observed)". (p 18, NICNAS 2013).

Human Health Guidelines		
Media	Concentration (mg/m <sup>3</sup> ; mg/L; mg/kg)	Reference
<b>Occupational Exposure Limits</b>		
Air (OEL)		
8-h TWA	-	
STEL	-	
Peak Limitation	152 mg/m <sup>3</sup>	Safe Work Australia, 2020
<b>Environmental Exposure</b>		
Air, ambient, residential	-	
Air, commercial/industrial	-	
Water, potable	2 mg/L	US EPA, 2019
Water, recreational	-	
Soil, residential	7 800 mg/kg	US EPA, 2019
Soil, commercial/industrial	120 000 mg/kg	US EPA, 2019
Soil, protection of groundwater	0.41 mg/kg	US EPA, 2019

Footnotes:

OEL = Occupational Exposure Limit

TWA = 8 h Time-Weighted Average

STEL = (15 min) Short-term Exposure Limit

**Qualifying Summary Comments**



Butyl alcohol is a flammable liquid (at 20°C and 1012 hPa), with a flash point of 35°C. It has many uses including in coatings (paints, inks, toners, adhesives), in lubricants, in metal working fluids and rolling oils, in cleaning agents and as a laboratory agent and a process chemical. Upon release to the environment, butyl alcohol is most likely to be found in water. Butyl alcohol is readily biodegraded, resulting in a short retention time under natural conditions. Bioaccumulation is not expected. Following human exposure, butyl alcohol is rapidly taken up and distributed throughout the body, followed by a fast and complete elimination.

Butyl alcohol has been ranking in Hazard Band 3 because it is corrosive to the eyes, causing serious and irreversible eye damage (classified as Category 1, H318: “Causes serious eye irritation”). It is also a skin irritant (classified as Category 2, H315: Causes skin irritation). As typical of alcohols, butyl alcohol can result in transient effects on the central nervous systems (CNS) consistent with general impairments of neurological and behavioural functions (drowsiness and dizziness). As such, butyl alcohol is also classified as specific target organ toxicity (STOT) Single Exposure Category 3 (H335: May cause respiratory irritation/ H336: May cause drowsiness or dizziness), and is also classified for acute oral toxicity as Category 4 (H302: Harmful if swallowed).

## References

European Chemicals Agency (ECHA), 2019. Registration Dossier for Butan-1-ol. Available at <https://echa.europa.eu/registration-dossier/-/registered-dossier/15322>. Last modified 04/01/2020., accessed January 2020.

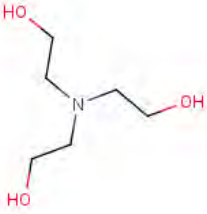
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Created by:	MGT	Date: 10/01/2020
Reviewed by:	CLB	Date and Revision: 21/01/2020

Name	Triethanolamine
Synonyms	Trolamine, triethanolamine, sterolamide, nitrilotriethanol, 2,2',2"-nitrilotriethanol
CAS number	102-71-6
Molecular formula	C <sub>6</sub> H <sub>15</sub> NO <sub>3</sub>
Molecular structure	

Overview	References
<p>Triethanolamine is a colourless to slightly liquid which is very hygroscopic and turns brown on exposure to air and light. It is a water-soluble strong base with a pH of 10.3 (concentration 1%) and emits a slight odour of ammonia.</p> <p>Triethanolamine is used commercially and industrially in the manufacture of surfactants and detergents, textiles, waxes, polishes, herbicides, petroleum demulsifiers, toilet goods, cement additives, cutting oils and other products.</p> <p>Kinetic studies in rats and mice using radioactive tracers indicate that triethanolamine identified that the compound distributes to the heart, kidney, liver, lung, and spleen with 40% of an intravenously administered dose excreted within 24 hours.</p> <p>Triethanolamine has a low order of acute and chronic toxicity. The principal route of exposure causing toxicity is through the skin, with some exposure occurring from inhalation of vapour and aerosols. Potential health effects in humans would be acute in nature and due to alkalinity rather than systemic toxicity. It is not genotoxic, carcinogenic, or toxic to development or the reproductive system.</p>	<p>HSDB (2009) ECHA (2020a)</p>

Human Health Toxicity Summary	Reference
<p><b>Carcinogenicity</b></p> <p>Not classifiable as to its carcinogenicity to humans (Group 3) based on inadequate evidence in experimental animals and humans.</p> <p>ECHA conclude from review of available data that triethanolamine is not considered carcinogenic for humans. Triethanolamine is not considered to be classified for carcinogenicity under Regulation (EC)</p>	<p>IARC (2000) ECHA (2020a)</p>

<p>No 1272/2008 and the available data are reliable and suitable for classification purposes under this regulation.</p>	
<p><b>Mutagenicity/Genotoxicity</b></p> <ul style="list-style-type: none"> <li>- Not classified as a mutagenic chemical. It is not genotoxic.</li> <li>- Triethanolamine did not induce mutations, DNA damage or other effects on genetic material in a number of non mammalian and mammalian tests both in vitro and in vivo. Based on available experimental information the test substance is not classified for genetic toxicity.</li> </ul>	<p>IARC (2000) ECHA (2020a)</p>
<p><b>Reproductive Toxicity</b></p> <ul style="list-style-type: none"> <li>- Not classified as a reproductive toxicant.</li> <li>- No reproductive or developmental effects were produced when rats and mice were exposed by topical administration. Other routes of exposure have not been studied.</li> </ul> <p>ECHA provide a summary of a screening reproduction/developmental toxicity study (OECD 421) with triethanolamine in rats, the NOAEL for systemic toxicity as well as for reproductive performance and fertility in parental animals was established at 1000 mg/kg bw/day, the highest dose tested. The NOAEL for postnatal toxicity in the offspring was 1000 mg/kg bw/day, whereas the NOAEL for prenatal developmental toxicity was determined to be 300 mg/kg bw/day based on decreased numbers of implants and delivered pups, and an increased postimplantation loss.</p>	<p>IARC (2000), ECHA (2020a)</p>
<p><b>Developmental Toxicity/Teratogenicity</b></p> <ul style="list-style-type: none"> <li>- Not classified as a developmental toxicant. Teratogenic at maternally toxic doses.</li> <li>- Maternal effects observed among rat dams given 225 mg/kg/day, however reproductive parameters in exposed rats were unaffected at this or lower dose levels (0-75 mg/kg/day). Maternal effects were observed in another rat study at 450 mg/kg/day.</li> <li>-</li> </ul>	<p>HSDB (2020) ECHA (2020a)</p>
<p><b>Endocrine Disruption</b></p> <p>Not listed as an endocrine disruptor on the European Commission List of Endocrine Disruptors.</p>	<p>EC, 2000</p>
<p><b>Acute Toxicity (oral, dermal, inhalation)</b></p> <ul style="list-style-type: none"> <li>- Large doses produced minimal toxicity when administered orally to laboratory animals.</li> <li>- When heated to decomposition it emits toxic and irritating fumes of nitrogen oxides and hydrogen cyanides.</li> <li>- The probably oral lethal dose in humans is 5-15 g/kg bw. Toxicity is low following single exposures.</li> </ul>	<p>HSDB (2020) OECD (2000)</p>
<p><b>Chronic/repeat dose toxicity (oral, dermal, inhalation)</b></p> <ul style="list-style-type: none"> <li>- Human data are limited. Based on data from animal studies, chemical is anticipated to have low chronic toxicity under typical human exposure conditions.</li> <li>- Skin irritation and ulceration have been reported following repeated, subchronic, and chronic topical exposure in laboratory animals.</li> <li>- Kidney toxicity is reported in a number of experimental animal studies. Aside from nephrotoxicity (the primary effect), side effects reported in laboratory animals following long-term oral administration include hepatic congestion, and demyelination of peripheral and sciatic nerve fibers.</li> <li>- Classified as causing potential organ damage.</li> <li>- Classified as a potential respiratory irritant.</li> </ul>	<p>HSDB (2020) ECHA (2020, b)</p>
<p><b>Sensitisation of the skin or respiratory system</b></p> <ul style="list-style-type: none"> <li>- A skin sensitiser.</li> <li>- Not sensitising in a guinea pig study.</li> <li>- Very low sensitisation potential in humans in a volunteer human study</li> </ul>	<p>Safe Work Australia (2020)</p>

	ECHA (2020a) ECHA (2020b)
<p><b>Corrosion (irreversible and reversible)/irritation of the skin or eye</b></p> <ul style="list-style-type: none"> <li>- Not irritating to skin in rabbit studies.</li> <li>- Not irritating to eyes in three rabbit studies. Irritating to eyes in two rabbit studies.</li> </ul> <p>Conclusive but not sufficient for classification</p>	ECHA (2020a) ECHA (2020b)

Physical Hazards	Reference
<b>Flammable Potential</b> Non flammable. Combustible, when exposed to heat or flame.	ECHA (2020a)
<b>Explosive Potential</b> There are no chemical groups associated with explosive properties in the molecule.	ECHA (2020a)

Toxicity Values	Value	Reference
<b>Human Toxicity Data</b>		
<i>Acute Toxicity</i>		
	NDF	All proposed data sources
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEC	NDF	
LOAEL	NDF	
<b>Animal Toxicity Data</b>		
<i>Acute Toxicity</i>		
<i>LD<sub>50</sub></i>		
Guinea pig (oral)	2200 mg/kg	PubChem (2020)
Mouse (intraperitoneal)	1450 mg/kg	PubChem (2020)
Mouse (oral)	5846 mg/kg	PubChem (2020)
Rabbit (oral)	2200 mg/kg	PubChem (2020)
Rabbit (skin)	>20 mL/kg	PubChem (2020)
Rat (intraperitoneal)	1510 mg/kg	PubChem (2020)

Rat (oral)	4920 uL/kg	PubChem (2020)
Rat (skin)	> 16 mL/kg	PubChem (2020)
Rabbit (dermal)	> 2,000 mg/kg	ECHA (2020a)
Rats (oral)	6400 mg/kg	ECHA (2020a)
<b>LC0</b>		
Rat (inhalation, 8h)	Saturated atmosphere (approximately 1.8 mg/m <sup>3</sup> )	ECHA (2020a)
<b>High Chronic/Repeat Dose Toxicity</b>		
NOAEL, rat , oral	1000 mg/kg bw	ECHA (2020a)
NOAEL (local effects), mouse	250 mg/kg bw/day	ECHA (2020a)
NOAEC (local effects), rat (inhalation)	0.02 mg/L air	ECHA (2020a)
NOAEL (local effects) male rat (dermal)	125 mg/kg bw/day	ECHA (2020a)
NOAEL (local effects) female rat (dermal)	250 mg/kg bw/day	ECHA (2020a)

Footnotes:

LD<sub>50</sub> – lethal dose for 50% of experimental population  
 LC<sub>50</sub> – lethal air concentration for 50% of experimental population  
 LOAEL – Lowest Observed Adverse Effect Level  
 LOAEC – Lowest Observed Adverse Effect Concentration  
 NDF – No data found within the limits of the search strategy

Human Health Toxicity Ranking*		
	Hazard data	Comment
<b>Hazard Band 4</b>		
Carcinogenicity (IARC Group 1 or 2A)	No	IARC (2000) Group 3 - Not classifiable based on inadequate evidence.
Mutagenicity/Genotoxicity (GHS Category 1A and 1B)	No	ECHA (2020a)
Reproductive Toxicity/Developmental toxicity (GHS Category 1, 1A and 1B)	No	ECHA (2020a); IARC (2000)
Endocrine Disruption <sup>1</sup>	No	Not listed as an endocrine disruptor by European Commission.
<b>Hazard Band 3</b>		
Carcinogenicity (IARC Group 2B)	No	IARC 2000
Mutagenicity/Genotoxicity (GHS Category 2)	No	Not classified as a germ cell mutagen by ECHA (2020a)
Reproductive Toxicity/Developmental toxicity (GHS Category 2)	No	
Acute Toxicity (oral, dermal or inhalation)  Very Toxic/Toxic <ul style="list-style-type: none"> <li>oral LD<sub>50</sub> ≤ 300 mg/kg<sup>3</sup></li> <li>dermal LD<sub>50</sub> ≤ 1000 mg/kg</li> </ul> inhalation LC <sub>50</sub> ≤ 10 mg/L <sup>4</sup> (or mg/m <sup>3</sup> ) (vapour)	No	-
High Chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>oral LOAEL ≤ 10 mg/kg/d<sup>3</sup>;</li> <li>dermal LOAEL ≤ 2.0 mg/kg/d;</li> <li>inhalation LOAEC (6 h/d) ≤ 50 ppm/d for gases, ≤ 0.2 mg/L/d for vapours or ≤ 0.02 mg/L/d for dust/mists/fumes<sup>4</sup></li> </ul>	No	-

Human Health Toxicity Ranking*		
	Hazard data	Comment
Corrosive (irreversible effect)	No	Not classified as corrosive to skin or eyes by ECHA (2020)
Respiratory sensitiser	No	Not classified as a respiratory system sensitiser by ECHA (2020)
<b>Hazard Band 2</b>		
Harmful chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL &gt; 10 mg/kg and ≤ 100 mg/kg/d</li> <li>• dermal LOAEL &gt; 20 mg/kg/d and ≤ 200 mg/kg/d</li> <li>• inhalation (6-h/d) LOAEC &gt; 50 mg/L ≤ 250 mg/L/d for gases, &gt; 0.2 mg/L ≤ 1.0 mg/L/d for vapours or &gt; 0.02 mg/L ≤ 0.2 mg/L/d for dust/mists/fumes<sup>4</sup></li> </ul>	Yes	Potential local effects (irritation) in the respiratory tract.
Skin Sensitiser	Yes	Safe Work Australia (2020) - Skin irritation – category 2
<b>Hazard Band 1</b>		
Acute Toxicity-Harmful <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> &gt; 300 mg/kg ≤ 2000 mg/kg</li> <li>• dermal LD<sub>50</sub> &gt; 1 000 mg/kg ≤ 2000 mg/kg;</li> </ul> inhalation LC <sub>50</sub> (6 h/d) > 10 mg/L ≤ 20 mg/L for vapours <sup>4</sup>	No	-
Irritant (reversible effect)	Yes	Safe Work Australia (2020) - Eye irritation – category 2A
<b>Hazard Band 0</b> All indicators outside criteria listed in Hazards 1-4		
<b>Physical Hazards</b>		
Flammable potential	No	-



Human Health Toxicity Ranking*		
	Hazard data	Comment
Explosive potential	No	-
<b>Hazard Evaluation (highest band) not including physical hazards</b>	<b>Band 2</b>	
<b>Data confidence (available points out of 12 parameters)</b>	12/12 = 100%	

\* Based on IMAP Framework [NICNAS (2013) Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework. National Industrial Chemicals Notification and Assessment Scheme. Department of Health and Aging, Canberra].

<sup>1</sup>Based on list of endocrine disrupting chemicals from the European Commission's Endocrine Disruptors website.

<sup>2</sup> Based on list of neurotoxic chemicals from US Agency for Toxic Substances and Disease Registry (ATSDR).

<sup>3</sup> milligrams per kilogram body mass (mg/kg) or milligrams per kilogram body mass per day (mg/kg/d)

<sup>4</sup> Based on GHS cut-offs for hazard classification. For chronic/repeat dose toxicity, GHS cut-offs are provided as guidance values (i.e. the dose/concentration at or below which significant health effects are observed"). (p 18, NICNAS 2013).

Human Health Guidelines		
Media	Concentration (mg/m <sup>3</sup> ; mg/L; mg/kg)	Reference
<b>Occupational Exposure Limits</b>		
<b>Air</b>		
8-h TWA	5 mg/m <sup>3</sup>	Safe Work Australia (2020)
STEL	NDF	
Peak Limitation	NDF	
<b>Environmental Exposure</b>		
<b>Air, ambient, residential</b>	NDF	
<b>Air, commercial/industrial</b>	NDF	

<b>Water</b> , potable	NDF	
<b>Water</b> , recreational	NDF	
<b>Soil</b> , residential	NDF	
<b>Soil</b> , commercial/industrial	NDF	
<b>Soil</b> , protection of groundwater	NDF	

Footnotes:

OEL = Occupational Exposure Limit

TWA = 8 h Time-Weighted Average

STEL = (15 min) Short-term Exposure Limit

## Qualifying Summary Comments

Triethanolamine is a colourless to slightly liquid which is very hygroscopic and turns brown on exposure to air and light. It is a water-soluble strong base with a pH of 10.3 (concentration 1%) and emits a slight odour of ammonia. Triethanolamine is used commercially and industrially in the manufacture of surfactants and detergents, textiles, waxes, polishes, herbicides, petroleum demulsifiers, toilet goods, cement additives, cutting oils and other products. Triethanolamine has a low order of acute and chronic toxicity. It is classified as a skin sensitiser and eye irritant. It is not genotoxic, carcinogenic, or toxic to development or the reproductive system. Given the relatively low to moderate hazard it is categorised in Hazard Band 2.

## References

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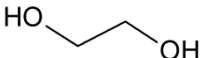
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Created by:	LPA	Date: 18/12/2019
Reviewed by:	CLB	Date and Revision: 20/01/20

yesName	Ethylene glycol
Synonyms	Ethane-1,2-diol, 1,2-ethanediol, glycol, ethylene alcohol, hypo-dicarbonous acid, mono-ethylene glycol, 1,2-dihydroxyethane, ethylene hydrate, MEG, Lutrol-9, Dowtherm Sr 1, Fridex, Norkool, Ramp, Tescol; Ucar 17
CAS number	107-21-1
Molecular formula	C <sub>2</sub> H <sub>6</sub> O <sub>2</sub>
Molecular structure	

Overview	References
<p>Ethylene glycol is a colourless, odourless, sweet tasting, relatively non-volatile liquid with high water solubility. It is a small molecular-weight alcohol which readily passes through biological membranes and is absorbed from the gastro-intestinal tract (GI) tract and in the lung.</p> <p>Ethylene glycol has numerous commercial and industrial applications such as in chemical manufacturing, natural gas processing and as an engine coolant. It is commonly used in antifreeze and hydraulic break fluids in both the automotive and aviation industry. It is also present in inks used in stamp pads, ballpoint pens and print shops.</p> <p>Ethylene glycol is considered highly toxic with multiple metabolites contributing to the toxic effects. The metabolites of ethylene glycol that have been typically detected are carbon dioxide, glycolic acid, and oxalic acid. Oxalic acid is converted to harmful calcium oxalate crystals, which are deposited in various tissues. Target organ cellular damage is seen in the kidney, brain, myocardium, pancreas, and blood vessel walls. Numerous human case studies and controlled experiments on animals are available to provide data on the toxic effects of ethylene glycol. Ethylene glycol is quickly and extensively absorbed through the GI tract of many species, but dermal absorption is slow in rodents and is slow and poorly absorbed through the skin in humans.</p>	<p>ATSDR 2010</p>

Human Health Toxicity Summary	Reference
<p><b>Carcinogenicity</b></p> <p>Ethylene glycol has not been evaluated by the International Agency for Research on Cancer.</p> <p>Ethylene glycol exhibited no evidence of carcinogenicity based on a two year bioassay with rats and mice. In several animal studies, there was no evidence of carcinogenicity in animals.</p>	<p>IARC 2019; ATSDR 2010</p>

<p><b>Mutagenicity/Genotoxicity</b></p> <p>Ethylene glycol is not classified as a mutagen by the European Chemicals Agency (ECHA).</p> <p>An ATSDR study reported that available <i>in vivo</i> and <i>in vitro</i> laboratory studies provided consistently negative genotoxicity results. No significant mutagenic activity was observed using the Ames test. <i>In vitro</i> mutagenicity studies in bacterial cells have consistently reported negative results.</p>	<p>ECHA 2020; ATSDR 2010</p>
<p><b>Reproductive Toxicity</b></p> <p>Ethylene glycol is not classified as reproductively toxic by ECHA on the basis that the data are sufficient and do not support classification under the GHS (Rev4)) thresholds. This fact contrasts with the ATSDR (2010) animal data on developmental toxicity (see section below). While the GHS classification includes both reproductive and developmental toxicity these data have been presented separately in this profile to differentiate the nature of the toxicological response.</p> <p>There have been equivocal studies of reproductive toxicity. There has been no evidence of an adverse impact on reproductive organs observed in repeated dose toxicity studies in animals while other contradictory reports suggest reproductive effects such as decreased number of litters per pair, number of live pups per pair, and live pup weight, pup facial deformities and abnormal skeletons following long-term exposure to high doses. While the latter was observed in mice the effect was not observed in rats or rabbits under the same conditions. A further study in rats reported embryotoxicity following administration of ethylene glycol.</p>	<p>ECHA 2020</p> <p>ATSDR 2010</p>
<p><b>Developmental Toxicity/Teratogenicity</b></p> <p>While there are insufficient human data on developmental toxicity / teratogenicity of ethyl glycol. There are animal data as presented in ATSDR (2010) and summarized below.</p> <p>Several acute-durational studies have been undertaken to assess developmental toxicity of ethylene glycol in mice, rats and rabbits. The studies indicate that malformations occur in both mice and rats exposure during gestations. Skeletal malformations were most apparent and mice appeared more sensitive than the other animals. Reduction in foetal body weight was also observed in laboratory animals exposed to ethylene glycol.</p> <p>ATSDR (2010) consider ethylene glycol to be teratogenic, more so in mice than in rats, rabbits and chickens. It induces primarily skeletal and external malformations. Teratogenic effects in mice were seen at all dose levels (750-3000 mg/kg/day) and in rats at 2500 and 5000 mg/kg/day. Animals given less than the limit dose (1000 mg/kg/day) only by the oral route and only when rapidly ingested (bolus) exhibited developmental toxicity.</p>	<p>ATSDR 2010</p>
<p><b>Endocrine Disruption</b></p> <p>Ethylene glycol is listed on the European Commission Priority List for endocrine disruptors as Category 3C. A classification of 3 indicates that the review found no scientific basis for inclusion in the priority list. The classification of C indicates that data were available on wildlife/relevant and/or mammal relevant endocrine effects for assessment.</p>	<p>EC 2000</p>

<p><b>Acute Toxicity (oral, dermal, inhalation)</b></p> <p><b>Oral</b></p> <p>Ethyl glycol is classified as acutely toxic via the oral route by ECHA based on its classification thresholds.</p> <p>ATSDR reports that in humans, the lethal dose of ethylene glycol is estimated to be in the range of 1,400–1,600 mg/kg. However, there are difficulties in quantifying the amounts consumed by persons who have succumbed to the toxic effects, which has led to uncertainty in the human lethal dose estimates. In laboratory animals (rats, mice, monkeys), oral doses of <math>\geq 4,000</math> mg/kg were required to cause death.</p> <p>Available information on the effects of acute accidental or intentional ingestion of ethylene glycol in humans suggests that acute oral toxicity in humans occurs in three stages within 72 hours of ingestion. Initially central nervous system depression, metabolic changes (hyper-osmolality) and gastrointestinal upset occurs and lasts from 30 minutes to 12 hours. These effects are followed by a second stage of symptoms which includes metabolic acidosis and associated cardio-pulmonary symptoms (tachypnea, hyperpnea, tachycardia, cyanosis, pulmonary oedema, and/or cardiac failure). The second stage of effects has been observed to last 12 – 24 hours after ingestion. The third stage (24 – 72 hours after ingestion) is characterized by renal involvement (flank pain and oliguria/anuria). There is also limited information suggesting a fourth stage, where cranial nerves (evident through deafness, facial paralysis, and other sequelae) may occur 6 or more days after exposure.</p> <p>Renal effects in orally exposed animals are consistent with those observed in humans. In acute-duration studies, effects occurred in the kidneys of rats exposed to 1,250–2,500 mg/kg/day by gavage or 2, 615– 5,270 mg/kg/day in drinking water for 9–29 days, and rabbits exposed to 2,000 mg/kg/day by gavage for 13 days.</p> <p><b>Inhalation</b></p> <p>A human inhalation study of short-term, high-exposure periods found that ethylene glycol was tolerated for only 15 minutes at 188 mg/m<sup>3</sup>; 2 minutes at 244 mg/m<sup>3</sup>; and one or two breaths at 308 mg/m<sup>3</sup>. The study reports that irritation of the respiratory tract became common at an ethylene glycol concentration of approximately 140 mg/m<sup>3</sup> (further data not provided), with concentration of <math>\geq 200</math> mg/m<sup>3</sup> being intolerable due to strong irritation of the upper respiratory tract. Reported effects included a burning sensation in the trachea and a burning cough.</p> <p><b>Dermal</b></p> <p>Information on the acute dermal toxicity of ethylene glycol is limited. ATSDR note one study in rabbits that found minimal skin and eye irritation following single applications and one negative developmental toxicity study in mice.</p>	<p>ECHA 2020; ATSDR 2010</p>
<p><b>Chronic/repeat dose toxicity (oral, dermal, inhalation)</b></p> <p>Ethylene glycol is classified as chronically toxic via the oral route by ECHA. Prolonged or repeat exposure may cause damage to the kidney (GHS Category 2).</p> <p>A 90-day study of rats exposed to ethylene glycol in drinking water found that renal effects were observed in males at <math>&gt; 947</math> mg/kg/day and females at 3, 087 mg/kg/day. The effects included renal tubular oxalate crystal deposition, dilation and degeneration of the kidney.</p>	<p>ECHA 2020; ATSDR 2010</p>

<p>Renal effects in rats and mice exposed to ethylene glycol in the diet for up to 2 years have also been studied. The studies showed males were more sensitive than females and rats were more sensitive than mice. At concentrations of <math>\geq 300</math> mg/kg/day, renal effects, including oxalate nephrosis, were observed in male rats. Oxalate crystal deposition and apparent tubular degenerative changes in male rats was observed at <math>\geq 375</math> mg/kg/day and in female rats at <math>\geq 750</math> mg/kg/day.</p> <p>A 30-day human study reported that inhalation exposure to ethylene glycol vapour was well tolerated at an average concentration of <math>30 \text{ mg/m}^3</math> for 20-22 hours/day. The effects reported were essentially limited to the occasional complaint about mild irritation of the upper respiratory tract.</p>	
<p><b>Sensitisation of the skin or respiratory system</b></p> <p>Ethylene glycol is not classified as a skin or respiratory system sensitiser by ECHA (considered conclusive data for not classifying the substance by ECHA).</p>	ECHA 2020
<p><b>Corrosion (irreversible)/irritation (reversible) effects on the skin or eye</b></p> <p>Ethylene glycol is not reported as causing corrosion or irritation effects on the skin or eyes by ECHA.</p>	ECHA 2020

Physical Hazards	Reference
<p><b>Flammable Potential</b></p> <p>Not considered flammable by ECHA.</p> <p>Flashpoint of 127°C, Auto-ignition temperature of 398°C.</p>	ECHA 2020; ATSDR 2010
<p><b>Explosive Potential</b></p> <p>Not considered explosive by ECHA.</p> <p>Explosive limits are reported as 3.20 – 53%</p>	ECHA 2020; ATSDR 2010

Toxicity Values	Value	Reference
<b>Human Toxicity Data</b>		
<i>High Chronic/Repeat Dose Toxicity</i>		
LD <sub>Lo</sub> (lowest lethal dose), male, lethal dose 48 hrs after single ingestion	4071 mg/kg	ATSDR 2010
LD <sub>Lo</sub> , lethal dose in 6/11 after single exposure	2379 mg/kg	ATSDR 2010
LOAEL, humans, inhalation, respiratory tract irritation	140 mg/m <sup>3</sup>	ATSDR 2010
<b>Animal Toxicity Data</b>		
<i>Acute Toxicity</i>		
<i>LD<sub>50</sub></i>		
Rat, oral, female	4000 mg/kg /day	ATSDR 2010
Rat, oral	7712 mg/ kg	ECHA 2020
Mouse, dermal	> 3500 mg/kg	ECHA 2020
<i>LC<sub>50</sub></i>		



Rat, 6 hr exposure	> 2.5 mg/L air (> 2500 mg/m <sup>3</sup> )	ECHA 2020
<b>High Chronic/Repeat Dose Toxicity</b>		
LOAEL, rats, 10 d, drinking water, renal toxicity	2615 mg/kg/day	ATSDR 2010
LOAEL, rats, male, 90 d drinking water, renal toxicity	947 mg/kg/day	ATSDR 2010
LOAEL, rats, female, 90 d drinking water, renal toxicity	3 087 mg/kg/day	ATSDR 2010
LOAEL, rats, male, 16 w dietary study, renal toxicity	180 mg/kg/day	ATSDR 2010
LOAEL, mice, oral, developmental toxicity	500 mg/kg/day	ATSDR 2010
LOAEL, rats, oral, developmental toxicity	750 mg/kg/day	ATSDR 2010
LOAEL, rabbit, 14 d GW, female, renal toxicity	2000 mg/kg/day	ATSDR 2010

Footnotes:

LD<sub>50</sub> – lethal dose for 50% of experimental population

LC<sub>50</sub> – lethal air concentration for 50% of experimental population

LOAEL – Lowest Observed Adverse Effect Level

LOAEC – Lowest Observed Adverse Effect Concentration

NDF – No data found within the limits of the search strategy

Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Band 4</b>		
Carcinogenicity (IARC Group 1 or 2A)	No	ATSDR 2010, Not classified by IARC
Mutagenicity/Genotoxicity (GHS Category 1A and 1B)	No	ATSDR 2010
Reproductive Toxicity/Developmental toxicity (GHS Category 1, 1A and 1B)	No	See below
Endocrine Disruption <sup>1</sup>	No	Listed as Category 3C on priority by EC (EC 2000)
<b>Hazard Band 3</b>		
Carcinogenicity (IARC Group 2B)	No	ATSDR 2010
Mutagenicity/Genotoxicity (GHS Category 2)	No	ATSDR 2010
Reproductive Toxicity/Developmental toxicity (GHS Category 2)	Yes	Development toxicity observed in animal studies, ATSDR 2010.
Acute Toxicity (oral, dermal or inhalation)  Very Toxic/Toxic <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> ≤ 300 mg/kg<sup>2</sup></li> <li>• dermal LD<sub>50</sub> ≤ 1000 mg/kg</li> <li>• inhalation LC<sub>50</sub> ≤ 10 mg/L<sup>3</sup> (or mg/m<sup>3</sup>) (vapour)</li> </ul>	No	See below
High Chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL ≤ 10 mg/kg/d<sup>2</sup>;</li> <li>• dermal LOAEL ≤ 20 mg/kg/d;</li> <li>• inhalation LOAEC (6 h/d) ≤ 50 ppm/d for gases, ≤ 0.2 mg/L/d for vapours or ≤ 0.02 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	No	See below
Corrosive (irreversible effect)	No	ECHA 2020
Respiratory sensitiser	No	ECHA 2020

Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Band 2</b>		
Harmful chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL &gt; 10 mg/kg/d and ≤ 100 mg/kg/d</li> <li>• dermal LOAEL &gt; 20 mg/kg/d and ≤ 200 mg/kg/d</li> <li>• inhalation (6-h/d) LOAEC &gt; 50 mg/L ≤ 250 mg/L/d for gases, &gt; 0.2 mg/L ≤ 1.0 mg/L/d for vapours or &gt; 0.02 mg/L ≤ 0.2 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	Yes	Prolonged or repeat does exposure may cause damage to the kidney (ATSDR 2010), GHS Category 2 (ECHA 2020)
Skin Sensitiser	No	ECHA 2020
<b>Hazard Band 1</b>		
Acute Toxicity-Harmful <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> &gt; 300 mg/kg ≤ 2000 mg/kg</li> <li>• dermal LD<sub>50</sub> &gt; 1 000 mg/kg ≤ 2000 mg/kg;</li> <li>• inhalation LC<sub>50</sub> (6 h/d) &gt; 10 mg/L ≤ 20 mg/L for vapours)<sup>3</sup></li> </ul>	No	LD <sub>50</sub> , rat, oral – 4 000 mg/kg/day (ATSDR 2010)
Irritant (reversible effect)	Yes	Respiratory tract irritation (ATSDR 2010)
<b>Hazard Band 0</b> All indicators outside criteria listed in Hazards 1-4	No	
<b>Physical Hazards</b>		
Flammable potential	No	
Explosive potential	No	
<b>Hazard Evaluation (highest band) not including physical hazards</b>	3	<b>Reproductive, developmental, teratogenic and neurological effects in animals.</b>
<b>Data confidence (available points out of 12 parameters)</b>	12/12	<b>100%</b>

\* Based on IMAP Framework [NICNAS (2013) Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework. National Industrial Chemicals Notification and Assessment Scheme. Department of Health and Aging, Canberra].

<sup>3</sup>Based on list of endocrine disrupting chemicals from the European Commission's Endocrine Disruptors website.

<sup>2</sup> milligrams per kilogram body mass (mg/kg) or milligrams per kilogram body mass per day (mg/kg/d)

<sup>3</sup> Based on GHS cut-offs for hazard classification. For chronic/repeat dose toxicity, GHS cut-offs are provided as guidance values (i.e. the dose/concentration at or below which significant health effects are observed)". (p 18, NICNAS 2013).

Human Health Guidelines		
Media	Concentration (mg/m <sup>3</sup> ; mg/L; mg/kg)	Reference
<b>Occupational Exposure Limits</b>		
<b>Air (OEL)</b>		
8-h TWA	52 mg/ m <sup>3</sup> (vapour) 10 mg/ m <sup>3</sup> (particulate)	Safe Work Australia 2020
STEL	104 mg/ m <sup>3</sup> (vapour)	Safe Work Australia 2020
Peak Limitation	NDF	
<b>Minimal Risk Levels (MRLs)</b>		
Inhalation (acute exposure, 14 days or less)	2 mg/m <sup>3</sup>	ATSDR 2010
Oral (acute exposure, 14 days or less)	0.8 mg/kg/day	ATSDR 2010
<b>Environmental Exposure</b>		
Air, ambient, residential	0.42 mg/m <sup>3</sup>	US EPA 2019
Air, commercial/industrial	1.8 mg/m <sup>3</sup>	US EPA 2019
<b>Water, potable</b>		
Water, potable	40 mg/L	USEPA 2019
<b>Water, recreational</b>		
Water, recreational	NDF	

<b>Soil, residential</b>	130 000 mg/kg	USEPA 2019
<b>Soil, commercial/industrial</b>	1 600 000*mg/kg	USEPA 2019
<b>Soil, protection of groundwater</b>		

Footnotes:

OEL = Occupational Exposure Limit

TWA = 8 h Time-Weighted Average

STEL = (15 min) Short-term Exposure Limit

\* Above limit of practicality

## Qualifying Summary Comments

Ethylene glycol exhibits a diverse range of adverse toxicological outcomes in animal studies including reproductive, developmental and teratogenic effects and renal effects after chronic exposure, although it is not considered highly acutely toxic via the oral, dermal and inhalation pathways. In humans it is considered to be acutely toxic. Furthermore, while ECHA has not classified ethylene glycol as a reproductive toxicant, ATSDR (2010) highlight the developmental toxicity of ethylene glycol in animals. Taking these concerns into account and subject to further evaluations of the animal data by regulatory agencies a Hazard Band 3 rating has been allocated. It is not flammable or explosive and burns with difficulty. While these properties warrant management for the occupational setting and where large scale emergency spills may result in local population exposure, data from river die-away tests suggest degradation is complete within 3 days at 20 deg C and 5-14 days at 8 deg C (HSDB, 2012). This implies rapid degradation of ethylene glycol in surface water. This limits its ability for accumulation and sustained environmental presence even though its mobility characteristics are high.

## References

ATSDR (Agency for Toxic Substances and Disease Registry), 2010. *Toxicological Profile for Ethylene Glycol.*, Division of Toxicology and Environmental Medicine/Applied Toxicology Branch, Public Health Service, US Department of Health and Human Services. Available at <http://www.atsdr.cdc.gov/ToxProfiles/TP.asp?id=86&tid=21>, Accessed January 2020.

EC (European Commission) 2000. *European Commission Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption, preparation of a candidate list of substances as a basis for priority setting, Final Report (Incorporating corrigenda to final report dated 21 June 2000)*. BKH Consulting Engineers, Delft, The Netherlands in association with TNO Nutrition and Food Research, Zeist, The Netherlands Available at [http://ec.europa.eu/environment/chemicals/endocrine/strategy/substances\\_en.htm#priority\\_list](http://ec.europa.eu/environment/chemicals/endocrine/strategy/substances_en.htm#priority_list), Accessed January 2020.

ECHA (European Chemicals Agency Registered Chemical Substances Search) 2020. *Dossier of Ethane-1,2-diol*. Available at <https://echa.europa.eu/registration-dossier/-/registered-dossier/15973/1>, Accessed January 2020.

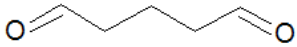
Safe work Australia (2020) HCIS (Hazardous Chemical Information System) 2020. *Hazardous Substances Information System for Ethylene glycol*. Safework Australia. Available at: <http://hcis.safeworkaustralia.gov.au/ExposureStandards/Details?exposureStandardID=722>, Accessed January 2020.

HSDB 2020. *Ethylene glycol*. Hazardous Substances Data Bank, PUBCHEM, US National Library of Medicine. Available at <https://pubchem.ncbi.nlm.nih.gov/compound/174> . Accessed January 2020.

IARC (International Agency for Research on Cancer) 2019. *International Agency for Research on Cancer Agents classified by IARC Monographs*, Volumes 1- 125. Last updated: 12 December 2019, Available at <http://monographs.iarc.fr/ENG/Classification/index.php>., Accessed January 2020.

USEPA (United States Environmental Protection Authority) 2019. *Regional Screening Levels for Chemical Contaminants at Superfund Sites* Updated November 2019. Accessed 23 January 2020. <https://www.epa.gov/risk/regional-screening-levels-rsls>

Created by:	LPA	Date: 18/12/2019
Reviewed by:	CLB	Date and Revision: 23/01/2020

Name	Glutaraldehyde
Synonyms	Glutaral; 1,5-pentanedial Pentanedial; 1,5-pentanedione; 1,3-diformylpropane; Glutaric dialdehyde; Glutaral Glutardialdehyde; Potentiated Acid Glutaraldehyde
CAS number	111-30-8
Molecular formula	C <sub>5</sub> H <sub>8</sub> O <sub>2</sub>
Molecular structure	

Overview	References
<p>Glutaraldehyde is a colourless oily liquid which has a variety of uses. In Australia, it's primarily used as a cold disinfectant by the health care industry. Other uses include as a hardener in x-ray film processing, as a fixative in tanning, as a disinfectant of animal housing, aircraft and portable toilets, as a preservative in industrial oils and as a biocide in aquaculture. Glutaraldehyde is primarily used as an aqueous solution, ranging in concentration from 50% w/w to less than 1% w/w. It is not manufactured as a pure chemical in Australia (based on the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (1994) review) but is imported by a number of companies (usually as a 25, 45 or 50 % w/w aqueous solution).</p> <p>Glutaraldehyde was declared a Priority Existing Chemical (PEC) in 1993 under the <i>Industrial Chemicals (Notification and Assessment) Act, 1989</i> due to adverse health concerns, which could result from individuals being exposed through the production, handling, use and disposal of glutaraldehyde. Occupational exposure to glutaraldehyde has resulted in occupational asthma, significant skin, respirator and eye irritation, as well as skin sensitisation in some cases.</p> <p>The Hazardous Chemical Information System (HCIS) provided by Safe Work Australia, lists the following hazard statements glutaraldehyde:</p> <ul style="list-style-type: none"> <li>• H330 (Fatal if inhaled)</li> <li>• H301 (Toxic if swallowed)</li> <li>• H335 (May cause respiratory irritation)</li> <li>• H314 (Causes severe skin burns and eye damage)</li> <li>• H334 (May cause allergy or asthma symptoms or breathing difficulties if inhaled)</li> <li>• H317 (May cause an allergic skin reaction)</li> <li>• H400 (Very toxic to aquatic life)</li> <li>• H411 (Toxic to aquatic life with long-lasting effects)</li> </ul>	<p>NICNAS 1994</p>

Human Health Toxicity Summary	Reference
<p><b>Carcinogenicity</b></p> <p>Glutaraldehyde has not been evaluated by the International Agency for Research on Cancer (IARC) as to its carcinogenicity.</p> <p>Glutaraldehyde is not classified as carcinogenic by ECHA, as no carcinogenic potential was evident from its review of oral and inhalative long-term animal studies. . ECHA presents a 2 year oral feeding study of rats which reported that neoplastic findings were spontaneous in origin and showed no treatment-relationship. The animals were fed glutaraldehyde (in water) daily ranging from 6.1 mg/kg bw/day to 176.4 mg/kg bw/day.</p> <p>In a second 2 years drinking water study rats receiving daily glutaraldehyde in water (between 4 mg/kg bw/day and 86 mg/kg bw/day) reported that overall there was a statistically significant increased incidence of large granular lymphocytic leukaemia (LGLL) in the liver and spleen only in female rats in both dose groups The finding was not conclusive as the strain of rats used in the study has a high natural susceptibility to LGLL and variation in control data existed within the study laboratory.</p>	<p>IARC 2020</p> <p>ECHA 2020</p> <p>OECD SIDS 2017</p>
<p><b>Mutagenicity/Genotoxicity</b></p> <p>Glutaraldehyde is not classified as a mutagen by ECHA. From a review of available information, ECHA concluded that no classification is warranted according to EU Classification, Labelling and Packaging of Substances and Mixtures (CLP) Regulation (EC) No. 1272/2008.</p> <p>An in vivo cytogenicity study indicates that for rats who received 200 mg/kg bw or 400 mg/kg bw glutaraldehyde by oral gavage, the test was negative for genotoxicity.</p> <p>However, studies have indicated the glutaraldehyde is mutagenic in bacterial assays (in vitro studies).</p>	<p>ECHA 2020</p> <p>ECHA 2020</p>
<p><b>Reproductive Toxicity</b></p> <p>Glutaraldehyde is not classified as reproductive toxicant by ECHA. From a review of available information, ECHA conclude that glutaraldehyde does not affect the reproductive performance and fertility, and neither possesses an embryo/fetotoxic nor a teratogenic potential. Therefore, no classification is warranted according to EU Classification, Labelling and Packaging of Substances and Mixtures (CLP) Regulation (EC) No. 1272/2008).</p> <p>A summary of a reproductive study states a NOAEL of 68 mg/kg bw/day for embryotoxicity. This was the highest dose group. Female rats were exposed to glutaraldehyde in their drinking water from day 6 to day 16 of gestation. Another similar study lists a LOAEL for maternal toxicity of 51 mg/kg bw/day (highest dose tested) based on reduction in food and water consumption and on the presence of foci in the glandular stomach of 2 animals.</p>	<p>ECHA 2020</p>
<p><b>Developmental Toxicity/Teratogenicity</b></p> <p>Glutaraldehyde is not classified as a developmental toxicant by ECHA (ECHA states conclusive data has been reviewed, indicating low toxicity which doesn't support classification under the GHS).</p> <p>Two studies cited by ECHA indicated there was no evidence of teratogenicity in female rats fed glutaraldehyde in water during gestation. The highest dose was 68 mg/kg bw/day.</p>	<p>ECHA 2020</p>



<p><b>Endocrine Disruption</b></p> <p>Glutaraldehyde is not identified in the European Commission (EC)'s report, "<i>Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption</i>" as a substance of interest.</p>	<p>EC 2000</p>
<p><b>Acute Toxicity (oral, dermal, inhalation)</b></p> <p>Glutaraldehyde is classified as acutely toxic via the oral and inhalation route by ECHA based on its classification thresholds (Acute Tox 3: H301: Toxic if swallowed and Acute Tox 2: H330: Fatal if inhaled.).</p> <p><i>Oral</i></p> <p>ECHA reports an oral LD<sub>50</sub> of 77 mg/kg bw for female rats (pure glutaraldehyde, based on a LD<sub>50</sub> of 154 mg/kg bw of the test substance) from the key study. The glutaraldehyde was administered orally (by gavage) at doses of 100, 200, 400 mg/kg bw (test material) for male rats and 100, 141, 200 mg/kg bw (test material 50%) for female rats. Other clinical signs of toxicity were seen in all treated groups and included sluggishness, lacrimation, piloerection, diarrhea, trace amount of blood in the urine of two rats, a red crust on the perinasal fur and a brown stain on the perineal fur (of 1 rat).</p> <p><i>Inhalation</i></p> <p>ECHA cites a study which reports an inhalation LC<sub>50</sub> of 0.48 mg/ L air (480 mg/m<sup>3</sup>) for male and female rats. The test was conducted in general accordance with OECD Guidelines 403 (Acute Inhalation Toxicity). The exposure duration was 4 hours and the rats were exposed to the test substance as liquid aerosol at the following nominal concentrations: 0.35, 0.58 and 0.72 mg/L.</p> <p>ECHA reports an inhalation LC<sub>50</sub> range between 0.28 and 0.39 mg/L air (50% glutaraldehyde). The test was conducted in general accordance with OECD Guidelines 403 (Acute Inhalation Toxicity). The exposure duration was 4 hours and the rats were exposed to the test substance as liquid aerosol.</p> <p><i>Dermal</i></p> <p>ECHA cites a study which reports a dermal LD<sub>50</sub> of &gt; 2000 mg/kg bw for male and female rabbits. Glutaraldehyde was applied semiocclusively at the one dose and the exposure period was 24 hours. Animals were observed for mortality, body weights, clinical signs or toxicity and local skin changes for 14 days after exposure. Limited clinical signs of mucoid faeces and wet brown urogenital staining were observed in the first 3 days of observation. Necropsy revealed thickening and scabbing of the application sites in all animals. No further treatment-related abnormalities were reported.</p>	<p>ECHA 2020</p>
<p><b>Chronic/repeat dose toxicity (oral, dermal, inhalation)</b></p> <p>Glutaraldehyde is not classified based on serious effects to organ systems following repeat dose exposure by the oral, dermal or inhalation route.</p> <p>ECHA presents summarise of a number of key studies including three <b>oral</b> studies where NOAELs determined ranged from 14.6 to 23.0 mg/kg bw pure glutaraldehyde. ECHA adopts a NOAEL for oral exposure of 15 mg/kg bw/day.</p> <p>Several <b>inhalation</b> studies indicate that glutaraldehyde affects primarily the respiratory tract. The NOAECs for local and systemic effects were determined to be 0.25 and 0.5 mg/m<sup>3</sup>, respectively.</p>	<p>ECHA 2020</p>

<p>A <b>dermal</b> exposure study conducted in accordance with OECD Guideline 411 (Subchronic Dermal Toxicity: 90-Day Study) examined doses of 0, 50, 100 and 150 mg/kg bw/day (active ingredient) applied to rats for 5 days a week over a period of 13 weeks. The NOAEL for systemic toxicity was established at 150 mg/kg/day.</p> <p>ECHA conclude that systemic toxicity of glutaraldehyde under repeated oral or dermal exposure is not expected, Under repeated inhalation exposure conditions, the upper respiratory tract was identified as target for the toxicity of glutaraldehyde vapours. Therefore, according to Annex VI of EU Classification, Labelling and Packaging of Substances and Mixtures (CLP) Regulation (EC) No. 1272/2008 and based on the available data, glutaraldehyde does not have to be classified.</p>	
<p><b>Sensitisation of the skin or respiratory system</b></p> <p>Glutaraldehyde is classified as potentially causing an allergic <b>skin</b> reaction by ECHA based on its classification thresholds. According to Annex VI of EU Classification, Labelling and Packaging of Substances and Mixtures (CLP) Regulation (EC) No. 1272/2008) and based on the available data, glutaraldehyde has to be classified as Skin Sens. 1A: H317 and Resp. Sens. 1: H334.</p> <p>ECHA based the above conclusion on a number of key studies, including tested with an open cutaneous test, LLNA, Guinea Pig Maximisation Test, Buehler test, and the mouse ear swelling test and human sensitising studies. Besides a Buehler test and one guinea pig maximisation test, all animal studies indicate that glutaraldehyde is sensitising to skin. Human sensitisation was reported in studies using patch tests on volunteers, and in clinical case reports of contact dermatitis, particularly in occupation settings.</p> <p>Animal studies of <b>respiratory sensitisation</b> are not available. However, several studies have indicated occupational asthma and/or rhinitis have been linked with exposure to glutaraldehyde in the workplace.</p> <p>Glutaraldehyde is classified by Safe Work Australia (2020) as potentially causing allergy or asthma symptoms or breathing difficulties if inhaled.</p>	<p>ECHA 2020</p> <p>Safe Work Australia 2020</p>
<p><b>Corrosion (irreversible)/irritation (reversible) effects on the skin or eye</b></p> <p>Glutaraldehyde is classified as causing severe skin burns and eye damage by ECHA based on its classification thresholds.</p> <p>According to Annex VI of EU Classification, Labelling and Packaging of Substances and Mixtures (CLP) Regulation (EC) No. 1272/2008 and based on the available data, glutaraldehyde has to be classified as Skin Corr. 1B: H314; Causes severe skin burns and eye damage and STOT SE 3: H335: May cause respiratory irritation.</p> <p>A skin corrosion/irritation study of white rabbits was presented by ECHA, which reported erythema and edema were observed after occlusive application of undiluted glutaraldehyde. The effects were observed to not be reversible after 4-hour exposure.</p> <p>ECHA provides a study which found that glutaraldehyde was found to cause eye damage which was not reversible. 0.1 mL of the test substance (~50% glutaraldehyde) was applied into the conjunctival sac of the right eye and the rabbits were observed for 8 days.</p>	<p>ECHA 2020</p>

Physical Hazards	Reference
<b>Flammable Potential</b> Non flammable liquid	ECHA 2020
<b>Explosive Potential</b> Non explosive	ECHA 2020

Toxicity Values	Value	Reference
<b>Human Toxicity Data</b>		
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEC	NDF	
LOAEL	NDF	
<b>Animal Toxicity Data</b>		
<i>Acute Toxicity</i>		
<i>LD<sub>50</sub></i>		
Rat, oral	77 mg/kg bw (pure GA)	ECHA 2020
Mouse, oral	27 mg/kg bw (pure GA)	ECHA 2020
Rabbit, oral	133 mg/kg bw (pure GA)	ECHA 2020
Rat, dermal	> 2000 mg/kg bw (50% GA)	ECHA 2020
Rabbit, dermal	> 2000 mg/kg bw (50% GA)	ECHA 2020
Mouse, dermal	> 2000 mg/kg bw (50% GA)	ECHA 2020
<i>LC<sub>50</sub></i>		
Rat	0.28 mg/L (280 mg/m <sup>3</sup> ) (50% GA)	ECHA 2020
<i>High Chronic/Repeat Dose Toxicity</i>		

LOAEL (rats, oral, maternal toxicity, 50% GA)	51 mg/ kg bw/day	ECHA 2020
NOAEL (rats, oral, non-neoplastic effects, pure GA)	15 mg/kg bw/day	ECHA 2020
NOAEL (rats, oral, reproductive toxicity, embryotoxicity, 50% GA)	68 mg/kg bw/day	ECHA 2020

Footnotes:

LD<sub>50</sub> – lethal dose for 50% of experimental population

LC<sub>50</sub> – lethal air concentration for 50% of experimental population

LOAEL – Lowest Observed Adverse Effect Level

LOAEC – Lowest Observed Adverse Effect Concentration

NDF – No data found within the limits of the search strategy

Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Band 4</b>		
Carcinogenicity (IARC Group 1 or 2A)	No	IARC 2020 ECHA 2020
Mutagenicity/Genotoxicity (GHS Category 1A and 1B)	No	ECHA 2020
Reproductive Toxicity/Developmental toxicity (GHS Category 1, 1A and 1B)	No	ECHA 2020
Endocrine Disruption <sup>1</sup>	No	EC 2000
<b>Hazard Band 3</b>		
Carcinogenicity (IARC Group 2B)	No	IARC 2020 ECHA 2020
Mutagenicity/Genotoxicity (GHS Category 2)	No	ECHA 2020
Reproductive Toxicity/Developmental toxicity (GHS Category 2)	No	ECHA 2020
Acute Toxicity (oral, dermal or inhalation)  Very Toxic/Toxic <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> ≤ 300 mg/kg<sup>2</sup></li> <li>• dermal LD<sub>50</sub> ≤ 1000 mg/kg</li> <li>• inhalation LC<sub>50</sub> ≤ 10 mg/L<sup>3</sup> (or mg/m<sup>3</sup>) (vapour)</li> </ul>	Yes	Oral LD <sub>50</sub> : 77 mg/kg bw (pure GA)  ECHA 2020, see below
High Chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL ≤ 10 mg/kg/d<sup>2</sup>;</li> <li>• dermal LOAEL ≤ 20 mg/kg/d;</li> <li>• inhalation LOAEC (6 h/d) ≤ 50 ppm/d for gases, ≤ 0.2 mg/L/d for vapours or ≤ 0.02 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	No	ECHA 2020, see below
Corrosive (irreversible effect)	Yes	ECHA 2020
Respiratory sensitiser	Yes	ECHA 2020

Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Band 2</b>		
Harmful chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL &gt; 10 mg/kg/d and ≤ 100 mg/kg/d</li> <li>• dermal LOAEL &gt; 20 mg/kg/d and ≤ 200 mg/kg/d</li> <li>• inhalation (6-h/d) LOAEC &gt; 50 mg/L ≤ 250 mg/L/d for gases, &gt; 0.2 mg/L ≤ 1.0 mg/L/d for vapours or &gt; 0.02 mg/L ≤ 0.2 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	Yes	Oral LOAEL, rats, of 51 mg/kg bw/day (50% GA) ECHA 2020
Skin Sensitiser	Yes	ECHA 2020
<b>Hazard Band 1</b>		
Acute Toxicity-Harmful <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> &gt; 300 mg/kg ≤ 2000 mg/kg</li> <li>• dermal LD<sub>50</sub> &gt; 1 000 mg/kg ≤ 2000 mg/kg;</li> <li>• inhalation LC<sub>50</sub> (6 h/d) &gt; 10 mg/L ≤ 20 mg/L for vapours)<sup>3</sup></li> </ul>	Yes	oral LD <sub>50</sub> , rat, of 316 mg/kg bw, ECHA 2020
Irritant (reversible effect)	Yes	
<b>Hazard Band 0</b> All indicators outside criteria listed in Hazards 1-4		
<b>Physical Hazards</b>		
Flammable potential	No	
Explosive potential	No	
<b>Hazard Evaluation (highest band) not including physical hazards</b>	Hazard Band 3	<b>Corrosive to skin and respiratory sensitiser, and acute oral toxicity</b>
<b>Data confidence (available points out of 12 parameters)</b>	12/12	<b>100%</b>

\* Based on IMAP Framework [NICNAS (2013) Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework. National Industrial Chemicals Notification and Assessment Scheme. Department of Health and Aging, Canberra].

<sup>1</sup> Based on list of endocrine disrupting chemicals from the European Commission's Endocrine Disruptors website.

<sup>2</sup> milligrams per kilogram body mass (mg/kg) or milligrams per kilogram body mass per day (mg/kg/d)

<sup>3</sup> Based on GHS cut-offs for hazard classification. For chronic/repeat dose toxicity, GHS cut-offs are provided as guidance values (i.e. the dose/concentration at or below which significant health effects are observed)". (p 18, NICNAS 2013).

Human Health Guidelines		
Media	Concentration (mg/m <sup>3</sup> ; mg/L; mg/kg)	Reference
<b>Occupational Exposure Limits</b>		
<b>Air (OEL)</b>		
8-h TWA	NDF	
STEL	NDF	
Peak Limitation	0.41 mg/m <sup>3</sup> (0.1 ppm)	Safe Work Australia 2020
<b>Environmental Exposure</b>		
<b>Air, ambient, residential</b>	NDF	
<b>Air, commercial/industrial</b>	NDF	
<b>Water, potable</b>	NDF	
<b>Water, recreational</b>	NDF	
<b>Soil, residential</b>	NDF	
<b>Soil, commercial/industrial</b>	NDF	
<b>Soil, protection of groundwater</b>		

Footnotes:

OEL = Occupational Exposure Limit

TWA = 8 h Time-Weighted Average

STEL = (15 min) Short-term Exposure Limit

### Qualifying Summary Comments

Glutaraldehyde is a colourless oily liquid which has a variety of uses. In Australia, it's primarily used as a cold disinfectant by the health care industry. Glutaraldehyde was declared a Priority Existing Chemical (PEC) in 1993 under the *Industrial Chemicals (Notification and Assessment) Act, 1989* due to adverse health concerns, which could result from individuals being exposed through the production, handling, use and disposal of glutaraldehyde. Glutaraldehyde is considered acutely toxic via the oral and inhalation route and is corrosive to the skin and eyes. Occupational exposure to glutaraldehyde has resulted in occupational asthma from inhalation, significant skin, respiratory system and eye irritation, as well as skin sensitisation in some cases from skin exposure. The inhalation hazards associated with use of glutaraldehyde need to be managed in an occupational setting as it can cause asthma. Glutaraldehyde has been ranked in Hazard Band 3, based on the potential for it to be corrosive to the skin and eyes, a respiratory sensitiser and acutely toxic via the oral route of exposure. These effects were observed for both undiluted and diluted solutions of glutaraldehyde. It is noted that the rapid metabolism of glutaraldehyde in soil and the rapid biodegradation of glutaraldehyde in the aquatic environment, along with the fact that it is not expected to bioaccumulate (see the Ecotoxicology section of the cover addendum), limits the potential for glutaraldehyde to persist under general environmental conditions.

### References

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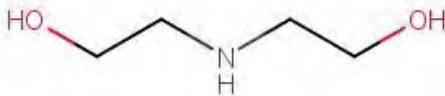
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Created by:	LP	Date: 18/12/2019
Reviewed by:	CLB	Date of Revision: 13/02/2020





Name	Diethanolamine
Synonyms	2,2'-iminodiethanol 2-[(2-hydroxyethyl)amino]ethan-1-ol DEA
CAS number	111-42-2
Molecular formula	C <sub>4</sub> H <sub>11</sub> NO <sub>2</sub>
Molecular Structure	 <p>(Source: ECHA, 2019)</p>

Overview	References
<p>Diethanolamine is a colourless solid, sometimes found as a syrupy liquid (at 20°C and 1013 hPa), with an ammonia-like odour. It has a molecular weight of 105.136. It has melting point of 27-28°C and a boiling point of 269.9°C at 1013.25 hPa, with decomposing likely at temperatures over 200°C. It has a density of 1.1 g/cm<sup>3</sup> and is considered miscible with water (solubility of 1000 g/L) at 20°C.</p> <p>Diethanolamine has numerous industrial uses, including as a chemical intermediate and as a corrosive inhibitor and surface-active agent in metal working fluids, leather, fuels, cosmetic formulations, papers and textiles, paints and inks, as well as a dispensing agent for agricultural chemicals and in gas treatment.</p> <p>Once in the environment, diethanolamine is considered readily biodegrade according to OECD criteria. Diethanolamine will rapidly degrade by photochemical processes (half-life of 4.2 hours) following evaporation or exposure to air. However, based on Henry's Law Constant, diethanolamine is not expected to evaporate into the atmosphere. Hydrolysis is also not expected based on structural properties. Diethanolamine has a low potential for bioaccumulation (a log k<sub>ow</sub> &lt;= 3) or bioconcentration, and adsorption to solid soil phase is not expected.</p>	<p>ECHA, 2019 U.S. EPA, 2012</p>

Human Health Toxicity Summary	Reference
<p><b>Carcinogenicity</b></p> <p>Diethanolamine has been evaluated by the International Agency for Research on Cancer (IARC) as to its carcinogenicity. Diethanolamine was assigned Group 2B (assessment in 2013) indicating it is possibly carcinogenic to humans.</p>	<p>IARC, 2019</p>

<p><b>Mutagenicity/Genotoxicity</b></p> <p>The ECHA dossier, based on the available data, considered that diethanolamine does not need to be classified for genotoxicity.</p> <p>The ECHA dossier cites several in vitro tests and an in vivo test observing no mutagenic, clastogenic or genotoxic effects. Diethanolamine did not induce reverse mutations in <i>Salmonella typhimurium</i> or <i>Escherichia coli</i>. Diethanolamine did not induce chromosomal aberrations in rat hepatocytes, sister chromatid exchange or chromosomal aberrations in Chinese hamster ovary cells or gene mutation in mouse lymphoma cells. Diethanolamine (formulated in ethanol) did not induce micronuclei in vivo peripheral blood erythrocytes of mice after repeated unoccluded dermal application for 13 weeks at doses clearly showing systemic availability.</p>	ECHA, 2019
<p><b>Reproductive Toxicity</b></p> <p>The ECHA dossier, based on the available data, classified diethanolamine for effects on fertility and developmental toxicity. ECHA states that “classification with category 2 for reproductive toxicity (H361) is considered the most appropriate in line with the criteria laid down in Regulation EC 1272/2008 (CLP)”.</p> <p>The ECHA dossier describes several reproductive toxicity tests. Details are provided for a key extended one-generation reproductive toxicity study in rats exposed to diethanolamine in drinking water. The LOAEL for general toxicity was 300 ppm based on evidence for distinct kidney toxicity and stomach irritation, as well as corresponding effects on water consumption, food consumption, body weights and clinical pathological parameters. The LOEAL for fertility and reproductive performance was 1000 ppm based on a lower number of implants, prolonged/irregular estrous cycles as well as pathological changes in sexual organs, pituitary and mammary glands of both genders. Although eosinophilic cysts in the pituitary gland were present in the F1 animals down to the 100 ppm dose level, but no assessment on adversity of this finding was possible.</p> <p>In summary, ECHA states that reproductive toxicity was substance- and dose relate but occurred in the presence of distinct general systemic toxicity in the mothers and in the offspring.</p>	ECHA, 2019
<p><b>Developmental Toxicity/Teratogenicity</b></p> <p>The ECHA dossier, based on the available data, classified diethanolamine for effects on fertility and developmental toxicity. ECHA states that “classification with category 2 for reproductive toxicity (H361) is considered the most appropriate in line with the criteria laid down in Regulation EC 1272/2008 (CLP)”.</p> <p>The ECHA dossier concluded that diethanolamine only caused developmental toxicity in the presence of clear maternal toxicity and at dose levels considered as high, based on the available studies with rats and rabbits for the inhalation, dermal and oral route of exposure. ECHA also noted that maternal toxicity was observed at levels higher/comparable to general toxic effects in the repeated dose toxicity studies.</p>	ECHA, 2019
<p><b>Endocrine Disruption</b></p> <p>Diethanolamine is not identified in the European Commission (EC)’s report, “<i>Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption</i>” as a substance of interest.</p>	EC, 2000

<p><b>Acute Toxicity (oral, dermal, inhalation)</b></p> <p>The ECHA dossier, based on the available data, classified diethanolamine for acute oral toxicity (classification Xn; R22). Diethanolamine is considered to have moderate acute oral toxicity and low toxicity following inhalation exposure.</p> <p>In the key study for <b>oral</b> exposure, the LD50 for males and females combined was 1 600 mg/kg bw. This study was performed to a comparable protocol as OECD guideline 401. Five rats per sex were dosed with 200 – 3200 mg/kg bw and observed up to 14 days. In their summary, ECHA reported that no deaths occurred up to 1000 mg/kg bw dosing group. Reported clinical signs were tumbling, staggering gait, twitches, convulsions, dyspnoea, abdominal lateral position and scrubby coat. Gross pathology revealed hydrothorax, local adhesions of the gut and signs of irritation on the gastrointestinal tract. Two additional acute oral studies were considered by ECHA as supporting studies. One study reported an LD<sub>50</sub> of 1 820 mg/kg bw in female Wistar rats. The second study reported that for male rats receiving a single oral dose of aqueous diethanolamine solutions in the range of 100 – 6400 mg/kg bw, at the top dose 7/8 rats died. At &gt; 100 mg/kg bw onwards increased liver weight was reported, and an increase in the relative kidney weight was reported at &gt;1600 mg/kg.</p> <p>Acute <b>inhalation</b> tests showed no mortality in rats after 8-hour exposure to an atmosphere enriched with diethanolamine vapour. The highest concentration attainable was approximately 1.9 mg/m<sup>3</sup>. Another study reported that after exposure of 3.35 mg/L for up to 4 hours no rats died. Toxicological signs consisted predominantly of lethargy and irregular respiration.</p> <p>For the <b>dermal</b> route of exposure, no reliable data was available.</p>	<p>ECHA, 2019</p>
<p><b>Chronic/repeat dose toxicity (oral, dermal, inhalation)</b></p> <p>The ECHA dossier, based on the available data, classified diethanolamine for chronic (repeated dose) oral toxicity, Classified as Xn, R48/22).</p> <p>The ECHA dossier cites two sub-chronic <b>oral</b> studies, with diethanolamine administered via drinking water (protocols similar to OECD TG 408). Mortality was observed in males at ≥ 5000 ppm and in females at ≥ 2 500 ppm. In the first study on rats, impaired body weight gains were observed at concentrations ≥ 320 ppm in females and 630 ppm in males. Systemic effects observed included anaemia, nephrotoxicity, cortical vacuolization of adrenal glands and demyelination of brain/spinal cord without any neurofunctional finding. Based on anaemia, a LOAEL of 25 mg/kg bw/day (equal to 320 ppm) male and of 14 mg/kg bw/day (equal to 160 ppm) for females was reported. In the second study on mice, body weight gain was decreased in both species at concentrations of 1250 ppm for females and 2500 ppm for males. Systemic effects consisted of hepato- and nephrotoxicity and myocardial degeneration. Based on necrotic liver damages, a LOAEL of 104 mg/kg bw/day (equal to 630 ppm) for males and a LOAEL of 142 mg/kg bw/day for females was reported (equal to 630 ppm).</p> <p><b>Dermal</b> exposure of rats and mice lead to mortality at high dose levels (&gt; 500 mg/kg bw in rats and &gt; 1000 mg/kg bw in mice). The study involved repeated unoccluded dermal application of ethanolic diethanolamine solution in subacute (14 days) and subchronic (13 weeks, protocol similar to OECD TP 411). Systemic effects observed in rats included signs of toxicity predominantly of anaemia and nephropathy. In mice, these effects were mainly in the form of liver and kidney damage. The study reported a LOAEL of 32 mg/kg bw/day in rats and a LOAEL of 80 mg/kg bw/day in mice.</p> <p>In a 2-year dermal study with rats and mice, non-carcinogenic effects were also observed. Critical effects were reported to be kidney (nephropathy) and liver toxicity, anaemia and dermal hyperkeratosis/acanthosis, with effects observed at the lowest tested dermal dose. The dermal LOAEL from this study was 8 mg/kg bw/day.</p> <p>Following <b>inhalation</b> (nose-only) exposure of rats to diethanolamine aerosols for 3 months, systemic and local effects were observed. Studies followed OECD TG 413. Systemic effects included kidney effects, adaptive liver effects and mild normochromic microcytic anaemia and some influences on the male reproductive system. Local effects observed included respiratory tract irritation, squamous</p>	<p>ECHA, 2019</p>

<p>metaplasia of the laryngeal epithelium and inflammatory responses. The NOAEC for systematic effects was 15 mg/m<sup>3</sup> and the NOAEC for local respiratory tract effects was 3 mg/m<sup>3</sup>.</p>	
<p><b>Sensitisation of the skin or respiratory system</b></p> <p>The ECHA dossier lists diethanolamine as not sensitising to the skin and states that based on the available data, diethanolamine does not need to be classified for skin sensitisation.</p> <p>In a Guinea pig Maximisation test according to OECD TG 406, no skin sensitising potential of Diethanolamine was noted. The test involved 40 female Himalayan Guinea pigs.</p> <p>The ECHA dossier identifies occupational sensitisation in the industrial use of diethanolamine in water-based metalworking fluids. However sensitisation was considered likely due to regular exposure to these fluids and secondary skin conditions not attributable to diethanolamine. .</p>	<p>ECHA, 2019</p>
<p><b>Corrosion (irreversible)/irritation (reversible) effects on the skin or eye</b></p> <p>The ECHA dossier lists diethanolamine as irritating to the skin and highly irritating to the eyes. Based on this, ECHA classifies diethanolamine as Xi; R38 (irritating to the skin) and R41 (risk of serious damage to eyes).</p> <p>The key experimental study cited by ECHA reported both pure and technical diethanolamine (concentration reported as undiluted) applied via a patch test induced slight skin irritation after 1 – 15 minutes, while distinct irritation was noted after 20 hours. The test was undertaken in either equivalent or similar to OECD Guideline 404. The mean erythema and edema scores for 24, 48 and 72 hours in case of 20 h exposure were 2 and 1.33, respectively (noting that erythema was present at 72 hours, while edema was absent at 72 hours). Comparable results were observed in another study.</p>	<p>ECHA, 2019</p>

Physical Hazards	Reference
<p><b>Flammable Potential</b></p> <p>The ECHA dossier lists diethanolamine as non-flammable upon ignition. Diethanolamine has no pyrophoric properties and does not liberate flammable gases in contact with water and the substance is not a self-heating substance or mixture.</p>	ECHA, 2019.
<p><b>Explosive Potential</b></p> <p>The ECHA dossier lists diethanolamine as non-explosive.</p>	ECHA, 2019.

Toxicity Values	Value	Reference
<b>Human Toxicity Data</b>		
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEC	NDF	
LOAEL	NDF	
<b>Animal Toxicity Data</b>		
<i>Acute Toxicity</i>		
<i>LD<sub>50</sub></i>		
Rat, oral	LD <sub>50</sub> : 1 820 mg/kg bw	ECHA, 2019
<i>LC<sub>50</sub></i>		
Rat	LC <sub>0</sub> (8 h, rat, male/female): 200 mg/m <sup>3</sup> LC <sub>0</sub> (4 h, rat, male) 3 350 mg/m <sup>3</sup>	ECHA, 2019
<i>High Chronic/Repeat Dose Toxicity</i>		
NOAEL/ LOAEL	LOAEL (rat, oral (drinking water), male): 25 mg/kg bw/day LOAEL (rat, oral (drinking water), female): 14 mg/kg bw/day  LOAEL (mouse, oral (drinking water), male): 104 mg/kg bw/day LOAEL (mouse, oral (drinking water), female): 142 mg/kg bw/day  LOAEL (rat and mouse, dermal): 8 mg/kg bw/day	ECHA, 2019

NOAEC/ LOAEC	NOAEC (rat, inhalation (nose-only), systemic): 15 mg/m <sup>3</sup> NOAEC (rat, inhalation (nose-only), local respiratory tract): 3 mg/m <sup>3</sup>	ECHA, 2019
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Footnotes:

LD<sub>50</sub> – lethal dose for 50% of experimental population  
 LC<sub>50</sub> – lethal air concentration for 50% of experimental population  
 LOAEL – Lowest Observed Adverse Effect Level  
 LOAEC – Lowest Observed Adverse Effect Concentration  
 NOAEL – No Observed Adverse Effect Level  
 NOAEC – No Observed Adverse Effect Concentration  
 NDF – No data found within the limits of the search strategy

Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Band 4</b>		
Carcinogenicity (IARC Group 1 or 2A)	No	
Mutagenicity/Genotoxicity (GHS Category 1A and 1B)	No	
Reproductive Toxicity/Developmental toxicity (GHS Category 1, 1A and 1B)	No	
Endocrine Disruption <sup>1</sup>	No	Not listed by EC.
<b>Hazard Band 3</b>		
Carcinogenicity (IARC Group 2B)	Yes	IARC classification
Mutagenicity/Genotoxicity (GHS Category 2)	No	Not classifiable according to ECHA.
Reproductive Toxicity/Developmental toxicity (GHS Category 2)	Yes	ECHA classification
Acute Toxicity (oral, dermal or inhalation)  Very Toxic/Toxic <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> ≤ 300 mg/kg<sup>2</sup></li> <li>• dermal LD<sub>50</sub> ≤ 1000 mg/kg</li> <li>• inhalation LC<sub>50</sub> ≤ 10 mg/L<sup>3</sup> (or mg/m<sup>3</sup>) (vapour)</li> </ul>	No	Oral LD <sub>50</sub> of 1820 mg/kg bw
High Chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL ≤ 10 mg/kg/d<sup>2</sup>;</li> <li>• dermal LOAEL ≤ 20 mg/kg/d;</li> <li>• inhalation LOAEC (6 h/d) ≤ 50 ppm/d for gases, ≤ 0.2 mg/L/d for vapours or ≤ 0.02 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	Yes	Dermal LOAEL of 8 mg/kg/d
Corrosive (irreversible effect)	No	
Respiratory sensitiser	No	
<b>Hazard Band 2</b>		



Human Health Toxicity Ranking		
	Hazard data	Comment
Harmful chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL &gt; 10 mg/kg/d and ≤ 100 mg/kg/d</li> <li>• dermal LOAEL &gt; 20 mg/kg/d and ≤ 200 mg/kg/d</li> <li>• inhalation (6-h/d) LOAEC &gt; 50 mg/L ≤ 250 mg/L/d for gases, &gt; 0.2 mg/L ≤ 1.0 mg/L/d for vapours or &gt; 0.02 mg/L ≤ 0.2 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	Yes	Oral LOAEL of 14 mg/kg/d
Skin Sensitiser	No	
<b>Hazard Band 1</b>		
Acute Toxicity-Harmful <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> &gt; 300 mg/kg ≤ 2000 mg/kg</li> <li>• dermal LD<sub>50</sub> &gt; 1 000 mg/kg ≤ 2000 mg/kg;</li> <li>• inhalation LC<sub>50</sub> (6 h/d) &gt; 10 mg/L ≤ 20 mg/L for vapours)<sup>3</sup></li> </ul>	Yes	Oral LD <sub>50</sub> of 1820 mg/kg bw
Irritant (reversible effect)	Yes	
<b>Hazard Band 0</b> All indicators outside criteria listed in Hazards 1-4	No	
<b>Physical Hazards</b>		
Flammable potential	No	
Explosive potential	No	
<b>Hazard Evaluation (highest band) not including physical hazards</b>	3	Based on carcinogenic and reproductive toxicity potential.
<b>Data confidence (available points out of 12 parameters)</b>	12/12	100%

\* Based on IMAP Framework [NICNAS (2013) Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework. National Industrial Chemicals Notification and Assessment Scheme. Department of Health and Aging, Canberra].

<sup>1</sup>Based on list of endocrine disrupting chemicals from the European Commission's Endocrine Disruptors website.

<sup>2</sup> milligrams per kilogram body mass (mg/kg) or milligrams per kilogram body mass per day (mg/kg/d)

<sup>3</sup> Based on GHS cut-offs for hazard classification. For chronic/repeat dose toxicity, GHS cut-offs are provided as guidance values (i.e. the dose/concentration at or below which significant health effects are observed)". (p 18, NICNAS 2013).

Human Health Guidelines		
Media	Concentration (mg/m <sup>3</sup> ; mg/L; mg/kg)	Reference
<b>Occupational Exposure Limits</b>		
<b>Air (OEL)</b>		
8-h TWA	13 mg/m <sup>3</sup>	Safe Work Australia, 2019
STEL	NDF	
Peak Limitation	NDF	
<b>Environmental Exposure</b>		
<b>Air</b> , ambient, residential	0.21 µg/m <sup>3</sup>	U.S. EPA, 2019
<b>Air</b> , commercial/industrial	0.88 µg/m <sup>3</sup>	U.S. EPA, 2019
<b>Water</b> , potable		
	40 µg/L	U.S. EPA, 2019
<b>Soil</b> , residential		
	130 mg/kg	U.S. EPA, 2019
<b>Soil</b> , commercial/industrial		
	1600 mg/kg	U.S. EPA, 2019
<b>Soil</b> , protection of groundwater		
	0.0081 mg/kg	U.S. EPA, 2019

Footnotes:

OEL = Occupational Exposure Limit

TWA = 8 h Time-Weighted Average

STEL = (15 min) Short-term Exposure Limit

### Qualifying Summary Comments

Diethanolamine is a colourless solid, with an ammonia-like odour. It has numerous industrial uses, including as a chemical intermediate and as a corrosive inhibitor and surface-active agent in metal working fluids, leather, fuels, cosmetic formulations, papers and textiles, paints and inks, as well as a dispensing agent for agricultural chemicals and in gas treatment. Once in the environment, diethanolamine will likely breakdown as it is readily biodegradable.

Diethanolamine was ranked in Hazard Band 3, based on carcinogenic and reproductive toxicity potential. Diethanolamine was assigned Group 2B by IARC indicating it is possibly carcinogenic to humans and it is classified by the ECHA dossier as Category 2 for reproductive toxicity (H361). The ECHA dossier also classifies diethanolamine for chronic (repeated dose) oral toxicity and as irritating to the skin and highly irritating to the eyes. Diethanolamine is considered to have moderate acute oral toxicity and low toxicity following inhalation exposure. It is considered to be not sensitising to the skin.

### References

European Commission (EC), 2000. *Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption, preparation of a candidate list of substances as a basis for priority setting, Final Report* (Incorporating corrigenda to final report dated 21 June 2000).

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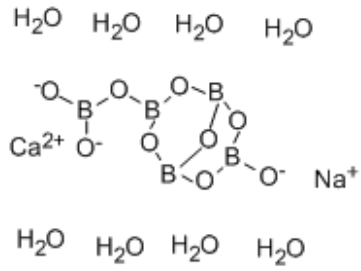
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Created by:	MGT	Date: 12/12/2019
Reviewed by:	CLB	Date and Revision: 14/01/20

[https://golderassociates.sharepoint.com/sites/117999/project files/6 deliverables/report 014/appendix e - human health summaries/19133367\\_hh\\_111-42-2 diethanolamine.docx](https://golderassociates.sharepoint.com/sites/117999/project%20files/6%20deliverables/report%20014/appendix%20e%20-%20human%20health%20summaries/19133367_hh_111-42-2_diethanolamine.docx)

Name	Ulexite
Synonyms	Boronatrocalcite, sodium calcium borate
CAS number	1319-33-1
Molecular formula	(NaCaB <sub>5</sub> O <sub>6</sub> (OH) <sub>6</sub> •5(H <sub>2</sub> O))
Molecular structure	 <p>The diagram illustrates the molecular structure of Ulexite. It features a central boron-oxygen ring structure (B<sub>5</sub>O<sub>6</sub>) coordinated with calcium (Ca<sup>2+</sup>) and sodium (Na<sup>+</sup>) ions. The structure is surrounded by five water molecules (H<sub>2</sub>O).</p>

Overview	References
<p>Boronatrocalcite is the mineral ulexite. Ulexite is a hydrated sodium calcium borate hydroxide mineral. Ulexite is slightly soluble, decomposes and contains approximately 13% boron.</p> <p>Ulexite is mined to produce borate products for uses such as insulation, textile grade fiberglass, bleach, fire retardants, agricultural fertilisers and herbicides (as a trace element), and enamels. A study of the thermal degradation of ulexite has shown under increased temperature (around 600°C) the crystalline structure will break down to eventually release NaB<sub>3</sub>O<sub>5</sub> and NaCaBO<sub>3</sub>.</p> <p>Limited toxicology data are available for ulexite; however, the assessment of boron salts was undertaken by WHO (1998) and ECHA (2015). Disodium octaborate tetrahydrate is converted to boric acid (B(OH)<sub>3</sub>) and disodium borate (2NaB(OH)<sub>4</sub>) upon dissolution in water. Low concentrations of simple inorganic borates (e.g. boric acid, disodium tetraborate pentahydrate, boric oxide and disodium octaborate tetrahydrate) will predominately exist as undissociated boric acid in aqueous solutions at physiological and acidic pH. At about pH 11 the metaborate anion (B(OH)<sub>4</sub><sup>-</sup>) becomes the main species in solution. In between pH 7 and 11, both un-dissociated boric acid and metaborate ions will be present. This leads to the conclusion that the main species in the plasma of mammals and in the environment is un-dissociated boric acid. Since other borates (such as potassium borate) dissociate to form boric acid in aqueous solutions, they too can be considered to exist as un-dissociated boric acid under the same conditions. Boron oxide /boric acid salts are used in this profile to describe the toxicity of ulexite.</p> <p>Boric acid and borax are absorbed from the gastrointestinal tract and the respiratory tract, as indicated by increased levels of boron in the blood, tissues, or urine or by systemic toxic effects of exposed individuals or laboratory animals. Clearance of boron compounds is similar in humans and animals. Elimination of borates from the blood is largely by excretion; 90% or more of the administered dose is eliminated via the urine, regardless of the route of administration. Excretion is relatively rapid, occurring over a period of a few, or possibly several, days.</p>	<p>WHO 1998; ECHA 2020; Stoch &amp; Waclawska, 1990</p> <p>WHO, 1998; ECHA, 2020</p>

Human Health Toxicity Summary	Reference
<p><b>Carcinogenicity</b></p> <p>Ulexite has not been classified as carcinogenic. The data that the classification is based on is categorised as 'conclusive'.</p> <p>No treatment related increase in tumour incidence was reported for a dietary, lifetime carcinogenicity study in B6C3F1 mice (test conducted according to OECD guidelines 451) with concentrations of boric acid up to 5000 ppm.</p> <p>Ulexite has not been evaluated by the International Agency for Research on Cancer (IARC) as to its carcinogenicity.</p>	<p>ECHA, 2020</p> <p>IARC, 2016</p>
<p><b>Mutagenicity/Genotoxicity</b></p> <p>Ulexite is not classified as a germ cell mutagen (the data that the classification is based on is categorised as 'conclusive').</p>	<p>ECHA, 2020</p>
<p><b>Reproductive Toxicity</b></p> <p>Suspected of damaging fertility or the unborn child (via oral route). ECHA lists disodium octaborate as having a GHS group of 1B and a class of H360FD. ECHA note that the classification and labelling of disodium octaborate tetrahydrate for reproductive toxicity is based on read-across from other tested borates (e.g. boric acid) and borate salts (borax or disodium tetraborate decahydrate) because its hydrolysis results in the formation of the same substances.</p> <p>In a multigenerational study with rats, boric acid was administered via the oral route at four doses, with a maximum of 336 mg/kg/d (boron equivalent of 58.5 mg/kg/d). The authors reported that male rats were sterile and evidence of decreased ovulation in about half of the ovaries examined from the females exposed to boric acid at 336 mg/kg/d. In addition, 1/16 high dose females produced a litter when mated with control male animals. The authors concluded that the boric acid LOAEL for reproductive effects was 336 mg/kg/d.</p> <p>Short- and long-term oral exposures to boric acid or borax in laboratory animals have demonstrated that the male reproductive tract is a consistent target of toxicity. Testicular lesions have been observed in rats, mice, and dogs given boric acid or borax in food or drinking-water.</p>	<p>ECHA, 2020</p> <p>WHO, 1998</p>
<p><b>Developmental Toxicity/Teratogenicity</b></p> <p>Evidence of developmental toxicity in offspring of rats fed boric acid (dose of 76 mg/kg bw/d) in their diet throughout gestation. The clinical observations included reduced foetal body mass, short and wavy ribs. These effects disappeared during the postnatal period. Similar but more marked effects were observed at the highest dose of 143 mg/kg and apart from a short 13th rib, they also disappeared during the postnatal period. The boric acid NOAEL for developmental effects was 55 mg/kg bw/d.</p>	<p>ECHA, 2020</p>
<p><b>Endocrine Disruption</b></p>	

<p>Ulexite is not identified in the European Commission (EC)'s report, "<i>Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption</i>" as a substance of interest.</p>	<p>EC, 2000</p>
<p><b>Acute Toxicity (oral, dermal, inhalation)</b></p> <p>Not classified as acutely toxic via oral, dermal or inhalation exposure. The data that the classification is based on is categorised as 'conclusive'</p> <p><i>Oral</i> The oral LD<sub>50</sub> of boric acid in male albino rats was 3690 mg/kg with 95 % confidence limits of 2710 - 5010 mg/kg (exposure by gavage). There were no control subjects in this experiment.</p> <p>ECHA summarises a number of key study findings:</p> <ul style="list-style-type: none"> <li>- The oral LD<sub>50</sub> of boric acid in male albino rats was 3450 mg/kg (Boron equivalent of 604 mg B/kg bw). In female albino rats the oral LD<sub>50</sub> of boric acid was 4080 mg/kg (Boron equivalent of 714 mg B/kg bw).</li> <li>- The oral LD<sub>50</sub> of boric acid in rats ranged from 2 660 mg/kg to 5140 mg/kg (Boron equivalent of 465 mg/kg to 899 mg/kg).</li> <li>- The oral LD<sub>50</sub> of disodium octaborate in rats was 2550 mg/kg bw.</li> <li>- The oral LD<sub>50</sub> of anhydrous boric acid was &gt;2000 mg/kg bw as single oral administration of boric acid at dose levels 1540 or 2600 mg/kg/ bw resulted in no deaths.</li> <li>- The oral LD<sub>50</sub> for male rats was &gt;2500 mg/kg/bw.</li> </ul> <p><i>Dermal</i> Acute dermal limit study of sodium tetraborate pentahydrate was carried out on New Zealand White rabbits (US EPA-FIFRA guidelines at the time, 1985). The exposure duration was 24 h. There were no control animals. The LD<sub>50</sub> was &gt; 2 000 mg/kg. Clinical changes included anorexia and decreased activity in four rabbits, diarrhoea and soft stools in 3 rabbits and nasal discharge in three rabbits, indicating low acute dermal toxicity.</p> <p><i>Inhalation</i> The inhalation LC<sub>50</sub> of disodium tetraborate pentahydrate in rats was &gt; 2.04 mg/L (2.04 g/m<sup>3</sup>) after exposure to dust for 4 h. During the first hour of exposure, ocular discharge, hypoactivity and hunched posture were noted. A few animals exhibited nasal discharge and/or hunched position. All animals recovered by day six after removal from chamber.</p> <p>ECHA also summarises other key study findings:</p> <p>The inhalation LC<sub>50</sub> of disodium octaborate tetrahydrate in rats was 2.01 mg/L after exposure for 4 h.</p> <p>The inhalation LC<sub>50</sub> of boric acid in rats was 2.12 mg/L after exposure to dust for 4 h.</p> <p>The inhalation LC<sub>50</sub> of boric acid in rats was &gt; 2.03 mg/L after exposure to aerosol for 4 h.</p>	<p>ECHA, 2020</p> <p>WHO, 1998</p> <p>ECHA, 2020</p>
<p><b>Chronic/repeat dose toxicity (oral, dermal, inhalation)</b></p> <p><i>Oral</i> The ECHA dossier for disodium octaborate notes a number of sub-chronic and chronic studies on boric acid and disodium tetraborate decahydrate were carried out in rats, mice and dogs. Most support</p>	<p>ECHA, 2020</p>

<p>that boron can cause adverse haematological effects and that the main target organ of boron toxicity is the testis.</p> <p>Male and female rats were exposed to oral doses to boric acid of 5.9 mg/kg/d, 17.5 mg/kg/d and 58.5 mg/kg/d in a two year dietary study.</p> <p>The NOAEL for boron was 17.5 mg/kg/d and the LOAEL 58.5 mg/kg/d.</p> <p>Testicular atrophy and seminiferous tubule degeneration were observed at (6, 12 and 24) months at the high boron dose of 58.5 mg/kg/d (body weight)</p> <p><i>Inhalation</i></p> <p>Albino rats and dogs were exposed to aerosols of boron oxide, showing no evident toxic signs. NOAEC for systemic toxicity in rats was 470 mg/m<sup>3</sup>. NOAEC for local effects due to irritation of noses of rats is 175 mg/m<sup>3</sup>. NOAEC for dogs is 57 mg/m<sup>3</sup>.</p>	
<p><b>Sensitisation of the skin or respiratory system</b></p> <p>Not classified as a skin or respiratory system sensitiser by ECHA. The data that the classification is based on is categorised as 'conclusive'.</p> <p>The exposure period was 0, 7 and 21 days. No irritation was observed in guinea pigs exposed to 95 % w/w (0.4 g) disodium tetraborate pentahydrate moistened with distilled water to enhance skin contact (OECD Guideline 406 "Skin Sensitisation" method [Buehler] test). ECHA interpretation of the results was not sensitising.</p> <p>Disodium octaborate tetrahydrate was determined to be not sensitising in guinea pigs according to OECD Guideline 406.</p> <p>Boric acid moistened with distilled water to enhance skin contact is considered a non-sensitiser for guinea pig according to OECD Guideline 406.</p>	ECHA, 2020
<p><b>Corrosion (irreversible)/irritation (reversible) effects on the skin or eye</b></p> <p>Not classified as corrosive to skin or eyes. The data that the classification is based on is categorised as 'conclusive'.</p> <p>Disodium octaborate tetrahydrate was not classified for skin irritation under criteria defined in directive 67/548/EEC, based on no irritating effects observed on application to the skin of test animals. It is also not considered an eye or respiratory irritant.</p> <p>Several studies are presented on the ECHA dossier, as follows:</p> <p>An in vivo skin corrosion test was carried out on rabbits exposed to potassium tetraborate powder for 4 h. No control animals were included. Potassium tetraborate was not corrosive.</p> <p>Potassium tetraborate was not irritating to the eyes of New Zealand White Rabbits in an OECD compliant study.</p> <p>Disodium tetraborate pentahydrate showed no irritancy for New Zealand White rabbit in compliance with US EPA-FIFRA guidelines.</p>	ECHA, 2020

<p>Disodium octaborate tetrahydrate produced iritis and conjunctival irritation persisting for less than 72 h when applied without rinsing to the eyes of six New Zealand white rabbits. However, no animals met irritation criteria based on average scores. No evidence of corrosion was noted.</p> <p>Boric acid was classified as not irritant under US CPS (16 CFR 15000.42) with minor effects on the iris and conjunctivae in New Zealand White rabbit.</p>	
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Physical Hazards	Reference
<p><b>Flammable Potential</b></p> <p>Not classified as flammable. The data that the classification is based on is categorised as 'conclusive'.</p>	ECHA, 2020
<p><b>Explosive Potential</b></p> <p>Not classified as explosive. The data that the classification is based on is categorised as 'conclusive'.</p>	ECHA, 2020

Toxicity Values	Value	Reference
<b>Human Toxicity Data</b>		
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEC	NDF	
LOAEL	NDF	
<b>Animal Toxicity Data</b>		
<i>Acute Toxicity</i>		
<i>LD<sub>50</sub></i>		
Rat, oral	2 550 to 5 140 mg/kg	WHO, 1998 & ECHA, 2020
Rabbit, dermal	> 2 000 mg/kg	ECHA, 2020
<i>LC<sub>50</sub></i>		
Rat	> 2040 mg/m <sup>3</sup>	ECHA, 2020



Toxicity Values	Value	Reference
<b><i>High Chronic/Repeat Dose Toxicity</i></b>		
LOAEL, rat, oral	58.5 mg B/kg/d	ECHA, 2020
NOAEL, rat, oral	17.5 mg B/kg/d	ECHA, 2020
NOEAC, rat, inhalation	470 mg/m <sup>3</sup>	ECHA, 2020
NOAEC, dog, inhalation	57 mg/m <sup>3</sup>	ECHA, 2020

Footnotes:

LD<sub>50</sub> – lethal dose for 50% of experimental population  
 LC<sub>50</sub> – lethal air concentration for 50% of experimental population  
 LOAEL – Lowest Observed Adverse Effect Level  
 LOAEC – Lowest Observed Adverse Effect Concentration  
 NDF – No data found within the limits of the search strategy

Human Health Toxicity Ranking*		
	Hazard data	Comment
<b>Hazard Band 4</b>		
Carcinogenicity (IARC Group 1 or 2A)	No	IARC 2016
Mutagenicity/Genotoxicity (GHS Category 1A and 1B)	No	Not classified as a germ cell mutagen by ECHA 2020
Reproductive Toxicity/Developmental toxicity (GHS Category 1, 1A and 1B)	Yes	ECHA 2020. May damage fertility or the unborn child - GHS Category 1B
Endocrine Disruption <sup>1</sup>	No	Not listed as an endocrine disruptor by European Commission.
<b>Hazard Band 3</b>		
Carcinogenicity (IARC Group 2B)	No	IARC 2016
Mutagenicity/Genotoxicity (GHS Category 2)	No	Not classified as a germ cell mutagen by ECHA 2020
Reproductive Toxicity/Developmental toxicity (GHS Category 2)	No	GHS Category 1B
Acute Toxicity (oral, dermal or inhalation)  Very Toxic/Toxic <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> ≤ 300 mg/kg<sup>2</sup></li> <li>• dermal LD<sub>50</sub> ≤ 1000 mg/kg</li> <li>• inhalation LC<sub>50</sub> ≤ 10 mg/L<sup>3</sup> (or mg/m<sup>3</sup>) (vapour)</li> </ul>	No	See below.
High Chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL ≤ 10 mg/kg/d<sup>2</sup>;</li> <li>• dermal LOAEL ≤ 20 mg/kg/d;</li> <li>• inhalation LOAEC (6 h/d) ≤ 50 ppm/d for gases, ≤ 0.2 mg/L/d for vapours or ≤ 0.02 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	No	See below.

Human Health Toxicity Ranking*		
	Hazard data	Comment
Corrosive (irreversible effect)	No	Not classified as corrosive to skin or eyes by ECHA (2020)
Respiratory sensitiser	No	Not classified as a respiratory system sensitiser by ECHA (2020)
<b>Hazard Band 2</b>		
Harmful chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL &gt; 10 mg/kg/d and ≤ 100 mg/kg/d</li> <li>• dermal LOAEL &gt; 20 mg/kg/d and ≤ 200 mg/kg/d</li> <li>• inhalation (6-h/d) LOAEC &gt; 50 mg/L ≤ 250 mg/L/d for gases, &gt; 0.2 mg/L ≤ 1.0 mg/L/d for vapours or &gt; 0.02 mg/L ≤ 0.2 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	Yes	LOAEL, rat, oral of 58.5 mg/kg/d
Skin Sensitiser	No	Not classified as a skin sensitiser by ECHA (2020)
<b>Hazard Band 1</b>		
Acute Toxicity-Harmful <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> &gt; 300 mg/kg ≤ 2000 mg/kg</li> <li>• dermal LD<sub>50</sub> &gt; 1 000 mg/kg ≤ 2000 mg/kg;</li> <li>• inhalation LC<sub>50</sub> (6 h/d) &gt; 10 mg/L ≤ 20 mg/L for vapours)<sup>3</sup></li> </ul>	No	LD50, Rat oral of 2550 to 5 140 mg/kg ECHA (2020)
Irritant (reversible effect)	No	Potassium tetraborate is classified as a non-irritant to the eyes of New Zealand White rabbits ECHA (2020)
<b>Hazard Band 0</b> All indicators outside criteria listed in Hazards 1-4		
<b>Physical Hazards</b>		
Flammable potential	No	

Human Health Toxicity Ranking*		
	Hazard data	Comment
Explosive potential	No	
<b>Hazard Evaluation (highest band) not including physical hazards</b>	4	Based on Reproductive Toxicity/Developmental toxicity
<b>Data confidence (available points out of 12 parameters)</b>	12/12 = 100 %	

\* Based on IMAP Framework [NICNAS (2013) Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework. National Industrial Chemicals Notification and Assessment Scheme. Department of Health and Aging, Canberra].

<sup>1</sup> Based on list of endocrine disrupting chemicals from the European Commission's Endocrine Disruptors website.

<sup>2</sup> milligrams per kilogram body mass (mg/kg) or milligrams per kilogram body mass per day (mg/kg/d)

<sup>3</sup> Based on GHS cut-offs for hazard classification. For chronic/repeat dose toxicity, GHS cut-offs are provided as guidance values (i.e. the dose/concentration at or below which significant health effects are observed)". (p 18, NICNAS 2013).

Human Health Guidelines		
Media	Concentration (mg/m <sup>3</sup> ; mg/L; mg/kg)	Reference
<b>Occupational Exposure Limits</b>		
<b>Air</b>		
8-h TWA	1 mg/m <sup>3</sup>	Exposure Standard for Disodium tetraborate pentahydrate, Safe Work Australia (2020)
STEL	NDF	
Peak Limitation	NDF	
<b>Environmental Exposure</b>		
<b>Air, ambient, residential</b>	NDF	
<b>Air, commercial/industrial</b>	NDF	

<b>Water, potable</b>	4 mg /L (boron)	NHMRC, 2011
<b>Soil, residential</b>	4 500 mg/kg (boron)	NEPM, 2013
<b>Soil, commercial/industrial</b>	300 000 mg/kg (boron)	NEPM, 2013
<b>Soil, protection of groundwater</b>	13 mg/kg	US EPA (2019)

Footnotes:

OEL = Occupational Exposure Limit

TWA = 8 h Time-Weighted Average

STEL = (15 min) Short-term Exposure Limit

NDF – No data found within the limits of the search strategy

## Qualifying Summary Comments

Ulexite has been assigned to Hazard Band 4 because of its potential to cause reproductive toxicity (infertility) and its potential for damaging the unborn child.

Ulexite is a hydrated sodium calcium borate hydroxide mineral. Ulexite is slightly soluble, decomposes and contains approximately 13% boron. Ulexite is mined to produce borate products. A study of the thermal degradation of ulexite has shown under increased temperature (around 600°C) the crystalline structure will break down to eventually release  $\text{NaB}_3\text{O}_5$  and  $\text{NaCaBO}_3$ . In aqueous solutions sodium borates are likely to convert to boric acid/borate and at physiological and acidic pH, predominately exist as un-dissociated boric acid. Based on this, the potential human toxicity of ulexite can be based on boric acid.

The reproductive toxicity of boric acid and its salts occurs at high doses via the oral route. It is unlikely to present a reproductive toxicity hazard via skin contact and when inhaled as dust below the occupational exposure limit.

## References

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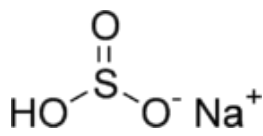
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[https://golderassociates.sharepoint.com/sites/117999/project files/6 deliverables/report 014/appendix e - human health summaries/19133367\\_hh\\_1319-33-1\\_ulexite\\_dec2019.docx](https://golderassociates.sharepoint.com/sites/117999/project%20files/6%20deliverables/report%20014/appendix%20e%20-%20human%20health%20summaries/19133367_hh_1319-33-1_ulexite_dec2019.docx)

Name	Sodium Bisulphite
Synonyms	Sodium hydrogensulphite, E222 (food additive)
CAS number	7631-90-5
Molecular formula	NaHSO <sub>3</sub>
Molecular structure	

Overview	References
<p>Sodium bisulphite occurs as a white crystal or crystalline powder. In many cases it is presented as an aqueous solution of varying strength. It has a disagreeable taste and slightly sulphurous odour. It is very soluble in water (&gt; 10 000 mg/L).</p> <p>The commercial uses of sodium bisulphite include as a disinfectant and bleach, in dyeing and paper-making, as a stripper (reducer) in laundering, and as a preservative and antiseptic. It is present as an antioxidant in some eye drops.</p> <p>It is “generally recognized as safe” (GRAS) and used as a food additive by the United States Food and Drug Administration (US FDA), with a few exceptions (for example, it is not used in meats or in food recognized as a source of vitamin B1).</p>	<p>HSDB, 2020; ECHA, 2020</p> <p>U.S. FDA, 2019</p>

Human Health Toxicity Summary	Reference
<p><b>Carcinogenicity</b></p> <p>Bisulphites have been evaluated by the International Agency for Research on Cancer (IARC) as to its carcinogenicity and were assigned Group 3 (not classifiable as to its carcinogenicity to humans based on inadequate evidence for the carcinogenicity in experimental animals).</p>	<p>IARC, 2019</p>
<p><b>Mutagenicity/Genotoxicity</b></p> <p>Sodium bisulphite is not classifiable as a mutagen according to GHS classification criteria (as listed by ECHA).</p>	<p>ECHA, 2020</p>



<p>ECHA provides two genetic toxicity in vitro studies which were used to determine the classification listed above. Both studies assessed disodium disulphite (<math>S_2O_5Na_2</math>) and concluded that the test substance did not appear to be mutagenic under the given test conditions.</p>	
<p><b>Reproductive Toxicity</b></p> <p>Sodium bisulphite is not classified by ECHA as a reproductive toxicant according to GHS classification criteria.</p> <p>ECHA cites a three-generation feeding study, where groups of 20 male and 20 female Wistar rats received 0, 0.125, 0.25, 0.5, 1.0 and 2.0% <math>S_2O_5Na_2</math> (which was calculated to be equivalent to 49, 108, 220, 460, and 955 milligram/kilogram body weight/day (mg/kg bw/day) as actual dose) in a thiamine-containing diet over periods of 2 years. Rats in the F0 generation were mated at about 21 weeks and half also at 34 weeks, the F1a generation were mated at wk 12 and wk 30 to produce the F2a and F2b litters, and then 10 males and 15 females were mated at wk 14 and wk 22 to produce the F3 generation. Based on the results of this study, no evidence of a treatment-related effect on reproduction and fertility was seen. Thus, the No Observed Adverse Effect Level (NOAEL) for fertility can be expected above a dose level of 2% disodium disulphite, corresponding to a dose of 955 mg/kg bw/d <math>Na_2S_2O_5</math> or 640 mg <math>SO_2</math>/kg bw/day. However, ECHA noted that there was a slight growth retardation during lactation in offspring of the 2% group.</p> <p>A drinking study is also provided which reported that continuous treatment of rats with <math>S_2O_5Na_2</math> (up to 750 ppm as <math>SO_2</math>) in drinking water for 2 years and in 3 successive generations was very well tolerated, with no signs of systematic toxicity observed. ECHA reports that there was no significant difference in the number of offspring for each generation and the proportion surviving the end of lactation did not differ. Based on these results, the NOAEL for systemic toxicity and effects on reproduction was expected to be above the highest dose level investigated, corresponding to 53 mg/kg bw/day.</p>	<p>ECHA, 2020</p>
<p><b>Developmental Toxicity/Teratogenicity</b></p> <p>Sodium bisulphite is not classified by ECHA as a developmental toxicant according to GHS classification criteria.</p> <p>Several developmental toxicity studies are listed by ECHA, with the following oral exposures:</p> <ul style="list-style-type: none"> <li>- Up to 100 mg/kg bw/d of sodium bisulphite to pregnant rabbits for 13 consecutive days</li> <li>- Up to 120 mg/kg bw/d of sodium bisulphite to pregnant hamsters for 5 consecutive days</li> <li>- Up to 150 mg/kg bw/d of sodium bisulphite to pregnant mice for 10 consecutive days</li> <li>- Up to 110 mg/kg bw/d of sodium bisulphite to pregnant rats for 10 consecutive days.</li> </ul> <p>In all cases the studies reported no clearly discernible effects on nidation or on maternal or foetal survival. There was no difference in the number of abnormalities seen in either soft or skeletal tissues of the test groups compared to the number occurring spontaneously in the sham-treated controls. Therefore, the NOAELs for maternal and developmental toxicity are expected to be above the exposure dose for each of the experiments listed above.</p>	<p>ECHA, 2020</p>

<p><b>Endocrine Disruption</b></p> <p>Sodium bisulphite (or bisulphites) is not identified in the European Commission (EC)'s report, "<i>Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption</i>" as a substance of interest.</p>	<p>EC, 2000</p>
<p><b>Acute Toxicity (oral, dermal, inhalation)</b></p> <p>Based on the GHS classification, sodium bisulphite is classified as having acute oral effects and has been assigned an 'Acute Tox. 4 H302: Harmful if swallowed' classification. It is not classified as having acute dermal or inhalation effects. The classification appears at odds with the LD<sub>50</sub> data and the reason for this is unknown although it is likely due to the production of sulphur dioxide and the low pH when administered in a non-aqueous form. When tested as an aqueous solution (38%) the oral LD<sub>50</sub> was greater than 2000 mg/kg.</p> <p>The Safe Work Australia Hazardous Chemical Information System (HCIS) also classifies sodium bisulphite (sodium hydrogensulphite) as Category 4 for acute toxicity (H302 - Harmful if swallowed)</p> <p>ECHA provides summaries of a number of studies including the following key results:</p> <p><b>Oral</b></p> <p>Sodium sulphite (SO<sub>3</sub>Na<sub>2</sub>) was administered orally to male and female rats at doses of 2150 mg/kg, 2610 mg/kg and 3160 mg/kg. The rats were observed during the 14 days following administration. A Lethal Dose (LD)<sub>50</sub> of approximately 2610 mg/kg bw was reported.</p> <p><b>Dermal</b></p> <p>In a rat study the LD<sub>50</sub> for the dermal route was reported to be &gt; 2,000 mg/kg bw for SO<sub>3</sub>Na<sub>2</sub> in male and female rats. ECHA reports the test item is not classified as acute toxic via the dermal route.</p> <p><b>Inhalation</b></p> <p>In a rat study the LC<sub>50</sub> for the inhalation route was &gt; 5.5 mg/L after 4 hours of exposure to SO<sub>3</sub>Na<sub>2</sub>, the maximum aerosol concentration tested. The animals were observed for a 14 day period following exposure and no mortality occurred. ECHA reports the test item is not classified as acute toxic via the inhalation route.</p> <p>The substance can be absorbed into the body by ingestion. Ingestion could cause asthma-like reactions or urticaria in sensitive persons.</p>	<p>ECHA, 2020</p> <p>Safe Work Australia, 2020</p> <p>ECHA, 2020</p> <p>IPCS, 2018</p>
<p><b>Chronic/repeat dose toxicity (oral, dermal, inhalation)</b></p> <p>Based on the GHS classification criteria sodium bisulphite is not classified by ECHA as causing repeat dose toxicity.</p> <p>ECHA cites three repeat dose studies where a NOAEL could not be derived. A fourth oral, feeding study in rats involved three experiments with varying timeframes; 1, 1.5 and 2 years. The study concluded no significant effects on growth were observed at dietary levels of 0.05% NaHSO<sub>3</sub>. At dietary levels of 0.1% or above, toxic effects were observed, e.g. growth retardation, clinical (polyneuritis, bleached teeth, spectacle eyes) and pathological/histopathological changes (brown uteri,</p>	<p>ECHA, 2020</p>

<p>testicular atrophy, gastric epithelial hyperplasia, and calcified renal tubular casts). At a dietary level of 2.0%, the majority of testes showed oedema. ECHA reports that taking all information from the different experiments together, the dose level of 0.05% NaHSO<sub>3</sub> can be regarded as the NOAEL based on the results of these studies, corresponding to 25 mg/kg bw/d NaHSO<sub>3</sub>.</p>	
<p><b>Sensitisation of the skin or respiratory system</b></p> <p>Based on the GHS classification criteria sodium bisulphite is not classified by ECHA as a skin sensitiser.</p> <p>ECHA presents a skin sensitising study (in vivo mouse local lymphnode assay) assessing SO<sub>3</sub>Na<sub>2</sub>, with the study concluding the test substance was not sensitising. Six female mice were exposed to sodium sulphite at concentrations of 10%, 25% and 50% (w/w) in aqua ad injectabilia (water for injection).</p> <p>Dermatitis has been observed from exposure of restaurant workers to preservatives in meat. Adverse reactions in humans have been reported while challenge tests have reported decrements in lung function associated with inhalation exposures.</p>	<p>ECHA, 2020</p> <p>HSDB, 2020</p>
<p><b>Corrosion (irreversible)/irritation (reversible) effects on the skin or eye</b></p> <p>Sodium bisulphite is not classified by ECHA as causing skin corrosion/irritation or eye damage/irritation based on the GHS classification criteria.</p> <p>ECHA list a skin irritation/corrosion study for SO<sub>3</sub>Na<sub>2</sub> on 2 male and 2 female rabbits. An approximate 0.5 mm thick layer of a 50% solution of SO<sub>3</sub>Na<sub>2</sub> was applied (comparable to 0.5 g of the test substance), with occlusive coverage. The observation period was 8 days, with readings at 30 – 60 minutes after application, as well as at 24 hours and 8 days. The study concluded the test substance was not irritating.</p> <p>ECHA presents an eye irritation study of six rabbits (2 males/ 4 females), again using SO<sub>3</sub>Na<sub>2</sub>, which concludes that the test substance is not an eye irritant. 162 mg of the test substance (Sodium sulphite + 0.5% cobalt sulfate) was applied and observations were taken at 1 h, 24 h, 8 h, 72 h and 8 days after application.</p> <p>IPCS (2018) notes that Sodium bisulphite is irritating to the skin, eyes, respiratory tract and gastrointestinal tract. Exposure could cause asthma-like reactions or urticaria in sensitive persons.</p> <p>Safe Work Australia (2020) classifies sodium bisulphite (sodium hydrogensulphite) as Category 1 for serious eye damage/irreversible affects on the eye (H318 - Causes serious eye damage).</p>	<p>ECHA, 2020</p> <p>IPCS, 2018</p> <p>Safe Work Australia, 2020</p>

Physical Hazards	Reference
<p><b>Flammable Potential</b></p> <p>Considered non-flammable</p> <p>Sodium bisulphite can decompose on heating and on contact with acids. This reaction can produce sulfuret oxides, which generates fire and explosive hazards.</p>	<p>ECHA, 2020</p> <p>IPCS, 2018</p>
<p><b>Explosive Potential</b></p> <p>Considered non-explosive</p>	<p>ECHA, 2020</p>

Toxicity Values	Value	Reference
<b>Human Toxicity Data</b>		
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEC	NDF	
LOAEL	NDF	
<b>Animal Toxicity Data</b>		
<i>Acute Toxicity</i>		
<i>LD<sub>50</sub></i>		
Rat, oral, SO <sub>3</sub> Na <sub>2</sub>	2610 mg/kg	ECHA, 2020
Rat, dermal, SO <sub>3</sub> Na <sub>2</sub>	> 2,000 mg/kg	ECHA, 2020
<i>LC<sub>50</sub></i>		
Rat, SO <sub>3</sub> Na <sub>2</sub>	> 5.5 mg/L	ECHA, 2020
<i>High Chronic/Repeat Dose Toxicity</i>		
NOAEL, rats, oral, growth, NaHSO <sub>3</sub>	25 mg/kg bw/day	ECHA, 2015

Toxicity Values	Value	Reference
NOAEL, rabbits, oral, maternal and developmental toxicity, NaHSO <sub>3</sub>	> 100 mg/kg bw/d	ECHA, 2020
NOAEL, hamsters, oral, maternal and developmental toxicity, NaHSO <sub>3</sub>	> 120 mg/kg bw/d	ECHA, 2020
NOAEL, mice, oral, maternal and developmental toxicity, NaHSO <sub>3</sub>	> 150 mg/kg bw/d	ECHA, 2020
NOAEL, rats, oral, maternal and developmental toxicity, NaHSO <sub>3</sub>	> 110 mg/kg bw/d	ECHA, 2020
NOAEL, rats, oral, fertility, Na <sub>2</sub> S <sub>2</sub> O <sub>5</sub>	> 955 mg/kg bw/d	ECHA, 2015
NOAEL, rats, oral, systemic toxicity and effects on reproduction	> 53 mg/kg bw/day	ECHA, 2015

Footnotes:

LD<sub>50</sub> – lethal dose for 50% of experimental population

LC<sub>50</sub> – lethal air concentration for 50% of experimental population

LOAEL – Lowest Observed Adverse Effect Level

LOAEC – Lowest Observed Adverse Effect Concentration

NDF – No data found within the limits of the search strategy

Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Band 4</b>		
Carcinogenicity (IARC Group 1 or 2A)	No	IARC, 2019
Mutagenicity/Genotoxicity (GHS Category 1A and 1B)	No	ECHA, 2020
Reproductive Toxicity/Developmental toxicity (GHS Category 1, 1A and 1B)	No	ECHA, 2020
Endocrine Disruption <sup>1</sup>	No	EC, 2000
<b>Hazard Band 3</b>		
Carcinogenicity (IARC Group 2B)	No	IARC, 2019
Mutagenicity/Genotoxicity (GHS Category 2)	No	ECHA, 2020
Reproductive Toxicity/Developmental toxicity (GHS Category 2)	No	ECHA, 2020
Acute Toxicity (oral, dermal or inhalation)  Very Toxic/Toxic <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> ≤ 300 mg/kg<sup>2</sup></li> <li>• dermal LD<sub>50</sub> ≤ 1000 mg/kg</li> <li>• inhalation LC<sub>50</sub> ≤ 10 mg/L (or mg/m<sup>3</sup>) (vapour)</li> </ul>	No	Oral LD <sub>50</sub> of 2,620 mg/kg, Dermal LD <sub>50</sub> of > 2,000 mg/kg, LC <sub>50</sub> of > 5.5 mg/L (ECHA, 2020)
High Chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL ≤ 10 mg/kg/d<sup>2</sup>;</li> <li>• dermal LOAEL ≤ 2 0 mg/kg/d;</li> <li>• inhalation LOAEC (6 h/d) ≤ 50 ppm/d for gases, ≤ 0.2 mg/L/d for vapours or ≤ 0.02 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	No	Oral NOAEL of 25 mg/kg bw/day (ECHA, 2020)
Corrosive (irreversible effect)	Yes	Safe Work Australia (2020) Category 1 - serious eye damage/irreversible effects on the eye (H318 - Causes serious eye damage)

Human Health Toxicity Ranking		
	Hazard data	Comment
Respiratory sensitiser	No	ECHA, 2020
<b>Hazard Band 2</b>		
Harmful chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL &gt; 10 mg/kg/d and ≤ 100 mg/kg/d</li> <li>• dermal LOAEL &gt; 20 mg/kg/d and ≤ 200 mg/kg/d</li> <li>• inhalation (6-h/d) LOAEC &gt; 50 mg/L ≤ 250 mg/L/d for gases, &gt; 0.2 mg/L ≤ 1.0 mg/L/d for vapours or &gt; 0.02 mg/L ≤ 0.2 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	Yes	Oral LOAEL for organ toxicity of approximately 50 mg/kg bw/day in a chronic rat study (ECHA, 2020)
Skin Sensitiser	No	ECHA, 2020
<b>Hazard Band 1</b>		
Acute Toxicity-Harmful <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> &gt; 300 mg/kg ≤ 2000 mg/kg</li> <li>• dermal LD<sub>50</sub> &gt; 1 000 mg/kg ≤ 2000 mg/kg;</li> <li>• inhalation LC<sub>50</sub> (6 h/d) &gt; 10 mg/L ≤ 20 mg/L for vapours)<sup>3</sup></li> </ul>	Yes	Although the oral LD <sub>50</sub> of 2,620 mg/kg, Dermal LD <sub>50</sub> of > 2,000 mg/kg, LC <sub>50</sub> of > 5.5 mg/L are reported, the hazard classification published by regulatory agencies reflects a classification as harmful for acute oral toxicity (ECHA, 2020 and Safe Work Australia 2020)
Irritant (reversible effect)	No	ECHA, 2020
<b>Hazard Band 0</b> All indicators outside criteria listed in Hazards 1-4	-	
<b>Physical Hazards</b>		
Flammable potential	Non-flammable	ECHA 2020
Explosive potential	Non-explosive	ECHA 2020

Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Evaluation (highest band) not including physical hazards</b>	3	Based potential for serious eye damage (Safe Work Australia, 2020)
<b>Data confidence (available points out of 12 parameters)</b>	12/12	100%

\* Based on IMAP Framework [NICNAS (2013) Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework. National Industrial Chemicals Notification and Assessment Scheme. Department of Health and Aging, Canberra].

<sup>1</sup> Based on list of endocrine disrupting chemicals from the European Commission's Endocrine Disruptors website.

<sup>2</sup> milligrams per kilogram body mass (mg/kg) or milligrams per kilogram body mass per day (mg/kg/d)

<sup>3</sup> Based on GHS cut-offs for hazard classification. For chronic/repeat dose toxicity, GHS cut-offs are provided as guidance values (i.e. the dose/concentration at or below which significant health effects are observed)". (p 18, NICNAS 2013).

Human Health Guidelines		
Media	Concentration (mg/m <sup>3</sup> ; mg/L; mg/kg)	Reference
<b>Occupational Exposure Limits</b>		
<b>Air (OEL)</b>		
8-h TWA	5 mg/m <sup>3</sup>	Safe Work Australia 2020
STEL	NDF	
Peak Limitation	NDF	
<b>Environmental Exposure</b>		
<b>Air, ambient, residential</b>	NDF	
<b>Air, commercial/industrial</b>	NDF	



<b>Water</b> , potable	NDF	
<b>Water</b> , recreational	NDF	
<b>Soil</b> , residential	NDF	
<b>Soil</b> , commercial/industrial	NDF	
<b>Soil</b> , protection of groundwater	NDF	

Footnotes:

OEL = Occupational Exposure Limit

TWA = 8 h Time-Weighted Average

STEL = (15 min) Short-term Exposure Limit

## Qualifying Summary Comments

Sodium bisulphite exhibits an overall low order of toxicity across toxicological parameters such as carcinogenicity, developmental, reproductive and neurotoxicity with acute toxicity considered to be low as reflected in its use as a preservative in the food and allied industries. At concentration of > 25% is it considered harmful if swallowed (acute oral toxicity). In an oral rat study organ toxicity (kidney, stomach, teste, uterus) was noted at approximately 50 mg/kg bw/d. Although ECHA (2020) do not classify sodium bisulphite, Safe Work Australia has classified it as category 1 serious eye damage. Based on this, it has been ranked in Hazard Band 3.

## References

EC (European Commission) 2000. *Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption*. M0355008/1786Q/10/11/00. Report dated 10 November 2000.

ECHA (European Chemicals Agency), 2020. Dossier for sodium hydrogensulphite. Available at [http://apps.echa.europa.eu/registered/data/dossiers/DISS-9eb5bf0a-f2e8-36c3-e044-00144f67d031/DISS-9eb5bf0a-f2e8-36c3-e044-00144f67d031\\_DISS-9eb5bf0a-f2e8-36c3-e044-00144f67d031.html](http://apps.echa.europa.eu/registered/data/dossiers/DISS-9eb5bf0a-f2e8-36c3-e044-00144f67d031/DISS-9eb5bf0a-f2e8-36c3-e044-00144f67d031_DISS-9eb5bf0a-f2e8-36c3-e044-00144f67d031.html), accessed January 2020.

HSDB (Hazardous Substances Data Bank) 2020. *Dossier for Sodium Bisulfite*. Toxicology Data Network (PUBCHEM). Available at <https://pubchem.ncbi.nlm.nih.gov/compound/23665763>, accessed January 2020.

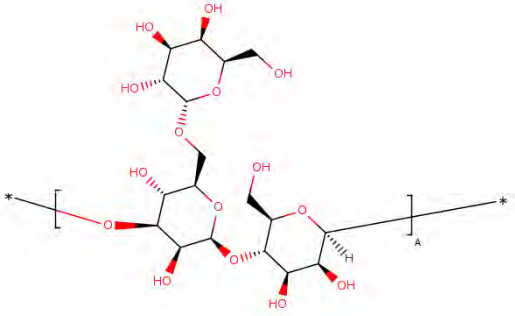
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IPCS (2018). *Sodium sulphite*. International Chemical Safety Card 1134 (sodium bisulphite 38-40% aqueous solution). Available at <http://www.inchem.org/documents/icsc/icsc/eics1134.htm>, accessed January 2020.

Safe Work Australia (2020). HCIS (Hazardous Chemical Information System), 2020. *Hazardous Chemical Information System: Sodium hydrogensulphite....%*. Safe Work Australia. Available at <http://hcis.safeworkaustralia.gov.au/HazardousChemical/Details?chemicalID=4176>, accessed January 2020.

U.S. FDA (U.S. Food and Drug Administration), 2015. Listing for Sodium bisulfite, revised as of April 1, 2019. Available at <http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=182.3739> & [https://www.ecfr.gov/cgi-bin/text-id?SID=e8fca02f2a6bd2da41a6b3a54b7d75f1&mc=true&node=se21.3.182\\_13739&rgn=div8](https://www.ecfr.gov/cgi-bin/text-id?SID=e8fca02f2a6bd2da41a6b3a54b7d75f1&mc=true&node=se21.3.182_13739&rgn=div8), accessed January 2020.

Created by:	LPA	Date: 18/12/2019
Reviewed by:	CLB	Date and Revision: 23/01/2020

Name	Guar Gum
Synonyms	Guar gum, carboxymethyl 2-hydroxypropyl ether, sodium salt
CAS number	9000-30-0
Molecular formula	Not available
Surrogates	Carboxymethyl guar gum sodium salt (CAS Reg. No. 39346-76-4) Carboxymethyl-hydroxypropyl guar (CAS Reg. No. 68130-15-4)
Molecular structure	 <p>Guar Gum (ChemIDplus, 2020)</p>

Overview	References
<p>Carboxymethyl guar and carboxymethyl-hydroxypropyl guar are slightly modified forms of guar gum (CAS 9000-30-0), a natural polymer that has been affirmed as generally recognized as safe (GRAS) by the US Food and Drug Administration (FDA) and a substance of low toxicity. Carboxymethyl guar and carboxymethyl-hydroxypropyl guar are also structurally similar to hydroxypropyl guar, another slightly modified form of guar gum. They all have same toxicity pattern but the exact mode of action is not known.</p> <p>Based upon the structural similarities between carboxymethyl guar gum, carboxymethyl-hydroxypropyl guar, guar gum, and hydroxypropyl guar, the risk assessment for carboxymethyl guar and carboxymethyl-hydroxypropyl guar relies upon available data on all four substances.</p> <p>Sub-chronic, reproductive and developmental, and carcinogenicity studies with guar gum showed no long term, reproductive/developmental, or carcinogenic effects. Overall, a low toxicity profile is expected with both carboxymethyl guar and carboxymethyl-hydroxypropyl guar because of likelihood of low absorption via any route of exposure due to their high molecular weights.</p>	<p>FR, 2011</p> <p>FDA, 2020</p>

Human Health Toxicity Summary	Reference
<p><b>Carcinogenicity</b></p> <p>No evidence of carcinogenicity was found in male and female F344 rats and B6C3F1 mice administered diets containing 25,000 or 50,000 ppm (approximately 3,570 or 7,140 mg/kg/day) guar gum for 103 weeks. A reduction in the mean body weight of the higher dose females and of the feed consumption was observed, as compared with the controls. No compound-related clinical signs of adverse effects on survival were observed. There was no increase in the incidence of tumors that could be related to the test substance.</p>	FR, 2011
<p><b>Mutagenicity/Genotoxicity</b></p> <p>Results of mutagenicity studies performed with guar gum, hydroxypropyl guar, and carboxymethyl-hydroxypropyl guar were all negative.</p>	FR, 2011
<p><b>Reproductive Toxicity</b></p> <p>The NOAEL for developmental and reproductive toxicity is 7,500 mg/kg/day for Osborne-Mendel rats fed guar gum.</p>	FR, 2011
<p><b>Developmental Toxicity/Teratogenicity</b></p> <p>Teratogenicity studies with guar gum in mice, rats, and hamsters did not indicate that guar gum is a teratogen; in mice at doses up to 800 mg/kg/day, in rats up to 900 mg/kg/day and in hamsters up to 600 mg/kg/day. Male and female Osborne-Mendel rats were fed guar gum at 0, 1, 2, 4, 5, 7, or 15% (approximately 0, 500, 1,000, 2,000, 3,750 or 7,500 mg/kg/day) in the diet for 13 weeks before mating, during mating, and throughout gestation. No effects on parental fertility, fetal development, sex distribution, and no malformations of the pups were observed.</p>	FR, 2011
<p><b>Endocrine Disruption</b></p> <p>Not listed as an endocrine disruptor by the European Commission.</p>	EC, 2000
<p><b>Acute Toxicity (oral, dermal, inhalation)</b></p> <p>Acute oral toxicity studies conducted with guar, hydroxypropyl guar, and carboxymethyl guar resulted in oral LD<sub>50</sub> values ranging from 7,060 milligrams per kilogram of body weight (mg/kg bw) to 17,800 mg/kg bw.</p>	FR, 2011
<p><b>Chronic/repeat dose toxicity (oral, dermal, inhalation)</b></p> <p>There are three 90-day toxicity studies available for guar gums:</p> <ol style="list-style-type: none"> <li>1. A LOAEL for guar gum in a diet was reported to be 1% (equivalent to 580 mg/kg/day) based on effects on body weight gains, and dose related decrease in kidney weights. A NOAEL was not established.</li> <li>2. Rats received doses up to 6% (equivalent to 3,000 mg/kg/day), no effects were observed.</li> </ol>	FR, 2011

<p>3. Rats were exposed to a dietary concentration of 2 and 5%. Observations included decreases in body weight gains, decreases in food efficiency, increases in blood urea nitrogen and thyroid toxicity (males only). A NOAEL was reported as 1% (equivalent to 500 mg/kg/day).</p> <p>In other studies, no adverse effects were reported in dogs that were fed 0, 1, 5, or 10% (approximately 0, 250, 1,250, or 2,500 mg/kg/day) of a precooked mixture of guar and carob bean for 30 weeks. No effects were observed in monkeys that were fed 1 gram (equal to 10 mg/kg/day) of guar flour for 2 months.</p>	
<p><b>Sensitisation of the skin or respiratory system</b></p> <p>Results of skin sensitization studies performed with guar gum, hydroxypropyl guar, and carboxymethyl-hydroxypropyl guar were all negative.</p> <p>Occupational asthma has been reported in subjects working with industrial production of guar gum.</p>	<p>FR, 2011</p> <p>NLM, 2020</p>
<p><b>Corrosion (irreversible)/irritation (reversible) of the skin or eye</b></p> <p>Dermal irritation studies conducted with guar, hydroxypropyl guar, and carboxymethyl guar resulted in no irritation to slight irritation. Eye irritation studies conducted with guar, hydroxypropyl guar, and carboxymethyl-hydroxypropyl guar demonstrated a range of results from non-irritation to severe irritation.</p> <p>ECHA classify Guar Gum as a Category 2 eye irritant (H319: causes serious eye irritation).</p>	<p>FR, 2011</p> <p>ECHA, 2020</p>

Physical Hazards	Reference
<b>Flammable Potential</b> NDF	
<b>Explosive Potential</b> NDF	

Toxicity Values	Value	Reference
<b>Human Toxicity Data</b>		
<i>Acute Toxicity</i>		
	NDF	
	NDF	
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEC	NDF	
LOAEL	NDF	
<b>Animal Toxicity Data</b>		
<i>Acute Toxicity</i>		
<i>LD<sub>50</sub></i>		
Rat, oral	6770 mg/kg	NLM, 2020 (Guar Gum)
Mouse, oral	8100 mg/kg	NLM, 2020 (Guar Gum)
Rabbit, oral	7000 mg/kg	NLM, 2020 (Guar Gum)
Rat, dermal	NDF	

Rabbit, dermal	NDF	
Mouse, dermal	NDF	
<b>LC<sub>50</sub></b>		
Rat	NDF	
<b>High Chronic/Repeat Dose Toxicity</b>		
LOAEL, decrease kidney weight	580 mg/kg/day	FR, 2011 (Guar Gum)
LOAEC	NDF	
NOAEL, rats, parental, developmental and reproductive	7,500 mg/kg/day	FR, 2011 (Guar Gum)

Footnotes:

LD<sub>50</sub> – lethal dose for 50% of experimental population  
 LC<sub>50</sub> – lethal air concentration for 50% of experimental population  
 LOAEL – Lowest Observed Adverse Effect Level  
 LOAEC – Lowest Observed Adverse Effect Concentration  
 NDF – No data found within the limits of the search strategy

Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Band 4</b>		
Carcinogenicity (IARC Group 1 or 2A)	No	FR, 2011
Mutagenicity/Genotoxicity (GHS Category 1A and 1B)	No	FR, 2011
Reproductive Toxicity/Developmental toxicity (GHS Category 1, 1A and 1B)	No	FR, 2011
Endocrine Disruption <sup>1</sup>	No	EC, 2000
<b>Hazard Band 3</b>		
Carcinogenicity (IARC Group 2B)	No	FR, 2011
Mutagenicity/Genotoxicity (GHS Category 2)	No	FR, 2011
Reproductive Toxicity/Developmental toxicity (GHS Category 2)	No	FR, 2011
Acute Toxicity (oral, dermal or inhalation)  Very Toxic/Toxic <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> ≤ 300 mg/kg<sup>2</sup></li> <li>• dermal LD<sub>50</sub> ≤ 1000 mg/kg</li> <li>• inhalation LC<sub>50</sub> ≤ 10 mg/L<sup>3</sup> (or mg/m<sup>3</sup>) (vapour)</li> </ul>	No	NLM, 2020
High Chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL ≤ 10 mg/kg/d<sup>2</sup>;</li> <li>• dermal LOAEL ≤ 2.0 mg/kg/d;</li> <li>• inhalation LOAEC (6 h/d) ≤ 50 ppm/d for gases, ≤ 0.2 mg/L/d for vapours or ≤ 0.02 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	No	NLM, 2020
Corrosive (irreversible effect)	No	FR, 2011



Human Health Toxicity Ranking		
	Hazard data	Comment
Respiratory sensitiser	Yes	Occupational asthma has been reported in subject working with industrial production of guar gum
<b>Hazard Band 2</b>		
Harmful chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>oral LOAEL &gt; 10 mg/kg/d and ≤ 100 mg/kg/d</li> <li>dermal LOAEL &gt; 20 mg/kg/d and ≤ 200 mg/kg/d</li> <li>inhalation (6-h/d) LOAEC &gt; 50 mg/L ≤ 250 mg/L/d for gases, &gt; 0.2 mg/L ≤ 1.0 mg/L/d for vapours or &gt; 0.02 mg/L ≤ 0.2 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	No	NLM, 2020
Skin Sensitiser	No	FR, 2011
<b>Hazard Band 1</b>		
Acute Toxicity-Harmful <ul style="list-style-type: none"> <li>oral LD<sub>50</sub> &gt; 300 mg/kg ≤ 2000 mg/kg</li> <li>dermal LD<sub>50</sub> &gt; 1 000 mg/kg ≤ 2000 mg/kg;</li> <li>inhalation LC<sub>50</sub> (6 h/d) &gt; 10 mg/L ≤ 20 mg/L for vapours)<sup>3</sup></li> </ul>	No	NLM, 2020
Irritant (reversible effect)	Yes	FR, 2011 ECHA, 2020
<b>Hazard Band 0</b> All indicators outside criteria listed in Hazards 1-4		
<b>Physical Hazards</b>		
Flammable potential	NDF	
Explosive potential	NDF	
<b>Hazard Evaluation (highest band) not including physical hazards</b>	3	

Human Health Toxicity Ranking		
	Hazard data	Comment
Data confidence (available points out of 12 parameters)	10/12	83% Data based on surrogate compounds

\* Based on IMAP Framework [NICNAS (2013) Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework. National Industrial Chemicals Notification and Assessment Scheme. Department of Health and Aging, Canberra].

<sup>1</sup> Based on list of endocrine disrupting chemicals from the European Commission's Endocrine Disruptors website.

<sup>2</sup> milligrams per kilogram body mass (mg/kg) or milligrams per kilogram body mass per day (mg/kg/d)

<sup>3</sup> Based on GHS cut-offs for hazard classification. For chronic/repeat dose toxicity, GHS cut-offs are provided as guidance values (i.e. the dose/concentration at or below which significant health effects are observed)". (p 18, NICNAS 2013).

Human Health Guidelines		
Media	Concentration (mg/m <sup>3</sup> ; mg/L; mg/kg)	Reference
<b>Occupational Exposure Limits</b>		
<b>Air (OEL)</b>		
8-h TWA	NDF	
STEL	NDF	
Peak Limitation	NDF	
<b>Environmental Exposure</b>		
<b>Air, ambient, residential</b>	NDF	
<b>Air, commercial/industrial</b>	NDF	
<b>Water, potable</b>	NDF	
<b>Water, recreational</b>	NDF	

<b>Soil, residential</b>	NDF	
<b>Soil, commercial/industrial</b>	NDF	
<b>Soil, protection of groundwater</b>	NDF	

Footnotes:

OEL = Occupational Exposure Limit

TWA = 8 h Time-Weighted Average

STEL = (15 min) Short-term Exposure Limit

## Qualifying Summary Comments

Sodium carboxymethyl-hydroxypropyl guar and related guar gums exhibit limited human health hazards across a diverse range of toxicological parameters and subsequently have been excepted in the US from the need for tolerance thresholds as additives in pesticides used for crop protection. The Hazard Band 3 rating is a reflection of reported occupational asthma suggestive of Type 1 hypersensitivity responses while dermal and eye irritancy is the other main consideration. The potential for dust generation with such a product may result in both of these adverse outcomes under conditions of occupational exposure and subsequently warrant management measures. In addition, as the product is an organic dust, ignition and explosion are further concerns related to worker safety during on-site use of this product during chemical stimulation activities.

## References

EC, 2000. Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption, preparation of a candidate list of substances as a basis for priority setting, Final Report (Incorporating corrigenda to final report dated 21 June 2000). European Commission.

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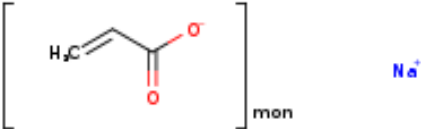
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Created by:	LPA	Date: 18/12/2019
Reviewed by:	CLB	Date and Revision: 28/01/2020

Name	Sodium polyacrylate
Synonyms	2-Propenoic acid, homopolymer, sodium salt
CAS number	9003-04-7
Molecular formula	$(C_3H_4O_2)_x \cdot xNa$
Molecular Structure	 <p>Source: ChemIDplus, 2019)</p>

Overview	References
<p>Sodium polyacrylate is part of a family of various polycarboxylates, distinguished by the monomer used for their preparation, acrylic acid and their molecular weight (MW). The family of linear homopolymers of acrylic acid and their sodium salts covers polymers with a broad molecular weight ranging from 1,000 to 78,000 g/mol. The polymer mostly used in detergents has a molecular weight of approximately 4,500 g/mol. These polymers are present in many commonly used low-phosphate and phosphate-free household, industrial and institutional detergents, for avoiding incrustation and soil redeposition. They are primarily used in automatic dishwashing detergents but are also used in laundry detergents. Typical average concentrations are approximately 0.5% in automatic dishwashing detergents. Based on a typical molecular weight polymer of 4,500 g/mol, the melting (decomposition) point is &gt; 150°C and a water solubility of &gt; 400 g/L.</p> <p>Due to the primary use being detergents, polycarboxylates can enter the environment via domestic wastewater and sewage treatment to surface waters. Once in the environment, lower molecular weight polymers (MW &lt; 2000 g/mol) are partly biodegraded. However, high MW polymers are considered poorly biodegradable. In soils, insoluble salts will likely form in the presence of calcium cations, leading to adsorption or precipitation. Abiotic degradation photolytic and hydrolytic processing are considered to not significantly influence the environmental fate of polycarboxylates. In addition, bioaccumulation is considered not significant based on potential uptake paths.</p>	<p>HERA, 2014</p>

Human Health Toxicity Summary	Reference
<p><b>Carcinogenicity</b></p> <p>Sodium polyacrylate has not been evaluated by the International Agency for Research on Cancer (IARC) as to its carcinogenicity.</p> <p>HERA conclude that a carcinogenic risk appears negligible based on no evidence of carcinogenic in repeated dose studies or <i>in-vitro</i> and <i>in-vivo</i> genotoxic studies. In addition, HERA identify that the monomers do not include alerting groups for a genotoxic or carcinogenic potential.</p>	<p>IARC, 2019</p> <p>HERA, 2014</p>
<p><b>Mutagenicity/Genotoxicity</b></p> <p>HERA concluded that tests performed to determine the potential of these polymer to induce DNA damage <i>in-vitro</i> (Ames test and Induction of Unscheduled DNA Synthesis) were negative. A negative result was also reported for test of the potential to induce chromosomal aberration <i>in-vitro</i>. The <i>in-vitro</i> results were supported by a test for chromosomal aberration <i>in-vivo</i>.</p>	<p>HERA, 2014</p>
<p><b>Reproductive Toxicity</b></p> <p>HERA concluded that reproductive toxicity potential was negligible, based on no observed effects on the reproductive organs of the test animals in a 91 day repeat dose inhalation study (see below).</p>	<p>HERA, 2014</p>
<p><b>Developmental Toxicity/Teratogenicity</b></p> <p>The polymer (MW= 4,500) was tested in a rat developmental toxicity study in which the compound was administered by gavage on day 6 -15 of pregnancy at does levels of 500, 1,000, and 3,000 mg/kg/bw. The study reported no treatment related effects on foetal development or on pregnancy were noted. A NOEL of 3,000 mg/kg bw/day was established.</p>	<p>HERA, 2014</p>
<p><b>Endocrine Disruption</b></p> <p>Sodium polyacrylate is not identified in the European Commission (EC)'s report, "Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption" as a substance of interest.</p>	<p>EC, 2000</p>
<p><b>Acute Toxicity (oral, dermal, inhalation)</b></p> <p>HERA concluded that based on the available data, the acute <b>oral</b> toxicity of the homopolymers with MW 1,000 – 78,000 is very low. In rats the reported LD<sub>50</sub> values ranged between &gt; 5 000 – 10 000 mg/kg bw (milligrams/kilogram body weight).</p> <p>These polymers were also reported to have low acute <b>dermal</b> toxicity to rabbits. Dermal exposure of the homopolymers with MW 1,000 – 4,500 g/mol in rabbits reported LD<sub>50</sub> &gt; 5,000 mg/kg bw.</p> <p>There was no data available on acute <b>inhalation</b> toxicity.</p>	<p>HERA, 2014</p>
<p><b>Chronic/repeat dose toxicity (oral, dermal, inhalation)</b></p> <p>Repeat dose <b>Oral</b> exposure was tested in an oral feed study for 28 days to examine the effect of the test substance on mineral homeostasis. This test is a Non-Guideline study and involved 6 male rats</p>	<p>HERA, 2014</p>

<p>being fed 2.5% of the polymer in their diet (about 1136 mg/kg bw/d). The applied dose was interpreted as a NOAEL.</p> <p>For repeat dose <b>inhalation</b> exposure, the primary study cited by HERA involved a 91-day study, conducted in compliance with the guidelines for the EPA's Toxic Substance Control Act and in compliance with the EPA GLP Regulations (40 CR, Part 792). The study involved 25 male and 25 female rats being exposure to 0.2, 1.0 and 5.0 mg/m<sup>3</sup> of the polymer as a dust aerosol for 6 h/d, 5 d/wk for 13 weeks. A NOEC of 0.2 mg/m<sup>3</sup> was established for respirable dust of the polymer (MW of 4,500) for local lung effects typical of insoluble respirable polymer dust, and a NOEC of greater than 5 mg/m<sup>3</sup> was established for systemic effects.</p> <p>There is no data available for the <b>dermal</b> exposure route. However, HERA conclude that the based on the similar acute oral and dermal toxicities, the repeat does oral toxicity can serve as a substitute for potential dermal toxicity.</p>	
<p><b>Sensitisation of the skin or respiratory system</b></p> <p>HERA concluded that homopolymers of acrylic acid and their sodium salts show no sensitising potential for the skin. This is based on the results of two Guinea Pig Maximisation tests which showed no skin reactions at doses ranging 0.1% - 20%, testing low and high molecular weight (4,500-78,000) polymers.</p>	HERA, 2014
<p><b>Corrosion (irreversible)/irritation (reversible) effects on the skin or eye</b></p> <p>HERA concluded that based on the studies they reviewed homopolymers of acrylic acid and their sodium salts show no skin irritation potential. Several skin irritation studies on rabbits were cited, testing different molecular weights (1,000-78,000) and concentrations between 15-45% or neat undiluted material, with exposure for 4 h-24 h and occlusive or semi-occlusive dressing.</p> <p>HERA concluded that based on the studies they reviewed that homopolymers of acrylic acid and their sodium salts, either as undilute neat substances or at very high concentrations, show non- to slight irritation (reversible) potential in rabbit studies. Several eye irritation studies were cited, testing different molecular weights (1,200 – 8,000), using a 45% solutions, according to OECD Guideline 405, but not according to GLP.</p>	HERA, 2014

Physical Hazards	Reference
<p><b>Flammable Potential</b></p> <p>No data available.</p>	
<p><b>Explosive Potential</b></p> <p>Reacts violently with oxidants. This generates fire and explosion hazard.</p>	INCHEM, 2017

Toxicity Values	Value	Reference
<b>Human Toxicity Data</b>		
<b><i>High Chronic/Repeat Dose Toxicity</i></b>		
LOAEC	NDF	
LOAEL	NDF	
<b>Animal Toxicity Data</b>		
<b><i>Acute Toxicity</i></b>		
<b><i>LD<sub>50</sub></i></b>		
Rat, oral	LD <sub>50</sub> (MW 1,000 – 78,000) > 5 000 – 10 000 mg/kg bw LD <sub>50</sub> > 40 000 mg/kg	HERA, 2014 ChemIDplus, 2019
Rabbit, dermal	LD <sub>50</sub> > 5,000 mg/kg	HERA, 2014
<b><i>High Chronic/Repeat Dose Toxicity</i></b>		
NOAEL	NOAEL (oral, rat, 4 wk, MW = 2,500): 1 136 mg/kg/d	HERA, 2014.
NOAEC	NOEC (inhalation, rat, 91 d, local lung effects, MW = 4,500): 0.2 mg/m <sup>3</sup> NOEC (inhalation, rat, 91 d, systemic effects, MW = 4,500): 5 mg/m <sup>3</sup>	HERA, 2014.

Footnotes:

LD<sub>50</sub> – lethal dose for 50% of experimental population  
 LC<sub>50</sub> – lethal air concentration for 50% of experimental population  
 NOAEL – No Observed Adverse Effect Level  
 NOAEC – No Observed Adverse Effect Concentration  
 NDF – No data found within the limits of the search strategy



Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Band 4</b>		
Carcinogenicity (IARC Group 1 or 2A)	No	
Mutagenicity/Genotoxicity (GHS Category 1A and 1B)	No	
Reproductive Toxicity/Developmental toxicity (GHS Category 1, 1A and 1B)	No	
Endocrine Disruption <sup>1</sup>	No	
<b>Hazard Band 3</b>		
Carcinogenicity (IARC Group 2B)	No	
Mutagenicity/Genotoxicity (GHS Category 2)	No	
Reproductive Toxicity/Developmental toxicity (GHS Category 2)	No	
Acute Toxicity (oral, dermal or inhalation)  Very Toxic/Toxic <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> ≤ 300 mg/kg<sup>2</sup></li> <li>• dermal LD<sub>50</sub> ≤ 1000 mg/kg</li> <li>• inhalation LC<sub>50</sub> ≤ 10 mg/L<sup>3</sup> (or mg/m<sup>3</sup>) (vapour)</li> </ul>	No	
High Chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL ≤ 10 mg/kg/d<sup>2</sup>;</li> <li>• dermal LOAEL ≤ 20 mg/kg/d;</li> <li>• inhalation LOAEC (6 h/d) ≤ 50 ppm/d for gases, ≤ 0.2 mg/L/d for vapours or ≤ 0.02 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	Yes	NOEC for inhalation of systematic effects of 5 mg/m <sup>3</sup> (0.005 mg/L) for respirable dust of the polymer.
Corrosive (irreversible effect)	No	
Respiratory sensitiser	-	
<b>Hazard Band 2</b>		

Human Health Toxicity Ranking		
	Hazard data	Comment
Harmful chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL &gt; 10 mg/kg/d and ≤ 100 mg/kg/d</li> <li>• dermal LOAEL &gt; 20 mg/kg/d and ≤ 200 mg/kg/d</li> <li>• inhalation (6-h/d) LOAEC &gt; 50 mg/L ≤ 250 mg/L/d for gases, &gt; 0.2 mg/L ≤ 1.0 mg/L/d for vapours or &gt; 0.02 mg/L ≤ 0.2 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	No	
Skin Sensitiser	No	
<b>Hazard Band 1</b>		
Acute Toxicity-Harmful <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> &gt; 300 mg/kg ≤ 2000 mg/kg</li> <li>• dermal LD<sub>50</sub> &gt; 1 000 mg/kg ≤ 2000 mg/kg;</li> <li>• inhalation LC<sub>50</sub> (6 h/d) &gt; 10 mg/L ≤ 20 mg/L for vapours)<sup>3</sup></li> </ul>	No	LD <sub>50</sub> (oral, MW 1,000 – 78,000) > 5 000 – 10 000 mg/kg  LD <sub>50</sub> (dermal) > 5,000 mg/kg
Irritant (reversible effect)	Yes	Irritation effects in the eyes.
<b>Hazard Band 0</b> All indicators outside criteria listed in Hazards 1-4	-	
<b>Physical Hazards</b>		
Flammable potential	-	
Explosive potential	Yes	Reacts with oxidants. INCHEM, 2017
<b>Hazard Evaluation (highest band) not including physical hazards</b>	3	Based on NOEC for inhalation of systematic effects of 5 mg/m <sup>3</sup> (0.005 mg/L) for respirable dust of the polymer.
<b>Data confidence (available points out of 12 parameters)</b>	9/12	75%

\* Based on IMAP Framework [NICNAS (2013) Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework. National Industrial Chemicals Notification and Assessment Scheme. Department of Health and Aging, Canberra].

<sup>3</sup>Based on list of endocrine disrupting chemicals from the European Commission's Endocrine Disruptors website.

<sup>2</sup> milligrams per kilogram body mass (mg/kg) or milligrams per kilogram body mass per day (mg/kg/d)

<sup>3</sup> Based on GHS cut-offs for hazard classification. For chronic/repeat dose toxicity, GHS cut-offs are provided as guidance values (i.e. the dose/concentration at or below which significant health effects are observed)<sup>3</sup>. (p 18, NICNAS 2013).

Human Health Guidelines		
Media	Concentration (mg/m <sup>3</sup> ; mg/L; mg/kg)	Reference
<b>Occupational Exposure Limits</b>		
<b>Air (OEL)</b>		
8-h TWA	NDF	
STEL	NDF	
Peak Limitation	NDF	
<b>Environmental Exposure</b>		
<b>Air, ambient, residential</b>	NDF	
<b>Air, commercial/industrial</b>	NDF	
<b>Water, potable</b>	NDF	
<b>Water, recreational</b>	NDF	
<b>Soil, residential</b>	NDF	
<b>Soil, commercial/industrial</b>	NDF	
<b>Soil, protection of groundwater</b>	NDF	

Footnotes:

OEL = Occupational Exposure Limit

TWA = 8 h Time-Weighted Average



STEL = (15 min) Short-term Exposure Limit

NDF – No data found within the limits of the search strategy

### Qualifying Summary Comments

Sodium polyacrylate is part of a family of various polycarboxylates, distinguished by the monomer used for their preparation, acrylic acid and their molecular weight. The family of linear homopolymers of acrylic acid and their sodium salts covers polymers with a broad molecular weight ranging from 1,000 to 78,000 g/mol. The polymer mostly used in detergents has a molecular weight of approximately 4,500 g/mol. These polymers are present in many commonly used low-phosphate and phosphate-free household, industrial and institutional detergents, for avoiding incrustation and soil redeposition.

Sodium polyacrylate was ranked in Hazard Band 3 based on the potential effects of inhalation of the respirable dust of the polymer. It is noted that this is based upon a no observed effect concentration, which was the highest concentration in a study. Given the limited information, it is concluded that there is the potential for toxicity effects due to chronic inhalation of respirable dust. Potential inhalation exposures would require management.

Sodium polyacrylate was reported to present low toxicity potential for acute oral and dermal exposure. These polymers also showed no skin irritation or sensitising potential. Studies assessing irritation of the eyes in rabbits reported non- to slight irritation (reversible) potential.

### References

ChemIDplus, 2019. Dossier for Substance Name: Polyacrylic acid, sodium salt. National Institutes of Health, Health & Human Services, U.S. National Library of Medicine. Available at: <https://chem.nlm.nih.gov/chemidplus/rm/9003-04-7>, accessed December 2019.

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Created by:	MGT	Date: 13/12/2019
Reviewed by:	CLB	Date and Revision: 28/01/2020

Name	Crystalline silica, quartz
Synonyms	Quartz (SiO <sub>2</sub> ); silicon oxide, di- (sand); silica dust; fibrous glass; aventurine
CAS number	14808-60-7
Molecular formula	O <sub>2</sub> Si
Molecular structure	 <p>(Source: NICNAS, 2018)</p>

Overview	References
<p>The Australian National Industrial Chemicals Notification and Assessment Scheme (NICNAS) undertook a Human Health Tier II assessment of compounds comprising the Crystalline Silica group in 2018. This group contained quartz (CAS No.: 14808-60-7), as well as silica (CAS No.: 7631-86-9), cristobalite (SiO<sub>2</sub>) (CAS No.: 14464-46-1) and fumes, silica (CAS No.: 69012-64-2). The grouping of these chemicals is due to their similar physico-chemical properties, related end-uses and toxicity. In addition, NICNAS outline that this group of crystalline silica should not be considered analogous to amorphous (polymorphic) form(s) of silicon dioxide, especially with respect to their toxicity. This is because crystalline silica has a regular repeating 3-dimensional patterns that is not present in amorphous forms of silica, resulting in a key physico-chemical difference between the two. The NICNAS assessment has been primarily used to complete this human health profile.</p> <p>Quartz has reported domestic and commercial uses in Australia. Domestic uses include as additives in construction materials and commercial uses also include as process regulators in the paper and pulp industry, in mining and metal extraction and as vulcanising agents (for the hardening of rubbers). Internationally, numerous domestic and commercial uses have been reported. With examples of domestic uses including as adhesives and binding agents, as cleaning and washing agents, as colouring agents, as corrosion inhibitors, as fertilisers and in construction materials. Examples of commercial uses include as anti-adhesive agents, anti-static agents, conductive agents, complexing and flocculating agents and stabilisers, in construction material, in pharmaceuticals and in pesticides.</p> <p>The NICNAS assessment notes the ubiquitous dermal and oral exposure of humans to silica, including quartz (sand) and silica food additives. Based on this NICNAS consider that acute toxicity, repeated dose toxicity, irritation and sensitisation from oral and dermal exposures are not relevant for their risk assessment. However, the use of crystalline silica in industrial applications have been associated with irreversible toxicity in the lungs, including carcinogenicity secondary to lung damage, due to worker exposure to respirable dusts (i.e. dust particles small enough to penetrate deep into the respiratory system). Due to this, NICNAS's assessment only considers inhalation toxicity of crystalline silica.</p>	<p>NICNAS, 2018</p>

<p>NICNAS reports that crystalline silica dust is largely insoluble in bodily fluids but can form silicic acid, which is readily excreted via the kidneys (US EPA, 1996, cited by NICNAS, 2018). Crystalline silica is cytotoxic towards macrophages (SCOEL, 2003, cited by NICNAS, 2018) and therefore, following inhalation exposure it can accumulate in the lungs because it disrupts macrophage-mediated mechanical clearance. This is generally seen when there are high levels of crystalline silica dust, with the phenomenon often referred to as 'particle overload' (WHO, 2000, cited by NICNAS, 2018). Although the implication of particle overload in humans has not been characterised, it is reported to initiate an inflammatory response in the rodent lung (WHO, 2000, cited by NICNAS, 2018). Inhaled particles of crystalline silica are reported to be transported to other parts of the body through the lymphatic system (US EPA, 1996, cited by NICNAS, 2018).</p>	
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Human Health Toxicity Summary	Reference
<p><b>Carcinogenicity</b></p> <p>Crystalline silica, quartz (CAS No. 14808-60-7) has been evaluated by the International Agency for Research on Cancer (IARC) as to its carcinogenicity. Quartz was assigned Group 1, indicating carcinogenic to humans, based on sufficient evidence for carcinogenicity in humans and experimental animals.</p> <p>Crystalline silica, quartz (CAS No. 14808-60-7) (respirable fraction) is classified by Safe Work Australia for carcinogenicity as Category 1A (Hazard statement: H350i (May cause cancer by inhalation)). An occupational exposure standard has been established in Australia of 0.1 mg/m<sup>3</sup> for the respirable fraction for quartz. However, based on the available epidemiological data for crystalline silica, NICNAS outline concerns that this standard might not be sufficiently protective to worker's health. NICNAS suggest a Tier III assessment might be necessary to provide further information as to whether or not the current standard is adequately protective of workers.</p> <p>Epidemiological pooled data and meta-analyses of available data provide the strongest evidence supporting carcinogenicity of crystalline silica in the lung. IARC concluded that crystalline silica is a confirmed human carcinogen based largely on nine studies of cohorts in four industry sectors there were considered to be least influenced by confounding factors, including gold mining, quarriers and granite works, ceramic/pottery/refractory brick industries and the diatomaceous earth industry (IARC, 2012, cited by NICNAS, 2018). Lung cancer tended to increase with cumulative exposure, duration of exposure, peak intensity of exposure and presence of silicosis, based on analysis from numerous epidemiology studies (Environment &amp; Health Canada, 2013, cited by NICNAS, 2018). Studies conducted in experimental animals have shown clear and consistent increases in lung tumours after chronic inhalation exposure, supporting the positive results from human data (Environment &amp; Health Canada, 2013, cited by NICNAS, 2018).</p> <p>Free silica (crystalline silicon dioxide) is restricted for use in abrasive blasting at a concentration of greater than 1 % and is listed in Schedule 10 (prohibited carcinogens, restricted carcinogens and restricted hazardous chemicals) of the Work Health and Safety Regulations (WHS, 2011, cited by NICNAS, 2018).</p>	<p>IARC, 2020</p> <p>Safe Work Australia, 2020a; NINCAS, 2018</p>
<p><b>Mutagenicity/Genotoxicity</b></p>	

<p>Crystalline silica, quartz has not been classified by NICNAS for genotoxicity, as based on the information available, it is not expected that these chemicals directly induce heritable mutations in human germ cells. Both positive and negative results have been reported in in vitro studies with chemicals in the crystalline silica group. NICNAS report that the majority of positive genotoxicity assay results can be explained by the generation of reactive oxygen specific (OECD, 2011, cited by NICNAS, 2018) resulting in DNA damage. As DNA damage is secondary to crystalline silica-induced oxidative damage, a direct genotoxic effect is not expected.</p>	<p>NICNAS, 2018</p>
<p><b>Reproductive Toxicity</b></p> <p>Crystalline silica, quartz is considered to be of low reproductive toxicity for exposure via the oral and dermal routes, based on ubiquitous exposure of humans to silica, including quartz (sand) and silica food additives. This end-point has therefore not been included in NICNAS's assessment.</p> <p>Data for reproductive toxicity from inhalation exposure is not available.</p>	<p>NICNAS, 2018</p>
<p><b>Developmental Toxicity/Teratogenicity</b></p> <p>No data found.</p>	
<p><b>Endocrine Disruption</b></p> <p>Crystalline silica, quartz is not identified in the European Commission (EC)'s report, "<i>Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption</i>" as a substance of interest.</p>	<p>EC, 2000</p>
<p><b>Acute Toxicity (oral, dermal, inhalation)</b></p> <p>Crystalline silica, quartz is considered to be of low acute toxicity for exposure via the <b>oral</b> and <b>dermal</b> routes, based on ubiquitous exposure of humans to silica, including quartz (sand) and silica food additives. These end-points have therefore not been included in NICNAS's assessment.</p> <p>No data is available to assess toxicity of acute <b>inhalation</b> exposure. However, exposure to respirable-sized, high quartz-content dust over a short period of time has been observed to cause the rare and fatal conditions of acute silicosis or silico-proteinosis. Although, it is noted that this condition has only been reported in historical case reports (e.g. during the building of the Gauley Bridge hydroelectric tunnel in West Virginia, USA IN 1930-2931). This condition is clinically similar to pulmonary oedema with the symptoms including shortness of breath and fluid accumulation in the upper and middle area so the lungs.</p>	<p>NICNAS, 2018</p>
<p><b>Chronic/repeat dose toxicity (oral, dermal, inhalation)</b></p> <p>Crystalline silica, quartz is considered to have repeated dose <b>inhalation</b> toxicity, based on available data in humans and animals. It has been classified for repeat dose toxicity as Category 1 (H372; causes damage to lungs through prolonged or repeated exposure through inhalation).</p> <p>The LOAEC for adverse pulmonary effects in various rat and mice studies ranged between 1 – 5 mg/m<sup>3</sup> (US EPA, 1996, cited by NICNAS, 2018). Non-neoplastic adverse effects specific to the lungs</p>	<p>NICNAS, 2018</p>



<p>of rodents included granulomatous lesions in the walls of the large bronchi, pulmonary fibrosis, hyperplasia of the alveolar compartment and increases in lung collagen content.</p> <p>Repeated occupational exposure to crystalline silica dust, mainly from quartz, has been reported to result in two forms of silicosis; accelerated (develops 5 – 10 years after initial exposure) and chronic (Develops 10 years after initial exposure) (US EPA, 1996, WHO, 2000, cited by NICNAS, 2018). This is based on observation in workers and epidemiological data.</p> <p>For repeat dose <b>dermal</b> exposure, long-term (3 – 34 years) of occupational exposure to silica dusts has been reported to be associated with connective tissue diseases with a potential to produce progressive systemic scleroderma. NICNAS note that there is debate about a true cause and effect relationship, although there is evidence to show a link between scleroderma and lung silicosis in occupational settings (Thomas et al., 2000, cited by NICNAS, 2018).</p>	
<p><b>Sensitisation of the skin or respiratory system</b></p> <p>Crystalline silica, quartz is considered to be of low sensitisation potential for exposure via the oral and dermal routes, based on ubiquitous exposure of humans to silica, including quartz (sand) and silica food additives. This end-point has therefore not been included in NICNAS's assessment.</p> <p>Data for sensitisation from inhalation exposure is not available.</p>	NICNAS, 2018
<p><b>Corrosion (irreversible)/irritation (reversible) effects on the skin or eye</b></p> <p>Crystalline silica, quartz is considered to be of low corrosion and irritation potential for exposure via the oral and dermal routes, based on ubiquitous exposure of humans to silica, including quartz (sand) and silica food additives. This end-point has therefore not been included in NICNAS's assessment.</p> <p>Data for irritation or corrosion from inhalation exposure is not available.</p>	NICNAS, 2018

Physical Hazards	Reference
<p><b>Flammable Potential</b></p> <p>NDF</p>	
<p><b>Explosive Potential</b></p> <p>NDF</p>	

Toxicity Values	Value	Reference
<b>Human Toxicity Data</b>		
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEC	NDF	
LOAEL	NDF	
<b>Animal Toxicity Data</b>		
<i>Acute Toxicity</i>		
<i>LD<sub>50</sub></i>		
Rat, oral	NDF	
<i>LC<sub>50</sub></i>		
Rat	NDF	
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEL	NDF	
LOAEC	LOAEC (adverse pulmonary effects, rat and mice): 1 – 5 mg/m <sup>3</sup>	Cited by NICNAS, 2018

Footnotes:

LD<sub>50</sub> – lethal dose for 50% of experimental population  
 LC<sub>50</sub> – lethal air concentration for 50% of experimental population  
 LOAEL – Lowest Observed Adverse Effect Level  
 LOAEC – Lowest Observed Adverse Effect Concentration  
 NDF – No data found within the limits of the search strategy

Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Band 4</b>		
Carcinogenicity (IARC Group 1 or 2A)	Yes	IARC Group 1
Mutagenicity/Genotoxicity (GHS Category 1A and 1B)	No	
Reproductive Toxicity/Developmental toxicity (GHS Category 1, 1A and 1B)	No	
Endocrine Disruption <sup>1</sup>	No	
<b>Hazard Band 3</b>		
Carcinogenicity (IARC Group 2B)	See above.	
Mutagenicity/Genotoxicity (GHS Category 2)	No	
Reproductive Toxicity/Developmental toxicity (GHS Category 2)	No	
Acute Toxicity (oral, dermal or inhalation)  Very Toxic/Toxic <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> ≤ 300 mg/kg<sup>2</sup></li> <li>• dermal LD<sub>50</sub> ≤ 1000 mg/kg</li> <li>• inhalation LC<sub>50</sub> ≤ 10 mg/L<sup>3</sup> (or mg/m<sup>3</sup>) (vapour)</li> </ul>	No	NDF for acute inhalation exposure. However, exposure to respirable sized, high quart-content dust over a short period of time has been reported to cause a rare and fatal condition of acute silicosis or silico-proteinosis in an occupational setting.
High Chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL ≤ 10 mg/kg/d<sup>2</sup>;</li> <li>• dermal LOAEL ≤ 2 0 mg/kg/d;</li> <li>• inhalation LOAEC (6 h/d) ≤ 50 ppm/d for gases, ≤ 0.2 mg/L/d for vapours or ≤ 0.02 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	Yes	LOAEC of 1 – 5 mg/m <sup>3</sup> for respirable dust (equivalent to 0.001 – 0.005 mg/L)
Corrosive (irreversible effect)	No	
Respiratory sensitiser	No	

Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Band 2</b>		
Harmful chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL &gt; 10 mg/kg/d and ≤ 100 mg/kg/d</li> <li>• dermal LOAEL &gt; 20 mg/kg/d and ≤ 200 mg/kg/d</li> <li>• inhalation (6-h/d) LOAEC &gt; 50 mg/L ≤ 250 mg/L/d for gases, &gt; 0.2 mg/L ≤ 1.0 mg/L/d for vapours or &gt; 0.02 mg/L ≤ 0.2 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	See above.	
Skin Sensitiser	No	
<b>Hazard Band 1</b>		
Acute Toxicity-Harmful <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> &gt; 300 mg/kg ≤ 2000 mg/kg</li> <li>• dermal LD<sub>50</sub> &gt; 1 000 mg/kg ≤ 2000 mg/kg;</li> <li>• inhalation LC<sub>50</sub> (6 h/d) &gt; 10 mg/L ≤ 20 mg/L for vapours)<sup>3</sup></li> </ul>	See above.	
Irritant (reversible effect)	No	
<b>Hazard Band 0</b> <b>All indicators outside criteria listed in Hazards 1-4</b>	No	
<b>Physical Hazards</b>		
Flammable potential	NDF	
Explosive potential	NDF	
<b>Hazard Evaluation (highest band) not including physical hazards</b>	1	Based on carcinogenicity
<b>Data confidence (available points out of 12 parameters)</b>	12/12	100%

\* Based on IMAP Framework [NICNAS (2013) Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework. National Industrial Chemicals Notification and Assessment Scheme. Department of Health and Aging, Canberra].

<sup>1</sup> Based on list of endocrine disrupting chemicals from the European Commission's Endocrine Disruptors website.

<sup>2</sup> milligrams per kilogram body mass (mg/kg) or milligrams per kilogram body mass per day (mg/kg/d)

<sup>3</sup> Based on GHS cut-offs for hazard classification. For chronic/repeat dose toxicity, GHS cut-offs are provided as guidance values (i.e. the dose/concentration at or below which significant health effects are observed)". (p 18, NICNAS 2013).

Human Health Guidelines		
Media	Concentration (mg/m <sup>3</sup> ; mg/L; mg/kg)	Reference
<b>Occupational Exposure Limits</b>		
<b>Air (OEL)</b>		
8-h TWA	0.1 mg/m <sup>3</sup> (for respirable dust)	Safe Work Australia, 2020b
STEL	NDF	
Peak Limitation	NDF	
<b>Environmental Exposure</b>		
Air, ambient, residential	0.0031 mg/m <sup>3</sup> (for silica (crystalline, respirable, CAS No.: 7631-86-9)	US EPA, 2019
Air, commercial/industrial	0.013 mg/m <sup>3</sup> (for silica (crystalline, respirable, CAS No.: 7631-86-9)	US EPA, 2019
<b>Water, potable</b>		
<b>Water, recreational</b>		
<b>Soil, residential</b>		
<b>Soil, commercial/industrial</b>		
<b>Soil, protection of groundwater</b>		

Footnotes:

OEL = Occupational Exposure Limit

TWA = 8 h Time-Weighted Average

STEL = (15 min) Short-term Exposure Limit

\* US EPA (2019) provide soil values for silica (crystalline, respirable, CAS No.: 7631-86-9), however these are above practical quantification (>1 000 000 mg/kg) and have therefore not been included.

## Qualifying Summary Comments

Crystalline silica, quartz (CAS No. 14808-60-7), commonly known as sand, has reported domestic and commercial uses in Australia. Domestic uses include as additives in construction materials and commercial uses also include as process regulators in the paper and pulp industry, in mining and metal extraction and as vulcanising agents (for the hardening of rubbers). NICNAS (2018) outline the ubiquitous dermal and oral exposure of humans to silica, including quartz (sand) and silica food additives. Based on this NICNAS consider that acute toxicity, repeated dose toxicity, irritation and sensitisation from oral and dermal exposures are not relevant for their risk assessment.

Crystalline silica, quartz (CAS No. 14808-60-7) has been ranked in Hazard Band 1, based on health effects associated with respirable dust. NICNAS (2018) outline that the critical health effects associated with respirable dust from crystalline silica, quartz are long term effects (carcinogenicity) and harmful effects following repeated exposure through inhalation (silicosis). Exposure to respirable dust is most likely in the occupational setting and exposure of the general public is considered low. Crystalline silica, quartz was assigned Group 1 by IARC, indicating carcinogenic to humans, and has been classified for repeat dose toxicity as Category 1 (H372; causes damage to lungs through prolonged or repeated exposure through inhalation). Epidemiological studies have indicated that silicosis is associated with the development of lung cancer. Therefore, preventing the onset of silicosis is likely to reduce the risk of lung cancer (SCOEL, 2003, cited by NICNAS, 2018). Although there is limited data to assess acute effects of inhalation exposure, based on historical case reports from occupational settings, high quartz-content dust over a short period of time has been observed to cause a rare and fatal condition of acute silicosis or silico-proteinosis.

The principle hazard is subsequently the generation of dusts under occupational settings which require management. Products in the workplace should be appropriately classified and labelled. An occupational exposure standard has been established in Australia of 0.1 mg/m<sup>3</sup> for the respirable fraction for quartz. However, based on the available epidemiological data for crystalline silica, NICNAS outline concerns that this standard might not be sufficiently protective to worker's health. NICNAS suggest a Tier III assessment might be necessary to provide further information as to whether or not the current standard is adequately protective of workers.

## References

European Commission (EC), 2000. Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption, preparation of a candidate list of substances as a basis for priority setting, Final Report (Incorporating corrigenda to final report dated 21 June 2000).

International Agency for Research on Cancer (IARC), 2019. Agents Classified by the IARC Monographs, Volumes 1–125, last updated 12 December 2019. Available at <https://monographs.iarc.fr/agents-classified-by-the-iarc/>, accessed February 2020.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS), 2018. Crystalline silica: Human health tier II assessment, 26 October 2018. Available at: [https://www.nicnas.gov.au/chemical-information/imap-assessments/imap-group-assessment-report?assessment\\_id=1120#cas-A\\_14808-60-7](https://www.nicnas.gov.au/chemical-information/imap-assessments/imap-group-assessment-report?assessment_id=1120#cas-A_14808-60-7), accessed February 2020.

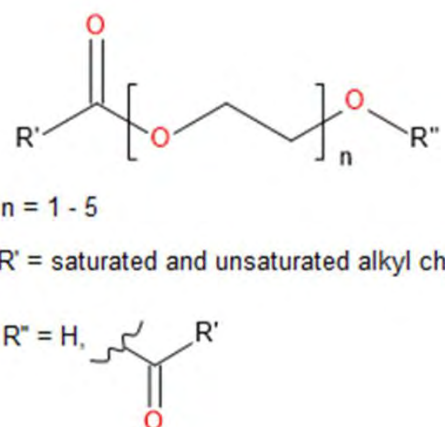
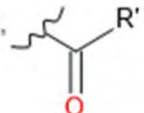
Safe Work Australia, 2020a. Hazardous Chemical Information System (HCIS): Hazardous Chemical Details for Quartz (SiO<sub>2</sub>) (respirable fraction). Available at: <http://hcis.safeworkaustralia.gov.au/HazardousChemical/Details?chemicalID=4837>, accessed February 2020.

Safe Work Australia, 2020b. Hazardous Chemical Information System (HCIS): Exposure Standards for Quartz (respirable). Available at: <http://hcis.safeworkaustralia.gov.au/ExposureStandards/Details?exposureStandardID=527>, accessed February 2020

U.S. Environmental Protection Agency (U.S. EPA), 2019. Regional Screening Levels (RSLs) – Generic Tables (Tables as of November 2019). Available at: <https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables>, accessed February 2020.

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[https://golderassociates.sharepoint.com/sites/117999/project files/6 deliverables/report 014/appendix e - human health summaries/19133367\\_hh\\_14808-60-7\\_crystalline silica, quart\\_2020.docx](https://golderassociates.sharepoint.com/sites/117999/project%20files/6%20deliverables/report%20014/appendix%20e%20-%20human%20health%20summaries/19133367_hh_14808-60-7_crystalline%20silica,%20quart_2020.docx)

Name	Fatty acids, tall-oil, ethoxylated
Synonyms	-
CAS number	61791-00-2
Molecular formula	C(18-50)H(34-98)O(3-8)
Molecular structure	 <p>n = 1 - 5</p> <p>R' = saturated and unsaturated alkyl chain from fatty acids, tall oil</p> <p>R'' = H, </p> <p>Source: ECHA, 2019</p>

Overview	References
<p>Fatty acids, tall-oil, ethoxylated is a liquid (at 20°C and 2013 hPa), that has a freezing point of -85°C. At a temperature of approximately 172°C the substance was observed to change state from a liquid to highly viscous. It is a component of a variety of products including coating, inks, adhesives, sealants and construction chemicals</p> <p>Following oral and dermal exposure of humans, the bioavailability of fatty acids, tall-oil, ethoxylated is considered likely negligible. Bioaccumulation is also not expected. Once in the environment, adsorption of fatty acids, tall-oil, ethoxylated to soil is expected. In water, fatty acids, tall-oil, ethoxylated is considered readily biodegradable (based on analytical results for a surrogate compound). Bioaccumulation of fatty acids, tall-oil, ethoxylated in aquatic organisms is not expected, based on rapid environmental biodegradation, metabolization in aquatic organisms to monoesters and diesters, and sterical hinderance of crossing biological membranes (high molecule weight of diesters).</p>	ECHA, 2019

Human Health Toxicity Summary	Reference
<p><b>Carcinogenicity</b></p> <p>Fatty acids, tall-oil, ethoxylated has not been evaluated by the International Agency for Research on Cancer (IARC) as to its carcinogenicity.</p>	IARC, 2019



<p><b>Mutagenicity/Genotoxicity</b></p> <p>The ECHA dossier outlines that, based on the available information, fatty acids, tall-oil, ethoxylated does not warrant a classification for genetic toxicity, in accordance with EU CLP Regulation No. 1272/2008.</p> <p>The ECHA dossier cites that the test substance is considered not mutagenic in bacteria or mammalian cells (determined in an OECD 471 study and an OECD 476 study, respectively) and not chromosome damaging (determined in an OECD 487 study).</p>	ECHA, 2019
<p><b>Reproductive Toxicity</b></p> <p>The ECHA dossier outlines that, based on the available data, fatty acids, tall-oil, ethoxylated does not warrant classification for reproductive toxicity according to CLP Regulation EC No. 1272/2008, as amended in Regulation EU No. 2017/776.</p> <p>The ECHA dossier cites an oral (sub-acute) Combine Repeated Dose Toxicity Study with the Reproduction/ Developmental Toxicity Screening Test in rats, undertaken in accordance with OECD Guideline 422. The test substance was administered daily to groups of 10 male and 10 female rats by gavage, at doses of 0 mg/kg bw/d, 100 mg/kg bw/d, 300 mg/kg bw/d and 1000 mg/kg bw/d. The treatment duration included a 2-week pre-mating period and mating in both sexes, as well as entire gestation and lactation period in females, up to one day prior to the day scheduled for animal sacrifice. For both parental animals and pups, no treatment-related, adverse effects were observed at any of the does levels. A NOAEL for reproductive performance and fertility was established to be 1000 mg/kg bw/day.</p>	ECHA, 2019
<p><b>Developmental Toxicity/Teratogenicity</b></p> <p>The ECHA dossier outlines that, based on the available data, fatty acids, tall-oil, ethoxylated does not warrant classification for developmental toxicity according to CLP Regulation EC No. 1272/2008, as amended in Regulation EU No. 2017/776.</p> <p>Test summarised in the 'Reproductive Toxicity' section. A NOAEL for developmental toxicity was established to be 1000 mg/kg bw/day.</p>	ECHA, 2019
<p><b>Endocrine Disruption</b></p> <p>Fatty acids, tall-oil, ethoxylated is not identified in the European Commission (EC)'s report, "<i>Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption</i>" as a substance of interest.</p>	EC, 2000
<p><b>Acute Toxicity (oral, dermal, inhalation)</b></p> <p>The ECHA dossier outlines that, based on the available data, fatty acids, tall-oil, ethoxylated do not warrant classification for acute oral toxicity and acute inhalation toxicity according to CLP Regulation (EC No. 1272/2008).</p> <p>A key acute <b>oral</b> toxicity study of rats is cited by ECHA, with groups consisting of 10 animals/sex/dose treated by a single gavage application with an aqueous solution of the test substance at concentrations of 6 400, 8 000 and 10 000 mg/kg bw. The study was performed similar to OECD</p>	ECHA, 2019

<p>guidelines 401. The animals were observed for mortality and for clinical symptoms of toxicity over a period of 7 days. Based on the results of this study, the acute oral LD<sub>50</sub> was determined to be &gt; 10 000 mg/kg bw.</p> <p>Two acute <b>inhalation</b> studies are cited by ECHA. However, for both studies an LD<sub>50</sub> can not be established because the tested concentrations were too low in relation to the classification criteria. In the first study, the exposure concentration was estimated to be 0.28 mg/L and the exposure duration was 8 hours. No mortality occurred at the concentration tested. In the second study, the exposure concentrations were estimated to be 0.04 mg/L and 0.34 mg/L and the exposure duration was 8 hours. No mortality occurred following exposure.</p> <p>There was no data available for acute dermal exposure.</p>	
<p><b>Chronic/repeat dose toxicity (oral, dermal, inhalation)</b></p> <p>The ECHA dossier outlines that fatty acids, tall-oil, ethoxylated does not warrant classification for specific target organ toxicity following repeated exposure (STOT RE) under Regulation (EC) No 1272-2008, as amended in Regulation (EU) No. 2017/776.</p> <p>The ECHA dossier cites a sub-acute oral study in rats, undertaken in accordance with GLP and OECD Guideline 422. Groups of 10 male and 10 female rats were given the test substance in a suspension daily, at does levels of 0 mg/ kg bw/day, 100 mg/ kg bw/day, 300 mg/ kg bw/day and 1000 mg/ kg bw/day. The study revealed no adverse signs of toxicity at any dose level. Therefore, a NOAEL for general systemic toxicity was established to be 1000 mg/kg bw/d.</p> <p>No studies were available for the assessment of chronic toxicity via dermal or inhalation exposure.</p>	ECHA, 2019
<p><b>Sensitisation of the skin or respiratory system</b></p> <p>The ECHA dossier outlines that fatty acids, tall-oil, ethoxylated is classified as sensitising Category 1B (H317): May cause an allergic skin reaction, in accordance with EU classification, CLP Regulation No. (EC) 1272/2008.</p> <p>The radioactive Murine Local Lymph Node Assay was used to assess skin sensitising potential, in compliance with GLP and according to OECD 429. This test concluded that fatty acids, tall-oil, ethoxylated does not show a skin sensitising effect in the Murine Local Lymph Node Assay under the test conditions. However, an animal Buehler test indicated the substance was potentially sensitising to the skin. This test was undertaken in accordance with guidelines OECD 406, 1992 and EEC 92/69 part B6", 1992 and was performed on 30 guinea pigs divided into a test group of 20 animals and a control group of 10 animals. Application of the substance included closed patch topical application for 6 hours once a week for 3 weeks. A challenge application involved a closed patch topical treatment on the flank 4 weeks after first induction. This study concluded that the substance was sensitising to the skin and is the basis for the classification.</p> <p>No studies are available to assess respiratory sensitisation.</p>	ECHA, 2019
<p><b>Corrosion (irreversible)/irritation (reversible) effects on the skin or eye</b></p>	ECHA, 2019

The ECHA dossier outlines that classification of fatty acids, tall-oil, ethoxylated for skin and eye irritation is not warranted, in accordance with EU Classification, CLP Regulation No. (EC) 1272/2008, based on the information available.

Fatty acids, tall-oil, ethoxylated was found to be not irritating or corrosive to the skin following an *in vitro* Skin Irritation Test (SIT) undertaken in compliance with GLP and OECD 431 and 439. The study was performed with three EpiDerm™ tissues that were incubated, following a single topical application of 30 µL of the test substance, for 1 hour followed by a 42-hour post-incubation period. The *in vitro* test results were supported by animal studies, which also considered the test substance to be not a skin irritant. Due to the SIT results being sufficient for final assessment, further testing in a Skin Corrosion Tests was waived.

Fatty acids, tall-oil, ethoxylated was found to be not irritating to the eyes following an *in vitro* EpiOcular Eye Irritation Test undertaken in compliance with GLP and OECD 492. The study was performed with two EpiOcular™ tissues, which were incubated, following a single topical application of 50 µL of the test substance, for 30 minutes, followed by a 2-hour post-incubation period. The irritation test results were supported by animal studies, in which the test substance was considered to be not irritating to the eyes. The results of the EpiOcular test along were sufficient for a final assessment, and therefore, further testing in a Bovine Corneal Opacity and Permeability Test was not warranted.

Physical Hazards	Reference
<p><b>Flammable Potential</b></p> <p>The ECHA dossier states the information on flammability is “conclusive but not sufficient for classification”.</p> <p>Fatty acids, tall-oil, ethoxylated is considered a hardly combustible liquid that does not emit flammable gases in the presence of water and has no self-heating properties. It has a self-ignition temperature of 377°C (at 1013.25 Pa)</p>	ECHA, 2019
<p><b>Explosive Potential</b></p> <p>The ECHA dossier states the information on the explosive potential is “conclusive but not sufficient for classification”. The substance was not classified as the exothermic decomposition energy is less than 500 J/g.</p>	ECHA, 2019

Toxicity Values	Value	Reference
<b>Human Toxicity Data</b>		
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEC	NDF	
LOAEL	NDF	
<b>Animal Toxicity Data</b>		
<i>Acute Toxicity</i>		
<i>LD<sub>50</sub></i>		
Rat, oral	LD <sub>50</sub> > 10 000 mg/kg bw	Cited by ECHA, 2019.
<i>LC<sub>50</sub></i>		
Rat	NDF	
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEL		

NOAEL	NOAEL (oral, rat, systemic toxicity, reproductive performance and fertility, and developmental toxicity): 1000 mg/kg bw/d.	Cited by ECHA, 2019
LOAEC	NDF	

Footnotes:

LD<sub>50</sub> – lethal dose for 50% of experimental population

LC<sub>50</sub> – lethal air concentration for 50% of experimental population

LOAEL – Lowest Observed Adverse Effect Level

NOAEL – No Observed Adverse Effect Level

LOAEC – Lowest Observed Adverse Effect Concentration

NDF – No data found within the limits of the search strategy

Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Band 4</b>		
Carcinogenicity (IARC Group 1 or 2A)	No	
Mutagenicity/Genotoxicity (GHS Category 1A and 1B)	No	
Reproductive Toxicity/Developmental toxicity (GHS Category 1, 1A and 1B)	No	
Endocrine Disruption <sup>1</sup>	No	
<b>Hazard Band 3</b>		
Carcinogenicity (IARC Group 2B)	No	
Mutagenicity/Genotoxicity (GHS Category 2)	No	
Reproductive Toxicity/Developmental toxicity (GHS Category 2)	No	
Acute Toxicity (oral, dermal or inhalation)  Very Toxic/Toxic <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> ≤ 300 mg/kg<sup>2</sup></li> <li>• dermal LD<sub>50</sub> ≤ 1000 mg/kg</li> <li>• inhalation LC<sub>50</sub> ≤ 10 mg/L<sup>3</sup> (or mg/m<sup>3</sup>) (vapour)</li> </ul>	No	
High Chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL ≤ 10 mg/kg/d<sup>2</sup>;</li> <li>• dermal LOAEL ≤ 20 mg/kg/d;</li> <li>• inhalation LOAEC (6 h/d) ≤ 50 ppm/d for gases, ≤ 0.2 mg/L/d for vapours or ≤ 0.02 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	No	
Corrosive (irreversible effect)	No	
Respiratory sensitiser	NDF	
<b>Hazard Band 2</b>		

Human Health Toxicity Ranking		
	Hazard data	Comment
Harmful chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>oral LOAEL &gt; 10 mg/kg/d and ≤ 100 mg/kg/d</li> <li>dermal LOAEL &gt; 20 mg/kg/d and ≤ 200 mg/kg/d</li> <li>inhalation (6-h/d) LOAEC               <ul style="list-style-type: none"> <li>&gt; 50 mg/L ≤ 250 mg/L/d for gases,</li> <li>&gt; 0.2 mg/L ≤ 1.0 mg/L/d for vapours or</li> <li>&gt; 0.02 mg/L ≤ 0.2 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul> </li> </ul>	No	
Skin Sensitiser	Yes	Classified as sensitising to the skin, Category 1B.
<b>Hazard Band 1</b>		
Acute Toxicity-Harmful <ul style="list-style-type: none"> <li>oral LD<sub>50</sub> &gt; 300 mg/kg ≤ 2000 mg/kg</li> <li>dermal LD<sub>50</sub> &gt; 1 000 mg/kg ≤ 2000 mg/kg;</li> <li>inhalation LC<sub>50</sub> (6 h/d) &gt; 10 mg/L ≤ 20 mg/L for vapours)<sup>3</sup></li> </ul>	No	
Irritant (reversible effect)	No	
<b>Hazard Band 0</b> <b>All indicators outside criteria listed in Hazards 1-4</b>	-	
<b>Physical Hazards</b>		
Flammable potential	No	
Explosive potential	No	
<b>Hazard Evaluation (highest band) not including physical hazards</b>	2	Based on skin sensitisation potential.
<b>Data confidence (available points out of 12 parameters)</b>	11/12	92%

\* Based on IMAP Framework [NICNAS (2013) Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework. National Industrial Chemicals Notification and Assessment Scheme. Department of Health and Aging, Canberra].

<sup>1</sup>Based on list of endocrine disrupting chemicals from the European Commission's Endocrine Disruptors website.

<sup>2</sup> milligrams per kilogram body mass (mg/kg) or milligrams per kilogram body mass per day (mg/kg/d)

<sup>3</sup> Based on GHS cut-offs for hazard classification. For chronic/repeat dose toxicity, GHS cut-offs are provided as guidance values (i.e. the dose/concentration at or below which significant health effects are observed)". (p 18, NICNAS 2013).

Human Health Guidelines		
Media	Concentration (mg/m <sup>3</sup> ; mg/L; mg/kg)	Reference
<b>Occupational Exposure Limits</b>		
<b>Air (OEL)</b>		
8-h TWA	NDF	
STEL	NDF	
Peak Limitation	NDF	
<b>Environmental Exposure</b>		
<b>Air, ambient, residential</b>	NDF	
<b>Air, commercial/industrial</b>	NDF	
<b>Water, potable</b>	NDF	
<b>Water, recreational</b>	NDF	
<b>Soil, residential</b>	NDF	
<b>Soil, commercial/industrial</b>	NDF	
<b>Soil, protection of groundwater</b>	NDF	

Footnotes:

OEL = Occupational Exposure Limit

TWA = 8 h Time-Weighted Average

STEL = (15 min) Short-term Exposure Limit

NDF – No data found within the limits of the search strategy



### Qualifying Summary Comments

Fatty acids, tall-oil, ethoxylated is a liquid (at 20°C and 2013 hPa) and a component of a variety of products including coating, inks, adhesives, sealants and construction chemicals. Once in the environment, fatty acids, tall-oil, ethoxylated will likely adsorb to soil and is considered readily biodegradable in water. Fatty acids, tall-oil, ethoxylated was ranked in Hazard Band 2 based on the potential for it to be sensitising to skin. Although it is noted that sensitising test produced mixed results. Fatty acids, tall-oil, ethoxylated has low oral acute and chronic toxicity.

### References

European Commission (EC), 2000. Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption, preparation of a candidate list of substances as a basis for priority setting, Final Report (Incorporating corrigenda to final report dated 21 June 2000).

European Chemicals Agency (ECHA), 2019. Registration Dossier for Fatty acids, tall-oil, ethoxylated. Available at <https://echa.europa.eu/registration-dossier/-/registered-dossier/25307>. Last modified 02/06/2018, accessed December 2019.

International Agency for Research on Cancer (IARC), 2019. Agents Classified by the IARC Monographs, Volumes 1–125, last updated 12 December 2019. Available at <https://monographs.iarc.fr/agents-classified-by-the-iarc/>, accessed December 2019.

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[https://golderassociates.sharepoint.com/sites/117999/project files/6 deliverables/report 014/appendix e - human health summaries/19133367\\_hh\\_61791-00-2 fatty acids, tall-oil, ethoxylated\\_dec2019.docx](https://golderassociates.sharepoint.com/sites/117999/project%20files/6%20deliverables/report%20014/appendix%20e%20-%20human%20health%20summaries/19133367_hh_61791-00-2%20fatty%20acids,%20tall-oil,%20ethoxylated_dec2019.docx)

Name	Hydrotreated light petroleum distillate
Synonyms	Distillates (petroleum), hydrotreated light; kerosines
CAS number	64742-47-8
Molecular formula	Too complex
Molecular structure	<p> <a href="#">Hydrocarbons, C8</a>  <a href="#">Hydrocarbons, C9</a>  <a href="#">Hydrocarbons, C10</a>  <a href="#">Hydrocarbons, C11</a>  <a href="#">Hydrocarbons, C12</a>  <a href="#">Hydrocarbons, C13</a>  <a href="#">Hydrocarbons, C14</a>  <a href="#">Hydrocarbons, C15</a>  <a href="#">Hydrocarbons, C16</a>  <a href="#">Hydrocarbons, C17</a>  <a href="#">Hydrocarbons, C18</a>  <a href="#">Hydrocarbons, C19</a>  <a href="#">Hydrocarbons, Non-aromatic</a>  <a href="#">Hydrocarbons, Mono-aromatic</a>  <a href="#">Hydrocarbons, Di-aromatic</a> </p> <p>(Source: ECHA,2020)</p>

Overview	References
<p>This assessment has been based on an ECHA dossier for CAS RN 64742-47-8 and a NICNAS assessment of Kerosines (including CAS RN 64742-47-8, as well as CAS RNs: 68477-39-4, 68477-40-7, 68477-54-3, 8008-20-6, 64741-73-7, 64742-31-0, 64742-81-0, 64742-88-7, 64742-91-2, 64742-94-5, 64742-96-7, 68333-23-3, and 70892-10-3). Information from the NICNAS assessment specific to CAS RN 64742-47-8 has primarily been adopted in this profile, with information applicable to the broader kerosine group also considered.</p> <p>NICNAS outlines the grouping is based on those chemicals assigned in the 'kerosines' category (including straight run, cracked and 'other') by the CONservation of Clean Air and Water in Europe (CONCAWE). Kerosines are the lighter end of a group of petroleum substances known as middle distillates, the heavier end being gas oils. NICNAS outline that chemicals in this group are of unknown or variable compositions, complex reaction products or biological materials (UVCBs) containing branched and straight chain paraffins and naphthenes (at least 70%), aromatic hydrocarbons (up to 25%), olefins (less than 5%) and minor quantities of additives (less than 0.1%) (US EPA, 2011, cited by NICNAS, 2016). The chemical composition depends both on the original source of the chemical and on the refinery process used during manufacture. Chemicals in this group are considered to primarily comprise C<sub>9</sub>-C<sub>16</sub> range compounds, have moderate to high volatility and low to moderate water solubility, with a boiling point range covering 140°C to 320°C.</p>	<p>ECHA, 2020 and NICNAS, 2016</p>

<p>The ECHA profile outlines that Distillates (petroleum), hydrotreated light (CAS RN 64742-47-8) is identified as a complex combination of hydrocarbons obtained by treating a petroleum fraction with hydrogen in the presence of a catalyst. It consists of hydrocarbons having carbon numbers predominantly in the range of C<sub>9</sub> through to C<sub>16</sub>. The boiling range is approximately 150°C to 290°C. The ECHA profile outlines physical and chemical properties of kerosene (a low-viscous liquid mixture of hydrocarbons). Kerosene is reported to have a density from 0.77 to 0.85 g/cm<sup>3</sup> at 15°C. It has a flash point of 29°C to 70°C and an auto-flammability of 220°C to 250°C.</p> <p>NICNAS identify that CAS RN 64742-47-8 has reported commercial uses in Australia as an adhesive, binding agent, floatation agent, lubricant and solvent. Internationally, potential domestic uses include as health fuels, in cleaning and washing agents, in automotive products, as corrosion inhibitors, in paints, lacquers and varnishes, as hydraulic fluids and additives, in adhesives and binding agents, in wood stains, flooring adhesives and adhesive strippers, and in auto products including engine and car body products and cleaning products.</p> <p>Once in the environment, there is a low potential for hydrolysis as chemical constituents that consist entirely of carbon and hydrogen do not contain hydrolysable groups. The potential for photo-transformation in water and soil is also considered low. Kerosene is inherently to readily biodegradable. Hydrotreated light petroleum distillates is reported to have a low bioaccumulation potential.</p> <p>NICNAS outlines that the chemicals in this category have unknown or variable compositions (UVCB substances) and therefore, definitive toxicokinetic data, on absorption, distribution, metabolisms and excretion, are difficult to ascertain (ATSDR, 1995, cited by NICNAS, 2016). However, generally these compounds are expected to be readily absorbed following inhalation and oral exposure, and to a lesser extent, following dermal exposure. The chemicals are expected to be excreted rapidly (within 24 hours of exposure), primarily in the urine, following absorption. Metabolism of aliphatic hydrocarbons typically involve side chain oxidation to alcohol and carboxylic acid derivations (OECD, 2011, cited by NICNAS, 2016).</p> <p>The NICNAS profile identifies that the toxicity of other petroleum substances is predominantly driven by the levels of either benzene and/or polycyclic aromatic compounds containing 3 – 7 fused-rings. Chemical mixtures in the kerosene group contain negligible levels of these constituents (AIP, 2010, cited by NICNAS, 2016).</p>	
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Human Health Toxicity Summary	Reference
<p><b>Carcinogenicity</b></p> <p>Hydrotreated light petroleum distillates have not been evaluated by the International Agency for Research on Cancer (IARC) as to their carcinogenicity.</p> <p>Kerosines are classified as non-carcinogenic based on the data available, according to the EU CLP Regulations EC No. 1272/2008, as outlined on the ECHA dossier.</p> <p>Kerosene is not carcinogenic when animals were exposed via the oral or inhalation routes. However, chronic skin contact with kerosene and jet fuels may lead to tumour formation as a consequence of repeated cycles of irritation, skin damage and repair. As summarised in the ECHA dossier, jet fuels and kerosines were found to be not mutagenic or genotoxic, with the observations from animal studies</p>	<p>IARC, 2020</p> <p>ECHA, 2020</p>

<p>confirming the non-genotoxic nature of the skin tumour formation. Although dermal irritation alone seems not sufficient to cause dermal tumourigenicity, studies have shown that dermal irritation and inflammation are prerequisites for dermal carcinogenicity. No skin tumours were observed in studies where irritation and/or inflammation were prevented but other factors (such as dermal update of polycyclic aromatic compounds were kept identical).</p> <p>NICNAS concluded that overall there is considered inadequate evidence of carcinogenicity for the chemicals in the kerosine group.</p>	<p>NICNAS, 2016</p>
<p><b>Mutagenicity/Genotoxicity</b></p> <p>Kerosine and jet fuels did not meet criteria for classification as mutagens under the EU CLP Regulation (EC No. 1272/2008), based on the weight of evidence from in vitro and in vivo mutagenic studies indicating these substances were likely not mutagens.</p> <p>ECHA report that there were no studies available that described mutagenic or genotoxic effects of kerosine or jet fuels in humans. Available animal studies include in vitro gene mutation studies in bacteria and mammalian cells and cytogenicity in mammalian cells studies, and in vivo chromosome aberration and dominant lethal assays. Some contradictory results were reported in in vivo cytogenicity animal testing, where negative results were obtained for hydrodesulfurised kerosine in rats and female mice, but positive results were obtained for male mice. However, the overall conclusions is that kerosines and jet fuels are not mutagenic or genotoxic, taking into account that the great majority of the studies were negative and that the data on various individual components of kerosine and jet fuels were negative.</p> <p>NICNAS also conclude that the kerosine chemical group is not considered to be genotoxic, based on the weight of evidence from the available in vitro and in vivo genotoxicity studies</p>	<p>ECHA, 2020</p> <p>NICNAS, 2016</p>
<p><b>Reproductive Toxicity</b></p> <p>Kerosines are not classified as toxic for reproduction under the EU CLP Regulation (EC No. 1272/2008), as outlined in the ECHA dossier. This was based on available data indicating that long-term oral or inhalation exposure to jet fuels and kerosines has no effect on the fertility of male rats up to a dose of 3 000 mg/kg bw/day or a concentration 1 000 mg/m<sup>3</sup> (highest concentration tested) and no effect on the fertility of female rats up to a dose of 1 500 mg/kg bw/day (highest concentrations tested).</p> <p>The key oral test cited by ECHA is a sub-chronic reproductive toxicity screening, where male rats were treated for 70 to 90 days with 0, 750, 1 500 or 3 000 mg/kg bw day of undiluted JP-8 jet fuel, then mated to untreated females. In the second part of the study, female rats were administered the test compound at doses of 0, 375, 750 or 1 500 mg/kg bw day undiluted JP-8 jet fuel for 90 days prior to mating, through mating, gestation, delivery and lactation for a total of 21 weeks. During mating, they were housed with untreated males. The study reported no systemic signs of toxicity.</p> <p>A supporting inhalation study is presented, where male rats were exposed for 6 hours a day for 91 consecutive days to JP-8 Jet Fuel vapour at concentrations of 0, 250, 500 and 1 000 mg/m<sup>3</sup>. The study concluded that rats did not exert any overt signs of clinical toxicity.</p> <p>A dermal reproductive/developmental toxicity screening study is also presented. This study involved 10 rats/sex/group being treated dermally with hydrodesulfurised kerosine at concentrations of 0, 165, 330 or 494 mg/kg bw/day in a mineral oil in a dosing volume of 1 mL/kg for a minimum of 6 hours,</p>	<p>ECHA, 2020</p>

<p>7 days/ week beginning pre-mating, during the mating period and through 20 days of gestation. Skin irritation occurred in both males (all doses) and females (high dose only). At terminal sacrifice, no findings were reported except for those on the skin.</p> <p>NICNAS concluded that there was no evidence indicating reproductive toxicity for the chemicals in the kerosine group.</p>	<p>NICNAS, 2016</p>
<p><b>Developmental Toxicity/Teratogenicity</b></p> <p>Kerosines are not classified as a developmental toxicant according to the EU CLP Regulation (EC No. 1272/2008), as outlined in the ECHA dossier. This was based on developmental studies not providing sufficient evidence to cause a strong suspicion of developmental toxicity in the absence of signs of marked maternal toxicity.</p> <p>The key study cited presents an oral, sub-acute NOAEL of 1 000 mg/kg bw/d for rats, with decreased body weight of female rats and pups observed at a dose of 1 500 mg/kg bw. This study involved 30 rats/dose being administered undiluted JP-8 jet fuel by gavage at doses of 0, 500, 1000, 1 500 and 2 000 mg/kg bw/day from day 6 through 15 of gestation. Significant decreases in foetal weight in both male and female fetuses was observed for doses of 1 500 mg/kg bw/day and 2 000 mg/kg bw/day.</p> <p>The dermal reproductive/developmental toxicity screening study outlined in the section above is presented. This study reports an offspring NOAEL of greater than or equal to 494 mg/kg bw/day (highest dose tested in this study).</p> <p>NICNAS concluded that there was no evidence indicating developmental toxicity for the chemicals in the kerosine group.</p>	<p>ECHA, 2020</p> <p>NICNAS, 2016</p>
<p><b>Endocrine Disruption</b></p> <p>Hydrotreated light petroleum distillates are not identified in the European Commission (EC)'s report, "Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption" as a substance of interest.</p>	<p>EC, 2000</p>
<p><b>Acute Toxicity (oral, dermal, inhalation)</b></p> <p>Kerosines are considered to have low acute oral, dermal and inhalation toxicity and do not meet the criteria for classification under the EU CLP Regulation (EC No. 1272/2008).</p> <p>The key acute <b>oral</b> study presented by ECHA reports a LD<sub>50</sub> of &gt; 5 000 mg/kg bw in male and female rats. The study was undertaken similar to OECD 420 guideline. Five rats per sex were given a single oral dose of 5 000 mg/kg bw of undiluted thermocracked kerosine and observed for 14 days. Additional studies reporting oral LD<sub>50</sub> of &gt; 5 000 mg/kg supported this conclusion.</p> <p>The key acute <b>dermal</b> study presented by ECHA reports a LD<sub>50</sub> of &gt; 2 000 mg/kg bw in male and female rabbits. The study was undertaken similar to OECD 402 guideline. Five rabbits per sex were dermally exposed to undiluted thermocracked kerosine for 24 hours to 10% of their body surface area at a dose of 2 000 mg/kg. Animals were then observed for 14 days. Additional studies reporting dermal LD<sub>50</sub> of &gt; 2 000 mg/kg bw supported this conclusion.</p> <p>The key acute <b>inhalation</b> study presented by ECHA reports a LC<sub>50</sub> of &gt; 5.28 mg/L in male and female rats. The study was undertaken similar to OECD 403 guideline. Five rats per sex were exposed to</p>	<p>ECHA, 2020</p>

<p>straight-run kerosene for 4 hours to their whole body at a single dose of 5.28 mg/L. The reported LC<sub>50</sub> of &gt; 5.28 mg/L is supported by additional studies.</p> <p>NICNAS report low acute <b>oral</b> toxicity based on animal studies, with an LD<sub>50</sub> of &gt; 2 000 mg/kg bw reported for rats.</p> <p>NICNAS report low acute <b>dermal</b> toxicity based on animal studies, with an LD<sub>50</sub> of &gt; 2 000 mg/kg bw reported for rats and rabbits.</p> <p>NICNAS report low acute <b>inhalation</b> toxicity based on animal studies, with an LC<sub>50</sub> of &gt; 5.28 and &gt; 5.2 mg/L reported for rats.</p> <p>NICNAS outlines that the kerosines group (including CAS RN 64742-47-8) are classified as hazardous, with a classification of Aspiration Hazard – Category 1; H304 (May be fatal if swallowed and enters airways) on Hazardous Chemical Information System (HCIS).</p> <p>NICNAS report that numerous cases of kerosine poisoning have been described in humans, particularly in children in areas where kerosine oil is used extensively. Although many signs of kerosine poisoning are asymptomatic, signs do include diarrhoea, nausea and vomiting (UK HP, 2007, cited by NICNAS 2016). Incidents of children surviving ingestion of up to 1700 mg/kg bw have been reported, with death from oral ingestion usually being associated with aspiration of vomit, rather than systemic toxicity (ATSDR, 1995; UK HPA, 2007, cited by NICNAS, 2016).</p> <p>NICNAS also report that acute exposure of humans to kerosine and kerosine-based fuels has been associated with a variety of effects including impaired central nervous system function, including irritability, restlessness, ataxia, drowsiness, convulsions, coma and death; these are generally considered to be secondary effects resulting from hypoxia (UK HPA, 2007, cited by NICNAS).</p>	<p>NICNAS, 2016</p> <p>Safe Work Australia, 2020</p>
<p><b>Chronic/repeat dose toxicity (oral, dermal, inhalation)</b></p> <p>Kerosines were reported to not meet criteria for classification for repeat dose toxicity, under the EU CLP Regulation EC No. 1272/2008. NICNAS also report that repeated oral, dermal and inhalation exposure to the chemicals in the kerosine group are not considered to cause serious damage to health based on the available data.</p> <p>ECHA reports that a number of subacute and subchronic studies with kerosines and jet fuels were available to assess repeat repeat dose toxicity. These studies were reportedly undertaken in accordance with OECD Guidelines 410, 412, 413 and other non-guideline protocols.</p> <p>The key sub-chronic <b>oral</b> study reported a LOAEL of 1500 mg/kg/day and NOAEL of 750 mg/kg bw/day in rats for systemic effects.</p> <p>The sub-chronic <b>inhalation</b> NOAEC was reported to be 1 000 mg/m<sup>3</sup> in rats for both systemic and local effects. This was based on six well conducted studies on representative samples from this category. For CAS RN. 64742-47-8 (vapour), NICNAS report a NOAEC of 6 000 mg/m<sup>3</sup> (the highest dose tested) in a 90-day rat inhalation toxicity study, undertaken in accordance with OECD 413 guidelines (OECD, 2012c, cited by NICNAS, 2016).</p>	<p>ECHA, 2020 and NICNAS, 2016</p>

<p>The sub-acute to sub-chronic <b>dermal</b> NOAEL was reported to be 495 mg/kg bw/day in rats for systemic effects. This was based on one of 15 well conducted studies with representatives of the kerosine category, covering sub-acute and sub-chronicle exposure.</p> <p>A sub-chronic <b>dermal</b> LOAEL of 1 mg/cm<sup>2</sup> was reported for local effect in rats.</p>	
<p><b>Sensitisation of the skin or respiratory system</b></p> <p>Kerosines do not meet the criteria for classification as a <b>skin</b> sensitiser under EU CLP Regulation (EC No. 1272/2008), according to the information presented in ECHA.</p> <p>The key study cited by ECHA tested thermocracked kerosene in mineral oil on male young adult pig/Hartley guinea pigs using a modified Buehler technique. Under the test conditions, thermocracked kerosine was not considered a delayed contact sensitiser. This conclusion was supported by other studies. NICNAS also conclude that the chemicals in the kerosine group are not skin sensitisers.</p> <p>No data was available to assess <b>respiratory</b> sensitisation of kerosines.</p>	<p>ECHA, 2020 and NICNAS, 2016</p>
<p><b>Corrosion (irreversible)/irritation (reversible) effects on the skin or eye</b></p> <p>Kerosines are classified as <b>Skin</b> Irritation Category 2 (H315), irritating to the skin, as defined by EU CLP Regulation (EC No. 1272/2008), according to ECHA.</p> <p>ECHA reports that animal studies indicated kerosene may act as a skin irritant, but the degree of irritancy appears to be substance, dose-exposure-time and methodology dependent. The results of studies of kerosines and jet fuels ranged from essentially non-irritating after 4 hours of semi-occlusive exposure to severely irritating after 24 hours of occluded exposure. The same results are cited by NICNAS. A potential mechanism suggested for irritation and the following inflammatory reaction is that fuels may induce the production and release of proinflammatory factors such as cytokines. Based on the weight-of-evidence, the substance is classified as irritating.</p> <p>Kerosines do not meet the criteria for classification as an <b>eye</b> irritant, as defined by EU CLP Regulation (EU No. 1272/2008), based on lack of corneal, iridial and conjunctival irritation, according to ECHA.</p> <p>ECHA reports that several irritation animal studies undertaken on a variety of kerosines indicated that none of the kerosines and jet fuels tested were more than slightly irritating to the eyes.</p> <p>NICNAS also conclude that the kerosines group are not ocular irritants. NICNAS outlines that the kerosines group (including CAS RN 64742-47-8) are given the hazard statement AUH066 (Repeated exposure may cause skin dryness and cracking).</p>	<p>ECHA, 2020</p> <p>NICNAS, 2016 Safe Work Australia, 2020</p>

Physical Hazards	Reference
<b>Flammable Potential</b> Flammable. Flash point of 29°C to 70°C and an auto-flammability of 220°C to 250°C.	ECHA, 2020
<b>Explosive Potential</b> Non-explosive. There are no chemical groups associated with explosive properties in the molecule.	ECHA, 2020

Toxicity Values	Value	Reference
<b>Human Toxicity Data</b>		
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEC	NDF	
LOAEL	NDF	
<b>Animal Toxicity Data</b>		
<i>Acute Toxicity</i>		
<i>LD<sub>50</sub></i>		
Rat, oral	LD <sub>50</sub> (male and female): > 5 000 mg/kg bw	Cited by ECHA, 2020
	LD <sub>50</sub> : > 2 000 mg/kg bw	Cited by NICNAS, 2016
Rat, dermal	LD <sub>50</sub> : > 2 000 mg/kg bw	Cited by NICNAS, 2016
Rabbit, dermal	LD <sub>50</sub> (male and female): > 2 000 mg/kg bw	Cited by ECHA, 2020
	LD <sub>50</sub> : > 2 000 mg/kg bw	Cited by NICNAS, 2016
<i>LC<sub>50</sub></i>		
Rat	LC <sub>50</sub> (male and female): > 5.28 mg/L	Cited by ECHA, 2020 and NICNAS, 2016
<i>High Chronic/Repeat Dose Toxicity</i>		



LOAEL	<p>LOAEL (rat, oral, subacute, developmental toxicity - decreased pub weight): 1 500 mg/kg bw/d</p> <p>LOAEL (rat, dermal, sub-chronic): 1 mg/cm<sup>2</sup></p>	Cited by ECHA, 2020
NOAEL	<p>NOAEL (rat, oral, systemic effects): &gt; 750 mg/kg bw/day)</p> <p>NOAEL (rat, dermal, sub-chronic, systemic effects): &gt; 495 mg/kg bw/day</p> <p>NOAEL (rat, oral, subacute, developmental toxicity - decreased pub weight): 1 000 mg/kg bw/d</p> <p>NOAEL (rat, dermal, reproductive and developmental toxicity): &gt; 494 mg/kg bw/day</p>	Cited by ECHA, 2020
NOAEC	<p>NOAEC (rat, inhalation, systemic and local effects): 1 000 mg/m<sup>3</sup> (or 1 mg/L)</p> <p>NOAEC (rat, inhalation): 6 000 mg/m<sup>3</sup> (or 6 mg/L)</p>	<p>Cited by ECHA, 2020</p> <p>Cited by NICNAS, 2016</p>

Footnotes:

LD<sub>50</sub> – lethal dose for 50% of experimental population

LC<sub>50</sub> – lethal air concentration for 50% of experimental population

LOAEL – Lowest Observed Adverse Effect Level

LOAEC – Lowest Observed Adverse Effect Concentration

NDF – No data found within the limits of the search strategy

Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Band 4</b>		
Carcinogenicity (IARC Group 1 or 2A)	No	
Mutagenicity/Genotoxicity (GHS Category 1A and 1B)	No	
Reproductive Toxicity/Developmental toxicity (GHS Category 1, 1A and 1B)	No	
Endocrine Disruption <sup>1</sup>	No	
<b>Hazard Band 3</b>		
Carcinogenicity (IARC Group 2B)	No	
Mutagenicity/Genotoxicity (GHS Category 2)	No	
Reproductive Toxicity/Developmental toxicity (GHS Category 2)	No	
Acute Toxicity (oral, dermal or inhalation)  Very Toxic/Toxic <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> ≤ 300 mg/kg<sup>2</sup></li> <li>• dermal LD<sub>50</sub> ≤ 1000 mg/kg</li> <li>• inhalation LC<sub>50</sub> ≤ 10 mg/L<sup>3</sup> (or mg/m<sup>3</sup>) (vapour)</li> </ul>	Yes (Aspiration hazard)	Classified as Aspiration Hazard – Category 1; H304 (May be fatal if swallowed and enters airways)  Inhalation - LC <sub>50</sub> (male and female): > 5.28 mg/L
High Chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL ≤ 10 mg/kg/d<sup>2</sup>;</li> <li>• dermal LOAEL ≤ 20 mg/kg/d;</li> <li>• inhalation LOAEC (6 h/d) ≤ 50 ppm/d for gases, ≤ 0.2 mg/L/d for vapours or ≤ 0.02 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	No	
Corrosive (irreversible effect)	No	
Respiratory sensitiser	NDF	

Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Band 2</b>		
Harmful chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL &gt; 10 mg/kg/d and ≤ 100 mg/kg/d</li> <li>• dermal LOAEL &gt; 20 mg/kg/d and ≤ 200 mg/kg/d</li> <li>• inhalation (6-h/d) LOAEC &gt; 50 mg/L ≤ 250 mg/L/d for gases, &gt; 0.2 mg/L ≤ 1.0 mg/L/d for vapours or &gt; 0.02 mg/L ≤ 0.2 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	No	
Skin Sensitiser	No	
<b>Hazard Band 1</b>		
Acute Toxicity-Harmful <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> &gt; 300 mg/kg ≤ 2000 mg/kg</li> <li>• dermal LD<sub>50</sub> &gt; 1 000 mg/kg ≤ 2000 mg/kg;</li> <li>• inhalation LC<sub>50</sub> (6 h/d) &gt; 10 mg/L ≤ 20 mg/L for vapours)<sup>3</sup></li> </ul>	No	Inhalation - LC <sub>50</sub> (male and female): > 5.28 mg/L
Irritant (reversible effect)	Yes	Classified as irritating to the skin.  Hazard statement AUH066 (Repeated exposure may cause skin dryness and cracking).
<b>Hazard Band 0</b> All indicators outside criteria listed in Hazards 1-4	-	
<b>Physical Hazards</b>		
Flammable potential	Yes	
Explosive potential	No	
<b>Hazard Evaluation (highest band) not including physical hazards</b>	3	
<b>Data confidence (available points out of 12 parameters)</b>	11/12	92%

\* Based on IMAP Framework [NICNAS (2013) Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework. National Industrial Chemicals Notification and Assessment Scheme. Department of Health and Aging, Canberra].

<sup>1</sup> Based on list of endocrine disrupting chemicals from the European Commission's Endocrine Disruptors website.

<sup>2</sup> milligrams per kilogram body mass (mg/kg) or milligrams per kilogram body mass per day (mg/kg/d)

<sup>3</sup> Based on GHS cut-offs for hazard classification. For chronic/repeat dose toxicity, GHS cut-offs are provided as guidance values (i.e. the dose/concentration at or below which significant health effects are observed)". (p 18, NICNAS 2013).

Human Health Guidelines		
Media	Concentration (mg/m <sup>3</sup> ; mg/L; mg/kg)	Reference
<b>Occupational Exposure Limits</b>		
<b>Air (OEL)</b>		
8-h TWA	NDF	
STEL	NDF	
Peak Limitation	NDF	
<b>Environmental Exposure</b>		
<b>Air, ambient, residential</b>	Total Petroleum Hydrocarbons (Aliphatic Low) – 630 µg/m <sup>3</sup> Total Petroleum Hydrocarbons (Aliphatic Medium) – 100 µg/m <sup>3</sup> Total Petroleum Hydrocarbons (Aromatic Low) – 31 µg/m <sup>3</sup> Total Petroleum Hydrocarbons (Aromatic Medium) – 3.1 µg/m <sup>3</sup>	US EPA, 2019
<b>Air, commercial/industrial</b>	Total Petroleum Hydrocarbons (Aliphatic Low) – 2600 µg/m <sup>3</sup> Total Petroleum Hydrocarbons (Aliphatic Medium) – 440 µg/m <sup>3</sup> Total Petroleum Hydrocarbons (Aromatic Low) – 130 µg/m <sup>3</sup> Total Petroleum Hydrocarbons (Aromatic Medium) – 13 µg/m <sup>3</sup>	US EPA, 2019

<b>Water, potable</b>	Total Petroleum Hydrocarbons (Aliphatic Low) – 1.3 mg/L Total Petroleum Hydrocarbons (Aliphatic Medium) – 0.1 mg/L Total Petroleum Hydrocarbons (Aromatic Low) – 0.033 mg/L Total Petroleum Hydrocarbons (Aromatic Medium) – 0.0055 mg/L	US EPA, 2019
<b>Water, recreational</b>	NDF	
<b>Soil, residential</b>	Total Petroleum Hydrocarbons (Aliphatic Low) – 520 mg/kg Total Petroleum Hydrocarbons (Aliphatic Medium) – 96 mg/kg Total Petroleum Hydrocarbons (Aromatic Low) - 82 mg/kg Total Petroleum Hydrocarbons (Aromatic Medium) – 97 mg/kg	US EPA, 2019
<b>Soil, commercial/industrial</b>	Total Petroleum Hydrocarbons (Aliphatic Low) – 2200 mg/kg Total Petroleum Hydrocarbons (Aliphatic Medium) – 440 mg/kg Total Petroleum Hydrocarbons (Aromatic Low) - 420 mg/kg Total Petroleum Hydrocarbons (Aromatic Medium) – 560 mg/kg	US EPA, 2019
<b>Soil, protection of groundwater</b>	Total Petroleum Hydrocarbons (Aliphatic Low) – 8.8 mg/kg Total Petroleum Hydrocarbons (Aliphatic Medium) – 1.5 mg/kg Total Petroleum Hydrocarbons (Aromatic Low) – 0.017 mg/kg Total Petroleum Hydrocarbons (Aromatic Medium) – 0.023 mg/kg	US EPA, 2019

Footnotes:

OEL = Occupational Exposure Limit

TWA = 8 h Time-Weighted Average

STEL = (15 min) Short-term Exposure Limit

### Qualifying Summary Comments

Hydrotreated light petroleum distillate (CAS RN.: 64742-47-8) is part of the group of chemicals referred to as kerosines, Kerosines are the lighter end of a group of petroleum substances known as middle distillates, the heavier end being gas oils. Distillates (petroleum), hydrotreated light (CAS RN 64742-47-8) is identified as a complex combination of hydrocarbons obtained by treating a petroleum fraction with hydrogen in the presence of a catalyst. It consists of hydrocarbons having carbon numbers predominantly in the range of C<sub>9</sub> through to C<sub>16</sub>, and consists of unknown or variable compositions. The boiling range is approximately 150°C to 290°C. Kerosines are reported to have a density from 0.77 to 0.85 g/cm<sup>3</sup> at 15°C. They are considered flammable, with a flash point of 29°C to 70°C and an auto-flammability of 220°C to 250°C. Distillates (petroleum), hydrotreated light has reported commercial uses in Australia as an adhesive, binding agent, floatation agent, lubricant and solvent.

The NICNAS profile identifies that the toxicity of other petroleum substances is predominantly driven by the levels of either benzene and/or polycyclic aromatic compounds containing 3 – 7 fused-rings. Chemical mixtures in the kerosine group contain negligible levels of these constituents (AIP, 2010, cited by NICNAS, 2016). Distillates (petroleum), hydrotreated light has been ranked in Hazard Band 3, based on a classification of Aspiration Hazard – Category 1; H304 (May be fatal if swallowed and enters airways) (Safe Work Australia, 2020). In addition, Kerosines are classified as Skin Irritation Category 2 (H315), irritating to the skin, and have the hazard statement AUH066 (Repeated exposure may cause skin dryness and cracking). Other than these hazards, studies reported low acute and chronic toxicity via the oral, dermal and inhalation route.

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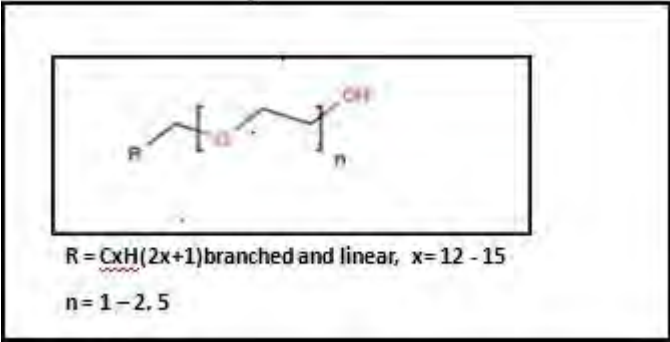
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[https://golderassociates.sharepoint.com/sites/117999/project files/6 deliverables/report 014/appendix e - human health summaries/19133367\\_hh\\_64742-47-8\\_hydrated light petroleum distillate jan2020.docx](https://golderassociates.sharepoint.com/sites/117999/project%20files/6%20deliverables/report%20014/appendix%20e%20-%20human%20health%20summaries/19133367_hh_64742-47-8_hydrated%20light%20petroleum%20distillate%20jan2020.docx)

Name	Alcohols, C12-15, ethoxylated
Synonyms	(C12-C15) Alkyl alcohol ethoxylate
CAS number	68131-39-5
Molecular formula	-
Molecular structure	 <p>R = C<sub>x</sub>H<sub>(2x+1)</sub> branched and linear, x = 12 - 15 n = 1 - 2.5</p> <p>(Source: ECHA, 2020)</p>
Surrogate	Alcohol ethoxylates (AE) group of chemicals

Overview	References
<p>Alcohols, C12-15, ethoxylated, belong to a large range of chemicals that exist as alcohol ethoxylates (AE). AE's are a widely used class of non-ionic surfactants. Nonionic surfactants are often used for wetting, detergency, foam stabilization, de-foaming, rheology modification, dispersion, and emulsification, or demulsification. They are widely used in laundry detergents and to a lesser extent in household cleaners, institutional and industrial cleaners, cosmetics, agriculture, and in textile, paper, oil and other process industries.</p> <p>The AE family is of the basic structure C<sub>x-y</sub> AE<sub>n</sub>. The subscript (x-y) following the 'C' indicates the range of carbon chain units. AEs with carbon unit range between C8 to C18 are most commonly used in household detergent products.</p> <p>AEs contain an ethylene oxide chain attached to the alcohol. The properties and behaviours of specific AE chemicals are dependent on the increase in carbon number and number of ethylene oxide units (indicated by sub script 'n' in formula above).</p> <p>For the purposes of this hazard profile, alcohols, C12-15, ethoxylated will be considered as part of the AE group.</p>	<p>HERA (2009)</p>



Human Health Toxicity Summary	Reference
<p><b>Carcinogenicity</b></p> <p>AEs have not been evaluated by the International Agency for Research on Cancer (IARC) as to their carcinogenicity.</p> <p>Toxicological data and information presented indicate that there is no evidence for AEs being carcinogenic. HERA reports studies were conducted using C<sub>14-15</sub>AE<sub>7</sub> and C<sub>12-13</sub>AE<sub>6.5</sub>.</p>	<p>IARC (2020)</p> <p>HERA (2009)</p>
<p><b>Mutagenicity/Genotoxicity</b></p> <p>Alcohol ethoxylates are not classified as mutagenic or genotoxic substances.</p> <p>The HERA report cites studies assessing the potential of C<sub>13-15</sub>AE<sub>7</sub> and C<sub>12-14</sub>AE<sub>7</sub> to induce chromosome damage in Chinese hamster bone marrow cells. Although the studies were not completed in full compliance with GLP and OECD guidelines, the studies were judged by HERA to be scientifically reliable. It was reported that there was no evidence was found that C<sub>13-15</sub>AE<sub>7</sub> or C<sub>12-14</sub>AE<sub>7</sub> damages bone marrow chromosomes under the conditions of the experiments. C<sub>14-15</sub>AE<sub>7</sub> was also administered orally to 5 male and female rats at doses of 250, 500 and 1,000 mg/kg in a GLP compliant study. Bone marrow smears were prepared 24 hours after and were processed for chromosome analysis. The test material did not show any potential for clastogenicity under the given test conditions. Two <i>in vivo</i> studies testing for chromosome damage with C<sub>12-15</sub>AE<sub>3</sub> and C<sub>12-14</sub>AE<sub>9</sub> in a mouse micronucleus test were also cited. No chromosome abnormalities were observed in these studies.</p>	<p>HERA (2009).</p>
<p><b>Reproductive Toxicity</b></p> <p>Alcohol ethoxylates are not classified as reproductive toxicants.</p> <p>In a two-generation study conducted in rats, the reproductive toxicity and developmental effects of C<sub>14-15</sub>AE<sub>7</sub> were evaluated at dietary levels of 0.05%, 0.1% and 0.5%. No compound related differences were seen between control and treated rats with respect to fertility, gestation or viability indices. No treatment-related changes in behaviour or appearance were observed in the parental rats or pups throughout the study. The reproductive toxicity and developmental effects of C<sub>12</sub>AE<sub>6</sub> was evaluated in a feeding study using a similar experimental design. Rats were exposed in a two-generation study to the compound at dose levels of 25, 50 or 250 mg/kg bw/d. No treatment related effects in the parents or pups on general behaviour, appearance or survival were observed. Fertility of treated groups was comparable with the controls.</p>	<p>HERA (2009)</p>
<p><b>Developmental Toxicity/Teratogenicity</b></p> <p>Two-generation developmental and teratogenicity study groups of rats of both sexes were fed C<sub>14-15</sub>AE<sub>7</sub> in the diet at dosage levels of 0.05, 0.1 and 0.5%. No compound related differences were seen between control and treated rats with respect to fertility, gestation or viability indices and the NOAEL for reproduction was assessed to be greater than 0.5% which equals the dose of about 250 mg/kg bw/d. In another studie where the test compounds were administered orally, a 'no observed adverse effect level' (NOAEL) greater than 50 mg/kg bw/d could be estimated for developmental toxicity. At higher exposure levels a reduced pup body weight was observed in the second generation of rats tested. When applied dermally, no adverse effects on the growth and</p>	<p>HERA (2009)</p>

<p>development of the offspring was observed during two generations of rats tested. Following dermal exposure, the NOAEL can be assumed to be higher than the highest tested dose of 250 mg/kg bw/d.</p>	
<p><b>Endocrine Disruption</b></p> <p>AEs are not identified in the European Commission (EC)'s report, "<i>Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption</i>" as a substance of interest.</p>	<p>EC (2000)</p>
<p><b>Acute Toxicity (oral, dermal, inhalation)</b></p> <p>HERA report that many studies investigating the acute toxicity of AEs have shown these compounds are of low oral, dermal and inhalational toxicity. The length of the alkyl chain did not exert any meaningful influence on acute toxicity. The degree of ethoxylation of the AE appear to be the only factor found to be of relevance in acute oral toxicity with the compounds with ethoxylate chains between 5 and 14 being more toxic by oral consumption than those with less than 4 or more than 21 ethoxy units.</p> <p><b>Oral toxicity</b></p> <p>Alcohol ethoxylates have been shown to have a low to moderate order of acute oral toxicity in the rat with LD<sub>50</sub> values ranging between 0.6 to more than 10 g/kg. It was also found that in some studies data for male and female animals were evaluated separately. Females appear to be more sensitive to AEs than males.</p> <p>Safe Work Australia (2020) provide the following the hazard categories and hazard statements for human health:</p> <ul style="list-style-type: none"> <li>• Acute Toxicity – Category 4; H302 (Harmful if swallowed)</li> </ul> <p><b>Inhalation Toxicity</b></p> <p>HERA reviewed three studies and concluded that alcohol ethoxylates are of low acute inhalation toxicity to rats with LC<sub>50</sub> values exceeding the saturated vapour concentration in air. Acute toxic thresholds were reached only when animals were exposed to the undiluted test chemical in the form of a respirable mist or aerosol.</p> <p><b>Dermal toxicity</b></p> <p>HERA conclude that alcohol ethoxylates have a low order of acute dermal toxicity and there was no relationship between compound structure and dermal toxicity. In a GLP-compliant study, five rats of each sex were given doses up to 2 g/kg. The acute dermal LD<sub>50</sub> of C<sub>12-15</sub>AE<sub>7</sub> was determined to be greater than 2 g/kg. The only signs of toxicity observed in both sexes were wet appearance of the fur and inflammation of the treated site.</p>	<p>HERA (2009)</p> <p>Safe Work Australia (2020)</p>
<p><b>Chronic/repeat dose toxicity (oral, dermal, inhalation)</b></p> <p>HERA (2009) reviewed a number of key studies that present a range of NOAELs, as follows:</p> <p>The repeated dose toxicity of 5 different AEs (i.e., C<sub>12-15</sub>AE<sub>3</sub>, C<sub>12-14</sub>AE<sub>7</sub>, C<sub>12-15</sub>AE<sub>7</sub>, C<sub>12-15</sub>AE<sub>11</sub>, C<sub>16-20</sub>AE<sub>18</sub>) was evaluated on the basis of a repeated dose 21-day oral toxicity assay. Three (3) rats per sex per dose and 6 animals of each sex in the control group were used in these investigations. On the</p>	<p>HERA (2009)</p>

basis of observed increases in liver weight and hepatocytic hypertrophy, the NOAEL was equivalent to a dose of about 433 mg/kg bw/d for females and 579 mg/kg bw/d for males. The study methodology used was similar to the OECD method 407 with the exception that the exposure duration in the OECD protocol is at 28 days and that at least 5 animals per dose and sex are required.

In a 90-day oral feeding study, C<sub>10</sub>AE<sub>5</sub> was fed to rats at doses of 125, 250 or 500 mg/kg bw/d. Clinical examinations did not indicate treatment-related effects, which were considered to be of biological significance. A NOAEL was established at 500 mg/kg bw/d under the assumption that the increased absolute and relative liver weights are of adaptive nature and not indicative of a toxic effect. Taking a more conservative approach, a NOAEL can be established at 250 mg/kg bw/d. Although the study was pre-GLP and not in full compliance with OECD guidelines, the study was judged by HEAR (2009) to be scientifically reliable.

C<sub>12-15</sub>AE<sub>7</sub> and C<sub>12-14</sub>AE<sub>7</sub> were tested in a 90-day dietary feeding study at dose levels of 0%, 0.0313%, 0.0625%, 0.125%, 0.25%, 0.5% and 1.0% active material in rats. NOAELs were established on the basis of hepatic histology at the 0.125% level, corresponding to a daily intake of C<sub>12-15</sub>AE<sub>7</sub> of 102 mg/kg bw/d and of C<sub>12-14</sub>AE<sub>7</sub> of 110 mg/kg bw/d. These studies were conducted pre-GLP and followed the principles of OECD guidelines.

In another 90-day study with C<sub>14-15</sub>AE<sub>7</sub>, the material was fed via the diet to three groups of young albino rats each consisting of 20 males and 20 females with control group consisting of an equal number of rats. The surfactant was incorporated in the diet at concentrations of 0.1%, 0.5% and 1%. During the in-life phase, standard haematological and biochemical parameters, and complete urinalyses were performed. As there were no treatment-related findings, the NOEL was established at the highest exposure level. The individual mean exposure for the high level males was 700 mg/kg bw/d of C<sub>14-15</sub>AE<sub>7</sub> and for females was 785 mg/kg bw/d. This study followed the principles of OECD methodology, but was not compliant with GLP regulations.

In a further 90-day oral feeding study, C<sub>14-15</sub>AE<sub>7</sub> was fed to Wistar rats at dietary concentrations of 0, 300, 1,000, 3,000, and 10,000 ppm of active ingredient. Significant treatment-related effects on body weight, food intake, organ weights, clinical chemistry and haematology were identified in one or both sexes fed with dietary concentrations of 3,000 and 10,000 ppm. Histopathologically, there were no compound-related effects at any dose level. No effects were observed on the organs of the reproductive system. Minor, but statistically significant changes in liver weight, kidney weights and plasma urea concentration were recorded in female rats in the 1,000 ppm group were not of toxicological significance. The NOEL for C<sub>14-15</sub>AE<sub>7</sub> was established at a dietary level of 300 ppm (15 mg/kg/day).

#### **Dermal**

Dermal treatment of 10 rats per sex per group for 90-days with 1%, 10% and 25% C<sub>9-11</sub>AE<sub>6</sub> did not result in any significant compound related effects. Scores for signs of irritation at the application site throughout the study were zero but at 10% and 25% dry and flaky skin was noted. Relative kidney weights were increased in both sexes at the 25% treatment level, but no histological lesions could be determined. As a result of the observation of the increases in relative kidney weight, the NOAEL was established at the 10% level. This exposure level reflects a dose of about 80 mg/kg bw/d. This study followed the principles of the OECD procedure 411 and was GLP compliant.

No treatment-related lesions were observed when C<sub>12-13</sub>AE<sub>6.5</sub> was applied to the backs of ICR Swiss mice three times a week at dilutions of 0, 0.2, 1.0 or 5.0% for 18 months. The 5% level is

<p>approximately equivalent to 270 mg/kg bw/d assuming that the mouse weight averages over the study was 75 g. No more detailed study information was available.</p>	
<p><b>Sensitisation of the skin or respiratory system</b></p> <p>Based on a weight-of-evidence approach and considering quality criteria in evaluating the studies, HERA conclude alcohol ethoxylates are not considered to be skin sensitizers. No data available to assess respiratory sensitisation.</p> <p>The majority of available guinea pig studies in which AEs were tested for skin sensitization properties demonstrated the absence of skin sensitization potential with both the Magnusson and Kligman and Buehler protocol.</p>	<p>HERA (2009), ECHA (2020)</p>
<p><b>Corrosion (irreversible and reversible)/irritation of the skin or eye</b></p> <p>HERA (2009) found that studies of skin and eye irritation potential show that the use of these AEs in household cleaning products is of low concern. When tested undiluted AEs were found to be slightly too severely irritating to skin in rabbits and rats and mildly to severely irritating to the rabbit eye.</p> <p>ECHA (2020) conclude that substance does not need to be classified for eye or skin irritation.</p> <p>Safe Work Australia (2020) provide the following the hazard categories and hazard statements for human health:</p> <ul style="list-style-type: none"> <li>• Eye damage – category 1; H318 (Causes serious eye damage)</li> <li>• Skin irritation – category 2; H315 (Causes skin irritation)</li> </ul>	<p>HERA (2009)</p> <p>ECHA (2020)</p> <p>Safe Work Australia (2020)</p>

Physical Hazards	Reference
<b>Flammable Potential</b> Non flammable	ECHA (2020)
<b>Explosive Potential</b> Non explosive	ECHA (2020)

Toxicity Values	Value	Reference
<b>Human Toxicity Data</b>		
<b>Acute Toxicity</b>		
	NDF	
	NDF	
<b>High Chronic/Repeat Dose Toxicity</b>		
LOAEC	NDF	
LOAEL	NDF	
<b>Animal Toxicity Data</b>		
<b>Acute Toxicity</b>		
<b>LD<sub>50</sub></b>		
Rat, oral	0.6 g/kg to >10 g/kg	HERA (2009)
Rat, dermal	>2 g/kg (C <sub>12-14</sub> AE <sub>3</sub> and C <sub>12-15</sub> AE <sub>7</sub> )	HERA (2009)
Rabbit, dermal	2 g/kg (C <sub>12-14</sub> AE <sub>3</sub> and C <sub>12-14</sub> AE <sub>6</sub> )	HERA (2009)
<b>LC<sub>50</sub></b>		
Rat	Acute 4h-LC <sub>50</sub> >0.22 mg/L	HERA (2009)

	1.5 - 20.7 mg/L	
<b>High Chronic/Repeat Dose Toxicity</b>		
LOAEL	NOAEL = 15 mg/kg bw/d to >500 mg/kg bw/d	HERA (2009)
LOAEC	NDF	

Footnotes:

LD<sub>50</sub> – lethal dose for 50% of experimental population

LC<sub>50</sub> – lethal air concentration for 50% of experimental population

LOAEL – Lowest Observed Adverse Effect Level

LOAEC – Lowest Observed Adverse Effect Concentration

NDF – No data found within the limits of the search strategy

Human Health Toxicity Ranking*		
	Hazard data	Comment
<b>Hazard Band 4</b>		
Carcinogenicity (IARC Group 1 or 2A)	No	HERA (2009)
Mutagenicity/Genotoxicity (GHS Category 1A and 1B)	No	HERA (2009)
Reproductive Toxicity/Developmental toxicity (GHS Category 1, 1A and 1B)	No	HERA (2009)
Endocrine Disruption <sup>1</sup>	No	EC (2000)
<b>Hazard Band 3</b>		
Carcinogenicity (IARC Group 2B)	No	HERA (2009)
Mutagenicity/Genotoxicity (GHS Category 2)	No	HERA (2009)
Reproductive Toxicity/Developmental toxicity (GHS Category 2)	No	HERA (2009)
Acute Toxicity (oral, dermal or inhalation)  Very Toxic/Toxic <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> ≤ 300 mg/kg<sup>2</sup></li> <li>• dermal LD<sub>50</sub> ≤ 1000 mg/kg</li> <li>• inhalation LC<sub>50</sub> ≤ 10 mg/L<sup>3</sup> (or mg/m<sup>3</sup>) (vapour)</li> </ul>	No	HERA (2009)
High Chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL ≤ 10 mg/kg/d<sup>2</sup>;</li> <li>• dermal LOAEL ≤ 2 0 mg/kg/d;</li> <li>• inhalation LOAEC (6 h/d) ≤ 50 ppm/d for gases, ≤ 0.2 mg/L/d for vapours or ≤ 0.02 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	No (based on 10X elevation from NOAEL to LOAEL consistent with uncertainty factor applications).	Lowest NOAEL (oral) = 15 mg/kg bw/d
Corrosive (irreversible effect)	No	
Respiratory sensitiser	NDF	
<b>Hazard Band 2</b>		

Human Health Toxicity Ranking*		
	Hazard data	Comment
Harmful chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>oral LOAEL &gt; 10 mg/kg/d and ≤ 100 mg/kg/d</li> <li>dermal LOAEL &gt; 20 mg/kg/d and ≤ 200 mg/kg/d</li> <li>inhalation (6-h/d) LOAEC               <ul style="list-style-type: none"> <li>&gt; 50 mg/L ≤ 250 mg/L/d for gases,</li> <li>&gt; 0.2 mg/L ≤ 1.0 mg/L/d for vapours or</li> <li>&gt; 0.02 mg/L ≤ 0.2 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul> </li> </ul>	No (based on 10X elevation from NOAEL to LOAEL consistent with uncertainty factor applications).	Lowest NOAEL (oral) = 15 mg/kg bw/d.
Skin Sensitiser	No	ECHA (2020)
<b>Hazard Band 1</b>		
Acute Toxicity-Harmful <ul style="list-style-type: none"> <li>oral LD<sub>50</sub> &gt; 300 mg/kg ≤ 2000 mg/kg</li> <li>dermal LD<sub>50</sub> &gt; 1 000 mg/kg ≤ 2000 mg/kg;</li> <li>inhalation LC<sub>50</sub> (6 h/d) &gt; 10 mg/L ≤ 20 mg/L for vapours)<sup>3</sup></li> </ul>	Yes	Oral LD50 = 0.6 g/kg to >10 g/kg
Irritant (reversible effect)	Yes	HERA (2009)
<b>Hazard Band 0</b>		
<b>All indicators outside criteria listed in Hazards 1-4</b>		
<b>Physical Hazards</b>		
Flammable potential	No	ECHA (2020)
Explosive potential	No	ECHA (2020)
<b>Hazard Evaluation (highest band) not including physical hazards</b>	Hazard band 1	
<b>Data confidence (available points out of 12 parameters)</b>	11/12	92%

\* Based on IMAP Framework [NICNAS (2013) Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework. National Industrial Chemicals Notification and Assessment Scheme. Department of Health and Aging, Canberra].

<sup>1</sup>Based on list of endocrine disrupting chemicals from the European Commission's Endocrine Disruptors website.

<sup>2</sup> Based on list of neurotoxic chemicals from US Agency for Toxic Substances and Disease Registry (ATSDR).

<sup>3</sup> milligrams per kilogram body mass(mg/kg) or milligrams per kilogram body mass per day (mg/kg/d)

<sup>4</sup> Based on GHS cut-offs for hazard classification. For chronic/repeat dose toxicity, GHS cut-offs are provided as guidance values (i.e. "the dose/concentration at or below which significant health effects are observed"). (p 18, NICNAS, 2013).



Human Health Guidelines		
Media	Concentration (mg/m <sup>3</sup> ; mg/L; mg/kg)	Reference
<b>Occupational Exposure Limits</b>		
<b>Air (OEL)</b>		
8-h TWA	NDF	
STEL	NDF	
Peak Limitation	NDF	
<b>Environmental Exposure</b>		
<b>Air</b> , ambient, residential	NDF	
<b>Air</b> , commercial/industrial	NDF	
<b>Water</b> , potable	NDF	
<b>Water</b> , recreational	NDF	
<b>Soil</b> , residential	NDF	
<b>Soil</b> , commercial/industrial	NDF	
<b>Soil</b> , protection of groundwater	NDF	

Footnotes:

OEL = Occupational Exposure Limit

TWA = 8 h Time-Weighted Average

STEL = (15 min) Short-term Exposure Limit

## Qualifying Summary Comments

Alcohols, C10-16, ethoxylated, propoxylated is a fractional alcohol ethoxylate range which is part of a large range of chemicals that exist as alcohol ethoxylates (AE) and has been assessed as Hazard Band 1. It has been considered as part of the group of alcohol ethoxylates taking into consideration the carbon number and extent of ethoxylation where data were available. The Hazard Band 1 rating reflects a low order of acute toxicity and its associated irritant properties, the latter of greater concern for the occupational setting. Overall, alcohols, C10-16, ethoxylated, propoxylated, exhibit a lack of carcinogenic, genotoxic, reproductive and developmental toxicities with the latter only evidenced at maternally toxic doses. It is not considered a sensitiser.

## References

EC (2000) European Commission Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption, preparation of a candidate list of substances as a basis for priority setting, Final Report (Incorporating corrigenda to final report dated 21 June 2000).

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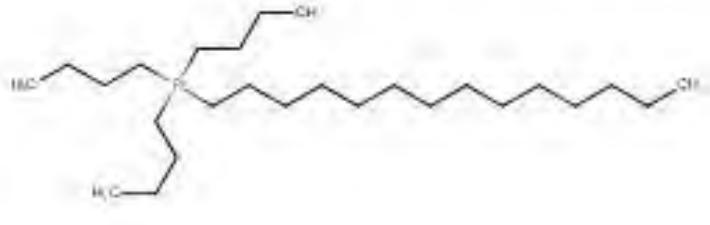
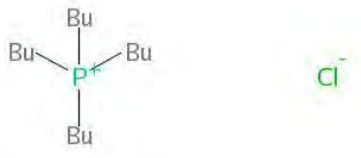
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National Environment Protection (Assessment of Site Contamination) Amended Measure 2013 (No.1). *Schedule B1: Guidelines on Investigation Levels for soil and groundwater*. National Environment Protection Council, Commonwealth Government of Australia.

Safe Work Australia (2020) Hazardous Chemical Information System (HCIS) <http://hcis.safeworkaustralia.gov.au/HazardousChemical/Details?chemicalID=100> Accessed February 2020.

Created by:	LPA	Date: 18/12/2019
Reviewed by:	CLB	Date and Revision: 20/01/20

<b>Name</b>	<b>Tributyl tetradecyl phosphonium chloride</b>
Synonyms	Tributyltetradecylphosphonium chloride
CAS number	81741-28-8
Molecular formula	C <sub>26</sub> H <sub>56</sub> P.Cl
Molecular structure	 <p>(Source: ECHAa, 2020)</p>
Surrogate	<p>Name: Tetra-n-butyl phosphonium chloride; tetrabutylphosphonium chloride CAS RN: 2304-30-5</p> <p>Basis for adoption: Limited information available for CAS 81741-28-8. U.S. EPA's Analog Identification Methodology (AIM) Tool software program identified Tetra-n-butyl phosphonium chloride as a read-across substance (U.S. EPA, 2020a).</p>
Molecular formula (surrogate)	C <sub>16</sub> H <sub>36</sub> P.Cl
Molecular structure (surrogate)	 <p>(Source: ECHAb, 2020)</p>

<b>Overview</b>	<b>References</b>
<p>Tetrabutylphosphonium chloride is an off-white waxy solid (at 20°C and 1013 hPa). It has a reported melting point of approximately 62°C - 64°C and will decompose upon boiling at approximately 345°C. Tetrabutylphosphonium chloride is considered completely miscible in water (at 25°C), has a vapour pressure of 0.018 Pa (at 25°C) and a relative density of 0.978 (at 20°C). It is considered non-flammable, non-explosive and non-oxidising.</p>	ECHA, 2020b

<p>Tetrabutylphosphonium chloride is registered for use in Scientific Research and Development.</p> <p>Tributyltetradecylphosphonium chloride is used as an active ingredient in pesticides and biocides and as an antimicrobial.</p> <p>Tetrabutylphosphonium chloride is reportedly not readily biodegradable in freshwater. The Log Kow was reported as -0.44 (at 23°C)</p>	<p>US EPA, 2020b</p>
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Human Health Toxicity Summary	Reference
<p><b>Carcinogenicity</b></p> <p>Tributyltetradecylphosphonium chloride or Tetrabutylphosphonium chloride have not been evaluated by the International Agency for Research on Cancer (IARC) as to its carcinogenicity.</p> <p>There is data lacking for assessment of carcinogenicity.</p>	<p>IARC, 2020</p> <p>ECHA, 2020b</p>
<p><b>Mutagenicity/Genotoxicity</b></p> <p>Tetrabutylphosphonium chloride was not classified for genotoxicity, based on CLP Regulation EC (No.) 1272/2008, based on available data according to ECHA.</p> <p>The key study cited by ECHA is an AMES test undertaken in accordance with OECD guideline 471 and GLP principles. The study reported all bacterial strains showed negative responses under the study conditions. Tetrabutylphosphonium chloride was determined to not be mutagenic in the Salmonella typhimurium reverse mutation assess and in the Escherichia coli reverse mutation assay with or without metabolic activation.</p>	<p>ECHA, 2020b</p>
<p><b>Reproductive Toxicity</b></p> <p>There is data lacking for assessment of reproductive toxicity.</p>	<p>ECHA, 2020b</p>
<p><b>Developmental Toxicity/Teratogenicity</b></p> <p>There is data lacking for assessment of developmental toxicity.</p>	<p>ECHA, 2020b</p>
<p><b>Endocrine Disruption</b></p> <p>Tributyltetradecylphosphonium chloride or Tetrabutylphosphonium chloride are not identified in the European Commission (EC)'s report, "<i>Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption</i>" as a substance of interest.</p>	<p>EC, 2000</p>
<p><b>Acute Toxicity (oral, dermal, inhalation)</b></p> <p>The acute <b>oral</b> toxicity of tetrabutylphosphonium chloride has been classified as Acute Toxicity 4 (H302: Harmful if swallowed), according to ECHA.</p>	<p>ECHA, 2020b</p>

<p>The key acute oral toxicity study cited by ECHA was undertaken on an analogue substance (Tetrabutylphosphonium Bromide) and was performed in accordance with OECD 423 guidelines and GLP principles. The study exposed female rats by gavage to 300 mg/kg bw and 2000 mg/kg bw. At the 2000 mg/kg dose, all animals were found dead on Day 1, and at the 300 mg/kg bw dose, no mortality occurred. The LD<sub>50</sub> was established to be within the range of 300-2000 mg/kg bw, with a LD<sub>50</sub> cut-off value of 500 mg/kg bw reported.</p> <p>The acute <b>dermal</b> toxicity of tetrabutylphosphonium chloride has been classified as Acute Toxicity 3 (H311: Toxic in contact with skin), according to ECHA.</p> <p>The key dermal toxicity study cited by ECHA was undertaken in accordance with OECD 402 Guideline and involved the application of tetrabutylphosphonium chloride to the skin of rabbits. Exposure included doses of 100, 200, 300 and 400 mg/kg undiluted compounds for 24 hours, with occlusive coverage. The LD<sub>50</sub> for the undiluted compounds was reported as 225 mg/kg (male rabbits).</p> <p>The acute <b>inhalation</b> toxicity of tetrabutylphosphonium chloride has been classified as Acute Toxicity 1 (H330: Fatal if inhaled), according to ECHA.</p> <p>The key inhalation toxicity study cited by ECHA was undertaken in accordance with EPA OPPTS 870.130 guideline and GLP principles. Rats (one group of 5 males and 5 females) were exposed to tetrabutylphosphonium chloride aerosol in a nose only inhalation chamber for 4 hours at 0.05 mg/L (gravimetric chamber concentration of 0.053 mg/L). Within 3 days of exposure, 4 males and 2 females died, and 1 male and 2 females were euthanised for humane reasons. Based on these results, the inhalation LC<sub>50</sub> 4 hour values was established to be &lt;0.05 mg/L.</p> <p>Another key inhalation toxicity study was cited by ECHA, but it was outlined that this study could not be used for classification purposes. The study was undertaken in accordance with EPA OPPTS 870.130 guideline and GLP principles. Rats (male and female) were exposed to tetrabutylphosphonium chloride aerosol (50% in water) in a nose only inhalation chamber for 1 hour at 0.04 mg/L. All animals survived the exposure. The LC<sub>50</sub> for 1 hr exposure was considered to be &gt; 0.04 mg/L.</p>	
<p><b>Chronic/repeat dose toxicity (oral, dermal, inhalation)</b></p> <p>There is data lacking for the assessment of the chronic/repeat dose toxicity.</p>	ECHA, 2020
<p><b>Sensitisation of the skin or respiratory system</b></p> <p>Tetrabutylphosphonium chloride has been classified as <b>Skin</b> Sensitising Category 1B (H317: May cause an allergic skin reaction), according to ECHA.</p> <p>The key study cited by ECHA is a mouse local lymph node assay (LLNA) skin sensitisation study that concludes tetrabutylphosphonium bromide (considered a read-across substance) is sensitising to skin. The study was performed according to OECD Guideline 429, EU Method B.42 and GLP principles.</p>	ECHA, 2020

<p>There is data lacking for assessment of <b>respiratory</b> sensitisation.</p>	
<p><b>Corrosion (irreversible)/irritation (reversible) effects on the skin or eye</b></p> <p>Tetrabutylphosphonium chloride has been classified as <b>Skin</b> Corrosion Category 1C (H314: Causes severe skin burns and eye damage), according to ECHA.</p> <p>ECHA cites an in vitro membrane barrier test for skin corrosion using Corrositex®, undertaken in accordance to OECD Guideline 435 and in compliance with GLP principles. The study involved tetrabutylphosphonium chloride being topically applied on top of a bio-barrier. The ability of the chemical to then pass through the bio-barrier and elicit a colour change in the underlying liquid chemical system was evaluated. It was concluded that the results indicated a corrosive potential.</p> <p>Tetrabutylphosphonium chloride has been classified as <b>Eye</b> Damage Category 1 (H318: Causes serious eye damage), according to ECHA.</p> <p>ECHA outlines that an eye irritation study is not required, because classification is triggered as a result of the skin irritation study.</p>	<p>ECHA, 2020b</p>

Physical Hazards	Reference
<b>Flammable Potential</b> Non-flammable. No flash point was observed up to 130°C in a closed cup experimental study.	ECHA, 2020
<b>Explosive Potential</b> Non-explosive. An experimental study was considered not warranted because the compound does not contain chemical groups present that are associated with explosive properties.	ECHA, 2020

Toxicity Values	Value	Reference
<b>Human Toxicity Data</b>		
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEC	NDF	
LOAEL	NDF	
<b>Animal Toxicity Data</b>		
<i>Acute Toxicity</i>		
<i>LD<sub>50</sub></i>		
Rat, oral	LD <sub>50</sub> cut-off 500 mg/kg bw	Cited by ECHA, 2020
Rabbit, dermal	LD <sub>50</sub> 225 mg/kg	Cited by ECHA, 2020
<i>LC<sub>50</sub></i>		
Rat	LC <sub>50</sub> (4 hour) <0.05 mg/L.	Cited by ECHA, 2020
<i>High Chronic/Repeat Dose Toxicity</i>		
LOAEL	NDF	
LOAEC	NDF	

**Footnotes:**

 LD<sub>50</sub> – lethal dose for 50% of experimental population

 LC<sub>50</sub> – lethal air concentration for 50% of experimental population



LOAEL – Lowest Observed Adverse Effect Level  
LOAEC – Lowest Observed Adverse Effect Concentration  
NDF – No data found within the limits of the search strategy



Human Health Toxicity Ranking		
	Hazard data	Comment
<b>Hazard Band 4</b>		
Carcinogenicity (IARC Group 1 or 2A)	No	Based on IARC, 2020
Mutagenicity/Genotoxicity (GHS Category 1A and 1B)	No	
Reproductive Toxicity/Developmental toxicity (GHS Category 1, 1A and 1B)	NDF	
Endocrine Disruption <sup>1</sup>	No	
<b>Hazard Band 3</b>		
Carcinogenicity (IARC Group 2B)	No	
Mutagenicity/Genotoxicity (GHS Category 2)	No	
Reproductive Toxicity/Developmental toxicity (GHS Category 2)	NDF	
Acute Toxicity (oral, dermal or inhalation)  Very Toxic/Toxic <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> ≤ 300 mg/kg<sup>2</sup></li> <li>• dermal LD<sub>50</sub> ≤ 1000 mg/kg</li> <li>• inhalation LC<sub>50</sub> ≤ 10 mg/L<sup>3</sup> (or mg/m<sup>3</sup>) (vapour)</li> </ul>	Yes	Dermal LD <sub>50</sub> 225 mg/kg Classified as toxic in contact with skin.  Inhalation LC <sub>50</sub> (4 hour) <0.05 mg/L. Classified as fatal if inhaled.
High Chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL ≤ 10 mg/kg/d<sup>2</sup>;</li> <li>• dermal LOAEL ≤ 20 mg/kg/d;</li> <li>• inhalation LOAEC (6 h/d) ≤ 50 ppm/d for gases, ≤ 0.2 mg/L/d for vapours or ≤ 0.02 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	NDF	
Corrosive (irreversible effect)	Yes	Classified as corrosive, causing skin burns and eye damage.

Human Health Toxicity Ranking		
	Hazard data	Comment
Respiratory sensitiser	NDF	
<b>Hazard Band 2</b>		
Harmful chronic/repeat dose toxicity <ul style="list-style-type: none"> <li>• oral LOAEL &gt; 10 mg/kg/d and ≤ 100 mg/kg/d</li> <li>• dermal LOAEL &gt; 20 mg/kg/d and ≤ 200 mg/kg/d</li> <li>• inhalation (6-h/d) LOAEC &gt; 50 mg/L ≤ 250 mg/L/d for gases, &gt; 0.2 mg/L ≤ 1.0 mg/L/d for vapours or &gt; 0.02 mg/L ≤ 0.2 mg/L/d for dust/mists/fumes<sup>3</sup></li> </ul>	NDF	
Skin Sensitiser	Yes	Classified as may cause allergic skin reaction.
<b>Hazard Band 1</b>		
Acute Toxicity-Harmful <ul style="list-style-type: none"> <li>• oral LD<sub>50</sub> &gt; 300 mg/kg ≤ 2000 mg/kg</li> <li>• dermal LD<sub>50</sub> &gt; 1 000 mg/kg ≤ 2000 mg/kg;</li> <li>• inhalation LC<sub>50</sub> (6 h/d) &gt; 10 mg/L ≤ 20 mg/L for vapours)<sup>3</sup></li> </ul>	Yes	Oral LD <sub>50</sub> cut-off 500 mg/kg bw Classified as harmful if swallowed.
Irritant (reversible effect)	No	Classified as corrosive.
<b>Hazard Band 0</b> All indicators outside criteria listed in Hazards 1-4	1	
<b>Physical Hazards</b>		
Flammable potential	No	
Explosive potential	No	
<b>Hazard Evaluation (highest band) not including physical hazards</b>	3	Based on acute inhalation and dermal toxicity, and corrosive to skin and eyes.
<b>Data confidence (available points out of 12 parameters)</b>	9/12	75% Data based on surrogate compound

\* Based on IMAP Framework [NICNAS (2013) Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework. National Industrial Chemicals Notification and Assessment Scheme. Department of Health and Aging, Canberra].

<sup>1</sup> Based on list of endocrine disrupting chemicals from the European Commission's Endocrine Disruptors website.

<sup>2</sup> milligrams per kilogram body mass (mg/kg) or milligrams per kilogram body mass per day (mg/kg/d)

<sup>3</sup> Based on GHS cut-offs for hazard classification. For chronic/repeat dose toxicity, GHS cut-offs are provided as guidance values (i.e. the dose/concentration at or below which significant health effects are observed)". (p 18, NICNAS 2013).

Human Health Guidelines		
Media	Concentration (mg/m <sup>3</sup> ; mg/L; mg/kg)	Reference
<b>Occupational Exposure Limits</b>		
<b>Air (OEL)</b>		
8-h TWA	NDF	
STEL	NDF	
Peak Limitation	NDF	
<b>Environmental Exposure</b>		
<b>Air</b> , ambient, residential	NDF	
<b>Air</b> , commercial/industrial	NDF	
<b>Water</b> , potable	NDF	
<b>Water</b> , recreational	NDF	
<b>Soil</b> , residential	NDF	
<b>Soil</b> , commercial/industrial	NDF	

<b>Soil</b> , protection of groundwater	NDF	
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Footnotes:

OEL = Occupational Exposure Limit

TWA = 8 h Time-Weighted Average

STEL = (15 min) Short-term Exposure Limit

### Qualifying Summary Comments

Tetrabutylphosphonium chloride (CAS RN: 2304-30-5) has been adopted as a surrogate compound for assessment of Tributyltetradecylphosphonium chloride (CAS RN: 81741-28-8), as there is limited data available for tributyltetradecylphosphonium chloride. Tetrabutylphosphonium chloride is an off-white waxy solid (at 20°C and 1013 hPa). It has a reported melting point of approximately 62°C - 64°C and will decompose upon boiling at approximately 345°C. Tetrabutylphosphonium chloride is considered completely miscible in water (at 25°C), has a vapour pressure of 0.018 Pa (at 25°C) and a relative density of 0.978 (at 20°C). It is considered non-flammable, non-explosive and non-oxidising. Tetrabutylphosphonium chloride is registered for use in Scientific Research and Development. Tributyltetradecylphosphonium chloride is an active ingredient in pesticides and biocides and is used as an antimicrobial.

Tetrabutylphosphonium chloride has been ranked in Hazard Band 3, due to acute inhalation and dermal toxicity, and corrosivity to skin and eyes. It is considered fatal if inhaled, toxic following contact with the skin and harmful if swallowed. It is also considered corrosive to the skin and eyes and sensitising to the skin. Data is lacking for the assessment of the chronic toxicity, reproductive toxicity and respiratory sensitization potential of tetrabutylphosphonium chloride.

### References

European Chemicals Agency (ECHA)a, 2020. Substance for Tributyltetradecylphosphonium chloride. Available at <https://echa.europa.eu/substance-information/-/substanceinfo/100.072.531>. Last modified 17/12/2019, accessed January 2020.

European Chemicals Agency (ECHA)b, 2019. Registration Dossier for Tetrabutylphosphonium chloride. Available at <https://echa.europa.eu/registration-dossier/-/registered-dossier/27398/1>. Last modified 03/02/2019, accessed January 2020.

European Commission (EC), 2000. Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption, preparation of a candidate list of substances as a basis for priority setting, Final Report (Incorporating corrigenda to final report dated 21 June 2000).

International Agency for Research on Cancer (IARC), 2019. Agents Classified by the IARC Monographs, Volumes 1–125, last updated 12 December 2019. Available at <https://monographs.iarc.fr/agents-classified-by-the-iarc/>, accessed January 2020.

U.S. Environmental Protection Agency (U.S. EPA), 2020a. *Analog Identification Methodology (AIM) Tool software program*. Available at <https://www.epa.gov/tsca-screening-tools/analog-identification-methodology-aim-tool>, accessed January 2020.

U.S. Environmental Protection Agency (U.S. EPA), 2020b. *Chemistry Dashboard* Available at <https://comptox.epa.gov/dashboard/dsstoxdb/results?search=DTXSID9034997#exposure>, accessed January 2020.

Created by:	MGT	Date: 24/01/2020
Reviewed by:	CLB	Date and Revision: 28/01/2020

**APPENDIX E**

**Chemical Information Sheets –  
Ecological Hazard Assessment**

Name	Ethanol
Synonyms	
CAS Number	64-17-5
Molecular Formula	C <sub>2</sub> H <sub>6</sub> O

Physical Properties	Value	Reference
PhaseState:	Liquid	ECHA 2020
Molecular Weight (g/mol):	46.07	ECHA 2020
Melting Point (°C):	-114.14	ECHA 2020
Boiling Point (°C):	78.3	ECHA 2020
Density / Specific Gravity (g/cm <sup>3</sup> ):	0.79	ECHA 2020
Vapour Pressure (mm Hg at 25°C):	5.93E+01	EPISUITE 2011 v4.1
Solubility (mg/L):	7.89E+05	ECHA 2020
Henry's Law Constant (atm m <sup>3</sup> /mole):	5.76E-06	EPISUITE 2011 v4.1
Organic carbon partition coefficient (Koc):	1.05	ECHA 2020
Log organic carbon partition coefficient (log Koc):	0.02	EPISUITE 2011 v4.1
Log octanol - water partition coefficient (log Kow):	-0.35	ECHA 2020

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation):	3.2573	EPISUITE 2011 v4.1
Biowin 4 (Primary Biodegradation):	3.9107	EPISUITE 2011 v4.1
EPISUITE Ready Biodegradability:	Biodegrades fast	EPISUITE 2011 v4.1
Biowin 7 (Anaerobic Model Prediction):	0.9153	EPISUITE 2011 v4.1
Fugacity_Air: (%)	7.4	EPISUITE 2011 v4.1
Fugacity_Water: (%)	41	EPISUITE 2011 v4.1
Fugacity_Soil: (%)	52	EPISUITE 2011 v4.1
Fugacity_Sediment: (%)	0.0718	EPISUITE 2011 v4.1
Bioconcentration factor (BCF):	3.162	EPISUITE 2011 v4.1
Biotransformation half - life (Days):	0.02866	EPISUITE 2011 v4.1

**Aquatic Ecotoxicological Data**

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Salmo gairdneri (Oncorhynchus mykiss)	Rainbow Trout	Fish LC50	MOR	Mortality	1	11200	ECHA 2020
Ceriodaphnia dubia	Water flea	Invertebrate LC50	MOR	Mortality/Immobilization	2	5012	ECHA 2020
Chlorella vulgaris	Green algae	Plant EC50	GRO	Growth	3	275	ECHA 2020

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time	Conc mg/L	Reference
Lemna gibba	Macrophyte	Plant NOEC	GRO	Growth	7	280	ECHA 2020
Daphnia magna	Water flea	Invertebrate NOEC	REP	Reproduction	10	9.6	ECHA 2020

**Terrestrial Ecotoxicological Data**

Acute Toxicity Data							
Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference	Units
Rat	Mammalian LD50	MOR	Mortality		2000	ECHA 2020	mg/kg
Guinea pig	Mammalian LD50	MOR	Mortality		5560	PubChem 2020	mg/kg
Mouse		MOR	Mortality		3450		
Mouse	Mammalian LD50	MOR	Mortality		3450	PubChem 2020	

Chronic toxicity data							
Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference	Units
Earthworm	1	MOR	Mortality	14	134	ECOSAR 2012	mg/L



Created By: Naomi Cooper

Date: 30/01/2020

Checked By: Carolyn Brumley

Date: 31/01/2020

Name	Butyl alcohol
Synonyms	
CAS Number	71-36-3
Molecular Formula	C4H10O

Physical Properties	Value	Reference
PhaseState:	Liquid	ECHA 2020
Molecular Weight (g/mol):		0
Melting Point (°C):	-90.00	ECHA 2020
Boiling Point (°C):	119	ECHA 2020
Density / Specific Gravity (g/cm <sup>3</sup> ):	0.81	ECHA 2020
Vapour Pressure (mm Hg at 25°C):	7.78E+00	EPISUITE 2011 v4.1
Solubility (mg/L):	6.60E+04	ECHA 2020
Henry's Law Constant (atm m <sup>3</sup> /mole):	9.99E-06	EPISUITE 2011 v4.1
Organic carbon partition coefficient (Koc):	3.47	EPISUITE 2011 v4.1
Log organic carbon partition coefficient (log Koc):	0.54	EPISUITE 2011 v4.1
Log octanol - water partition coefficient (log Kow):	1	ECHA 2020

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation):	3.4937	EPISUITE 2011 v4.1
Biowin 4 (Primary Biodegradation):	4.1393	EPISUITE 2011 v4.1
EPISUITE Ready Biodegradability:	Biodegrades fast	EPISUITE 2011 v4.1
Biowin 7 (Anaerobic Model Prediction):	0.6495	EPISUITE 2011 v4.1
Fugacity_Air: (%)	4.56	EPISUITE 2011 v4.1
Fugacity_Water: (%)	40	EPISUITE 2011 v4.1
Fugacity_Soil: (%)	55	EPISUITE 2011 v4.1
Fugacity_Sediment: (%)	0.0747	EPISUITE 2011 v4.1
Bioconcentration factor (BCF):	3.162	EPISUITE 2011 v4.1
Biotransformation half - life (Days):	0.06816	EPISUITE 2011 v4.1

### Aquatic Ecotoxicological Data

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Pimephales promelas	Fathead minnow	Fish LC50	MOR	Mortality	4	1376	ECHA 2020
Daphnia magna	Water flea	Invertebrate EC50	MOR	Mortality/Immobilization	4	1328	ECHA 2020

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time	Conc mg/L	Reference
Daphnia magna	Water flea	Invertebrate NOEC	REP	Reproduction	21	4.1	ECHA 2020
Selenastrum capricornutum	Green algae	Plant NOEC	GRO	Growth	4	129	ECHA 2020

### Terrestrial Ecotoxicological Data

Acute Toxicity Data							
Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference	Units
Rat	Mammalian LD50	MOR	Mortality		2292	ECHA 2020	mg/kg bw
Mouse	Mammalian LD50	MOR	Mortality		2680	ECHA 2020	mg/kg bw
Rabbit	Mammalian LD50	MOR	Mortality		3500	ECHA 2020	mg/kg bw
Earthworm	QSAR Earthworm LC50	MOR	Mortality	14	170	ECOSAR 2012	mg/L
Hamster	Mammalian LD50	MOR	Mortality		1200	ECHA 2020	mg/kg bw



Project number: 12766600

Created By: Naomi Cooper

Checked By: Carolyn Brumley

Date: 31/01/2020

Date: 31/01/2020

ORGANIC

Name	Amides, C18-unsaturated, N,N-bis(hydroxyethyl)
Synonyms	
CAS Number	93-83-4
Molecular Formula	C22H43NO3

Physical Properties	Value	Reference
PhaseState:	Liquid	ECHA 2020
Molecular Weight (g/mol):		0
Melting Point (°C):	-80.00	ECHA 2020
Boiling Point (°C):	300	ECHA 2012
Density / Specific Gravity (g/cm <sup>3</sup> ):	0.97	ECHA 2020
Vapour Pressure (mm Hg at 25°C):	8.00E-07	ECHA 2020
Solubility (mg/L):	1.20E-01	ECHA 2020
Henry's Law Constant (atm m <sup>3</sup> /mole):	1.04E-11	EPISUITE 2011 v4.1
Organic carbon partition coefficient (Koc):	1,448.00	EPISUITE 2011 v4.1
Log organic carbon partition coefficient (log Koc):	3.16	EPISUITE 2011 v4.1
Log octanol - water partition coefficient (log Kow):	6	ECHA 2020

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation):	2.9465	EPISUITE 2011 v4.1
Biowin 4 (Primary Biodegradation):	4.0479	EPISUITE 2011 v4.1
EPISUITE Ready Biodegradability:	Biodegrades fast	EPISUITE 2011 v4.1
Biowin 7 (Anaerobic Model Prediction):	0.4572	EPISUITE 2011 v4.1
Fugacity_Air: (%)	0.102	EPISUITE 2011 v4.1
Fugacity_Water: (%)	24	EPISUITE 2011 v4.1
Fugacity_Soil: (%)	75	EPISUITE 2011 v4.1
Fugacity_Sediment: (%)	1.14	EPISUITE 2011 v4.1
Bioconcentration factor (BCF):	99.66	EPISUITE 2011 v4.1
Biotransformation half - life (Days):	0.2725	EPISUITE 2011 v4.1

### Aquatic Ecotoxicological Data

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Danio rerio	Zebrafish	Fish LC50	MOR	Mortality	4	5.1	ECHA 2020
Daphnia magna	Water flea	Invertebrate EC50	MOR	Mortality/Immobilization	1	3.3	ECHA 2020
Desmodesmus subspicatus	Green algae	Plant EC50	GRO	Growth	3	18.6	ECHA 2020

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time	Conc mg/L	Reference
Oncorhynchus mykiss	Rainbow trout	Fish NOEC	MOR	Mortality	28	0.26	ECHA 2020
Daphnia magna	Water flea	Invertebrate NOEC	MOR/REP	Mortality and reproduction	21	0.07	ECHA 2020
Oncorhynchus mykiss	Rainbow trout	Fish LOEC	MOR	Mortality	28	0.83	ECHA 2020
Daphnia magna	Water flea	Invertebrate LOEC	MOR	Mortality	21	0.24	ECHA 2020

### Terrestrial Ecotoxicological Data

Acute Toxicity Data							
Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference	Units
Rat	Mammalian LD50	MOR	Mortality		10000	ECHA 2020	mg/kg/bw

Created By: Naomi Cooper

Date: 30/01/2020

Checked By: Carolyn Brumley

Date: 31/01/2020

Name	Triethanol amine
Synonyms	
CAS Number	102-71-6
Molecular Formula	C <sub>6</sub> H <sub>15</sub> NO <sub>3</sub>

Physical Properties	Value	Reference
PhaseState:	Liquid	PubChem 2020
Molecular Weight (g/mol):	149.19	PubChem 2020
Melting Point (°C):	21.50	PubChem 2020
Boiling Point (°C):	350	PubChem 2020
Density / Specific Gravity (g/cm <sup>3</sup> ):	1.12	PubChem 2020
Vapour Pressure (mm Hg at 25°C):	3.59E-06	PubChem 2020
Solubility (mg/L):	1.00E+06	EPISUITE 2011 v4.1
Henry's Law Constant (atm m <sup>3</sup> /mole):	7.05E-13	EPISUITE 2011 v4.1
Organic carbon partition coefficient (Koc):	10.00	PubChem 2020
Log organic carbon partition coefficient (log Koc):	1.00	PubChem 2020
Log octanol - water partition coefficient (log Kow):	-1	PubChem 2020

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation):	3.0946	EPISUITE 2011 v4.1
Biowin 4 (Primary Biodegradation):	3.7328	EPISUITE 2011 v4.1
EPISUITE Ready Biodegradability:	Biodegrades fast	EPISUITE 2011 v4.1
Biowin 7 (Anaerobic Model Prediction):	0.3155	EPISUITE 2011 v4.1
Fugacity_Air: (%)	0.0000161	EPISUITE 2011 v4.1
Fugacity_Water: (%)	31	EPISUITE 2011 v4.1
Fugacity_Soil: (%)	69	EPISUITE 2011 v4.1
Fugacity_Sediment: (%)	0.0688	EPISUITE 2011 v4.1
Bioconcentration factor (BCF):	3.9	PubChem 2020
Biotransformation half - life (Days):	0.0008924	EPISUITE 2011 v4.1

**Aquatic Ecotoxicological Data**

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Scenedesmus subspicatus	Green algae	Plant EC50	GRO	Growth	2	470	ECOTOX 2020
Ceriodaphnia dubia	Water flea	Invertebrate EC50	IMB	Immobilization	2	610	ECOTOX 2020
Pimephales promelas	Fathead minnow	Fish LC50	MOR	Mortality	4	11800	ECOTOX 2020

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time	Conc mg/L	Reference
Scenedesmus quadricauda	Green algae	Plant LOEC	GRO	Growth		1.8	ECOTOX 2020
Daphnia magna	Water flea	Invertebrate NOEC	REP	Reproduction	21	16	ECOTOX 2020

**Terrestrial Ecotoxicological Data**

Acute Toxicity Data							
Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference	Units
Mouse	Mammalian LD50	MOR	Mortality		5846	PubChem 2020	mg/kg
Rat	Mammalian LD50	MOR	Mortality		4920	PubChem 2020	mg/kg
Guinea Pig	Mammalian LD50	MOR	Mortality		2200	PubChem 2020	mg/kg
Rabbit	Mammalian LD50	MOR	Mortality		2200	PubChem 2020	mg/kg





Project number: 12766600

Checked By: Carolyn Brumley

Date: 17/01/2020

ORGANIC

Name	Ethylene glycol
Synonyms	
CAS Number	107-21-1
Molecular Formula	C <sub>2</sub> H <sub>6</sub> O <sub>2</sub>

Physical Properties	Value	Reference
PhaseState:	Liquid	ECHA 2020
Molecular Weight (g/mol):	62.068	ATSDR 2010
Melting Point (°C):	-13.00	ECHA 2020
Boiling Point (°C):	197.4	ECHA 2020
Density / Specific Gravity (g/cm <sup>3</sup> ):	1.11	ECHA 2020
Vapour Pressure (mm Hg at 25°C):	8.90E-02	ATSDR 2010
Solubility (mg/L):	1.00E+06	ECHA 2020
Henry's Law Constant (atm m <sup>3</sup> /mole):	6.00E-08	ATSDR 2010
Organic carbon partition coefficient (Koc):	1.00	EPISUITE 2011 v4.1
Log organic carbon partition coefficient (log Koc):	0.00	EPISUITE 2011 v4.1
Log octanol - water partition coefficient (log Kow):	-1.36	ECHA 2020

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation):	3.3891	EPISUITE 2011 v4.1
Biowin 4 (Primary Biodegradation):	4.0171	EPISUITE 2011 v4.1
EPISUITE Ready Biodegradability:	Biodegrades fast	EPISUITE 2011 v4.1
Biowin 7 (Anaerobic Model Prediction):	1.1563	EPISUITE 2011 v4.1
Fugacity_Air: (%)	1.44	EPISUITE 2011 v4.1
Fugacity_Water: (%)	36	EPISUITE 2011 v4.1
Fugacity_Soil: (%)	62	EPISUITE 2011 v4.1
Fugacity_Sediment: (%)	0.0638	EPISUITE 2011 v4.1
Bioconcentration factor (BCF):	3.162	EPISUITE 2011 v4.1
Biotransformation half - life (Days):	0.0065	EPISUITE 2011 v4.1

**Aquatic Ecotoxicological Data**

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Pimephales promelas	Fathead minnow	Fish LC50	MOR	Mortality	4	16	ECOTOX 2020
Daphnia magna	Water flea	Invertebrate EC50	MOR	Mortality	2	6900	ECOTOX 2020

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time	Conc mg/L	Reference
Ceriodaphnia magna	Water flea	Fish MATC	MOR	Mortality	7	4.2	ECOTOX 2020
Pimephales promelas	Fathead minnow	Fish NOEC	GRO	Growth	7	<3330	ECOTOX 2020
Ceriodaphnia dubia	Water flea	Invertebrate NOEC	REP	Reproduction	7	<3330	ECOTOX 2020

**Terrestrial Ecotoxicological Data**

Acute Toxicity Data							
Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference	Units
Rat	Mammalian LD50	MOR	Mortality		4000	ATSDR 2010	mg/kg day
Earthworm	QSAR Earthworm LC50	MOR	Mortality	14	232	ECOSAR 2012	mg/L

Created By: Naomi Cooper

Date: 3/02/2020

Checked By: Carolyn Brumley

Date: 3/02/2020

Name	Glutaraldehyde
Synonyms	
CAS Number	111-30-8
Molecular Formula	C5H8O2

Physical Properties	Value	Reference
PhaseState:	Liquid	ECHA 2019
Molecular Weight (g/mol):		0
Melting Point (°C):	-33.00	ECHA 2019
Boiling Point (°C):	101.5	ECHA 2019
Density / Specific Gravity (g/cm <sup>3</sup> ):	1.13	ECHA 2019
Vapour Pressure (mm Hg at 25°C):	6.00E-01	EPISUITE 2011 v4.1
Solubility (mg/L):	1.67E+05	EPISUITE 2011 v4.1
Henry's Law Constant (atm m <sup>3</sup> /mole):	1.10E-07	EPISUITE 2011 v4.1
Organic carbon partition coefficient (Koc):	1.00	EPISUITE 2011 v4.1
Log organic carbon partition coefficient (log Koc):	0.00	EPISUITE 2011 v4.1
Log octanol - water partition coefficient (log Kow):	-0.36	ECHA 2019

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation):	3.0226	EPISUITE 2011 v4.1
Biowin 4 (Primary Biodegradation):	4.0966	EPISUITE 2011 v4.1
EPISUITE Ready Biodegradability:	Biodegrades fast	EPISUITE 2011 v4.1
Biowin 7 (Anaerobic Model Prediction):	1.1592	EPISUITE 2011 v4.1
Fugacity_Air: (%)	0.395	EPISUITE 2011 v4.1
Fugacity_Water: (%)	40	EPISUITE 2011 v4.1
Fugacity_Soil: (%)	59	EPISUITE 2011 v4.1
Fugacity_Sediment: (%)	0.0755	EPISUITE 2011 v4.1
Bioconcentration factor (BCF):	3.162	EPISUITE 2011 v4.1
Biotransformation half - life (Days):	0.05197	EPISUITE 2011 v4.1

**Aquatic Ecotoxicological Data**

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Pimephales promelas	Fathead minnow	Fish LC50	MOR	Mortality	4	5.4	ECOTOX 2020
Daphnia magna	Water flea	Invertebrate EC50	MOR	Mortality/Immobilization	2	0.75	ECOTOX 2020
Scenedesmus subspicatus	Green algae	Plant EC50	GRO	Growth	3	0.375	ECHA 2019

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time	Conc mg/L	Reference
Oncorhynchus mykiss	Rainbow trout	Fish NOEC	MOR/GRO	Mortality/growth	97	1.6	ECHA 2019
Oncorhynchus mykiss	Rainbow trout	Fish LOEC	MOR/GRO	Mortality/growth	97	5	ECHA 2019
Daphnia magna	Water flea	Invertebrate NOEC	REP	Reproduction	21	5	ECHA 2019
Pseudokirchneriella subcapitata	Algae	Plant NOEC	GRO	Growth	4	0.042	ECOTOX 2020

**Terrestrial Ecotoxicological Data**

Acute Toxicity Data							
Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference	Units
Rat	Mammalian LD50	MOR	Mortality		77	ECHA 2019	mg/kg bw
Mouse	Mammalian LD50	MOR	Mortality		27	ECHA 2019	mg/kg bw
Rabbit	Mammalian LD50	MOR	Mortality		133	ECHA 2019	mg/kg bw
Earthworm	QSAR Earthworm LC50	MOR	Mortality	14	170	ECHA 2019	mg/kg soil dw



Project number: 12766600

ORGANIC

Created By: Naomi Cooper

Date: 31/01/2020

Checked By: Carolyn Brumley

Date: 31/01/2020

Name	Diethanolamine
Synonyms	
CAS Number	111-42-2
Molecular Formula	C4H11NO2

Physical Properties	Value	Reference
PhaseState:	Viscous liquid or deliquescent prisms	PubChem 2020
Molecular Weight (g/mol):	105.14	PubChem 2020
Melting Point (°C):	27.90	PubChem 2020
Boiling Point (°C):	268.8	PubChem 2020
Density / Specific Gravity (g/cm <sup>3</sup> ):	1.10	ECHA 2020
Vapour Pressure (mm Hg at 25°C):	2.80E-04	PubChem 2020
Solubility (mg/L):	1.00E+06	PubChem 2020
Henry's Law Constant (atm m <sup>3</sup> /mole):	3.90E-11	PubChem 2020
Organic carbon partition coefficient (Koc):	3.97	PubChem 2020
Log organic carbon partition coefficient (log Koc):	0.60	PubChem 2020
Log octanol - water partition coefficient (log Kow):	-1.43	PubChem 2020

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation):	3.3112	EPISUITE 2011 v4.1
Biowin 4 (Primary Biodegradation):	3.9982	EPISUITE 2011 v4.1
EPISUITE Ready Biodegradability:	Biodegrades fast	EPISUITE 2011 v4.1
Biowin 7 (Anaerobic Model Prediction):	1.3829	EPISUITE 2011 v4.1
Fugacity_Air: (%)	0.00135	EPISUITE 2011 v4.1
Fugacity_Water: (%)	34	EPISUITE 2011 v4.1
Fugacity_Soil: (%)	66	EPISUITE 2011 v4.1
Fugacity_Sediment: (%)	0.0593	EPISUITE 2011 v4.1
Bioconcentration factor (BCF):	3	PubChem 2020
Biotransformation half - life (Days):	0.01362	EPISUITE 2011 v4.1

**Aquatic Ecotoxicological Data**

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Oncorhynchus mykiss	Rainbow trout	Fish LC50	Mortality	Mortality	6	460	ECHA 2020
Daphnia magna	Water flea	Invertebrate LC50	Mortality	Mortality	4	1	ECOTOX 2020
Pseudokirchneriella subcapitata	Green algae	Plant EC50	GRO	Growth	3	9.5	ECHA 2020

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time	Conc mg/L	Reference
Daphnia magna	Water flea	Invertebrate NOEC	Reproduction	Reproduction	21	1.05	ECHA 2020
Pseudokirchneriella subcapitata	Green algae	Plant NOEC	Growth	Population changes	7	10	ECOTOX 2020
Pseudokirchneriella subcapitata	Green algae	Plant LOEC	Growth	Population changes	7	100	ECOTOX 2020

**Terrestrial Ecotoxicological Data**

Acute Toxicity Data							
Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference	Units
Rat	Mammalian LD50	MOR	Mortality		1100	ECHA 2020	mg/kg bw
Earthworm	QSAR Earthworm LC50	MOR	Mortality	35	>1000	ECHA 2020	mg/kg soil dw
Earthworm	QSAR Earthworm LC50	REP	Reproduction	63	776	ECHA 2020	mg/kg soil dw

Created By: Naomi Cooper

Date: 9/01/2020

Checked By: Carolyn Brumley

Date: 17/01/2020



<b>Name</b>	<b>Tetra-n-butyl phosphonium chloride</b>
Synonyms	
CAS Number	2304-30-5
Molecular Formula	C16H36P.Cl

Physical Properties	Value	Reference
PhaseState:	Solid	ECHA 2019
Molecular Weight (g/mol):		0
Melting Point (°C):	62.75	ECHA 2019
Boiling Point (°C):	344.8	ECHA 2019
Density / Specific Gravity (g/cm <sup>3</sup> ):	0.98	ECHA 2019
Vapour Pressure (mm Hg at 25°C):	5.20E-04	EPISUITE 2011 v4.1
Solubility (mg/L):	8.43E-02	EPISUITE 2011 v4.1
Henry's Law Constant (atm m <sup>3</sup> /mole):	1.54E-02	EPISUITE 2011 v4.1
Organic carbon partition coefficient (Koc):	78,830.00	EPISUITE 2011 v4.1
Log organic carbon partition coefficient (log Koc):	4.90	EPISUITE 2011 v4.1
Log octanol - water partition coefficient (log Kow):	-0.44	ECHA 2019

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation):	3.8170	EPISUITE 2011 v4.1
Biowin 4 (Primary Biodegradation):	4.5483	EPISUITE 2011 v4.1
EPISUITE Ready Biodegradability:	Biodegrades fast	EPISUITE 2011 v4.1
Biowin 7 (Anaerobic Model Prediction):	-0.4412	EPISUITE 2011 v4.1
Fugacity_Air: (%)	8.16	EPISUITE 2011 v4.1
Fugacity_Water: (%)	24	EPISUITE 2011 v4.1
Fugacity_Soil: (%)	60	EPISUITE 2011 v4.1
Fugacity_Sediment: (%)	8.12	EPISUITE 2011 v4.1
Bioconcentration factor (BCF):	286.4	EPISUITE 2011 v4.1
Biotransformation half - life (Days):	13.87	EPISUITE 2011 v4.1

**Aquatic Ecotoxicological Data**

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Pimephales promelas	Fathead minnow	Fish LC50	MOR	Mortality	4	>100	ECHA 2019
Ceriodaphnia dubia	Water flea	Invertebrate EC50	MOR	Mortality/Immobilization	2	1.5	ECHA 2019
Pseudokirchneriella subcapitata	Green algae	Plant EC50	GRO	Growth	3	2.84	ECHA 2019

**Terrestrial Ecotoxicological Data**

Acute Toxicity Data							
Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference	Units
Rat	Mammalian LD50	MOR	Mortality		300	ECHA 2019	mg/kg bw
Earthworm	QSAR Earthworm LC50	MOR	Mortality	14	162	ECOSAR 2012	mg/L

Created By: Naomi Cooper

Date: 31/01/2020

Checked By: Carolyn Brumley

Date: 31/01/2020

Name	Sodium bisulfite
Synonyms	Monosodium sulfite, sodium sulhydrate, sodium hydrogen sulphite
CAS Number	7631-90-5
Molecular Formula	NaHSO <sub>3</sub>

Physical Properties	Value	Reference
PhaseState:	Solid	ECHA 2020
Molecular Weight (g/mol):		
Melting Point (°C):		
Boiling Point (°C):		
Solubility (mg/L):	724,000.00	ECHA 2020

Other Relevant Factors	Value	Reference
<b>Reactivity</b>		
Species:		
Reaction type:		
<b>pH / Acidity</b>		
acid / alkaline		
pH (10% solution)		

Sodium bisulfite is highly reactive (oxidation). Exposure potential is therefore limited.

### Aquatic Ecotoxicological Data

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Ceriodaphnia dubia	Water flea	Invertebrate LC50	MOR	Mortality	2	1.94	ECOTOX 2020
Pimephales promelas	Fathead minnow	Fish LC50	MOR	Mortality	4	26.2	ECOTOX 2020
	Green algae	Plant EC50	GRO	Growth	3	36.8	ECHA 2020

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time	Conc mg/L	Reference
Danio rerio	Zebrafish	Fish NOEC	MOR	Mortality	34	200.5	ECHA 2020
Daphnia magna	Water flea	Invertebrate NOEC	REP	Reproduction	21	8.41	ECHA 2020

### Terrestrial Ecotoxicological Data

Acute Toxicity Data							
Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference	Units
Rat	Mammalian LD50	MOR	Mortality		1420	ECHA 2020	mg/kg bw

Created By: Naomi Cooper

Date: 3/02/2020

Checked By Carolyn Brumley

Date: 3/02/2020

Name	Guar gum
Synonyms	
CAS Number	9000-30-0
Molecular Formula	C <sub>10</sub> H <sub>14</sub> N <sub>5</sub> Na <sub>2</sub> O <sub>12</sub> P <sub>3</sub>

Physical Properties	Value	Reference
PhaseState:	Solid	
Molecular Weight (g/mol):	535.2	PubChem 2020
Melting Point (°C):		
Boiling Point (°C):		
Density / Specific Gravity (Enter Unit):		
Vapour Pressure (mm Hg at 25°C):		
Solubility (mg/L):	1.00E+00	PubChem 2020
Henry's Law Constant (atm m <sup>3</sup> /mole):		
Organic carbon partition coefficient (Koc):		
Log organic carbon partition coefficient (log Koc):		
Log octanol - water partition coefficient (log Kow):		

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation):		
Biowin 4 (Primary Biodegradation):		
EPISUITE Ready Biodegradability:		
Biowin 7 (Anaerobic Model Prediction):		
Fugacity_Air: (%)		
Fugacity_Water: (%)		
Fugacity_Soil: (%)		
Fugacity_Sediment: (%)		
Bioconcentration factor (BCF):		
Biotransformation half - life (Days):		

Notes: Solubility is < 1mg/L at 18.9oC (66oF)

**Aquatic Ecotoxicological Data**

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Daphnia magna	Water flea	Invertebrate LC50	MOR	Mortality	4	<6.2	ECOTOX 2020
Oncorhynchus mykiss	Rainbow trout	Fish LC50	MOR	Mortality	4	218	ECOTOX 2020

**Terrestrial Ecotoxicological Data**

Acute Toxicity Data							
Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference	Units
Rat	Mammalian LD50	MOR	Mortality		7060	FR 2011	mg/kg bw

Created By: Naomi Cooper

Date: 3/02/2020

Checked By: Carolyn Brumley

Date: 3/02/2020

Name	Sodium Polyacrylate
Synonyms	
CAS Number	9003-04-7
Molecular Formula	(C3H4O2) <sub>x</sub> -x-Na

Physical Properties	Value	Reference
PhaseState:		
Molecular Weight (g/mol):	4500	HERA 2014
Melting Point (°C):		
Boiling Point (°C):		
Density / Specific Gravity (g/cm <sup>3</sup> ):	1.10	ChemIDplus 2020
Vapour Pressure (mm Hg at 25°C):		
Solubility (mg/L):	4.00E+05	HERA 2014
Henry's Law Constant (atm m <sup>3</sup> /mole):		
Organic carbon partition coefficient (Koc):		
Log organic carbon partition coefficient (log Koc):		
Log octanol - water partition coefficient (log Kow):		

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation):		
Biowin 4 (Primary Biodegradation):		
EPISUITE Ready Biodegradability:		
Biowin 7 (Anaerobic Model Prediction):		
Fugacity_Air: (%)		
Fugacity_Water: (%)		
Fugacity_Soil: (%)		
Fugacity_Sediment: (%)		
Bioconcentration factor (BCF):		
Biotransformation half - life (Days):		

**Aquatic Ecotoxicological Data**

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Danio rerio	Zebrafish	Fish LC50	MOR	Mortality	4	>200	HERA 2014
Daphnia magna	Water flea	Invertebrate EC50	MOR	Mortality/Immobilization	2	>200	HERA 2014
Selenastrum capricornutum	Green algae	Plant EC50	GRO	Growth	3	40	HERA 2014

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time	Conc mg/L	Reference
Pimephales promelas	Fathead minnow	Fish NOEC	GRO	Growth	32	56	HERA 2014
Daphnia magna	Water flea	Invertebrate NOEC	REP	Reproduction	21	5.6	HERA 2014
Scenedesmus subspicatus	Green algae	Plant NOEC	GRO	Growth	4	32.8	HERA 2014

**Terrestrial Ecotoxicological Data**

Acute Toxicity Data							
Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference	Units
Earthworm	QSAR worms	MOR	Mortality	14	1000	HERA 2014	mg/kg
Rat	Mammalian LD50	MOR	Mortality		>1000	HERA 2014	mg/kg
Rat	Mammalian LD50	MOR	Mortality	28	1136	HERA 2014	mg/kg/bw/d



Name	Disodium Octaborate Tetrahydrate
Synonyms	Boric acid - disodium salt, boron sodium oxide, disodium octoborate
CAS Number	12008-41-2
Molecular Formula	B <sub>8</sub> Na <sub>2</sub> O <sub>13</sub>

Physical Properties	Value	Reference
PhaseState:	Crystalline powder	PubChem 2020
Molecular Weight (g/mol):	340.5	PubChem 2020
Melting Point (°C):	1,000.00	PubChem 2020
Boiling Point (°C):		
Solubility (mg/L):	224,000.00	ECHA 2020

Other Relevant Factors	Value	Reference
<b>Reactivity</b>		
Species:		
Reaction type:		
<b>pH / Acidity</b>		
acid / alkaline		
pH (10% solution)		

### Aquatic Ecotoxicological Data

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Pimephales promelas	Fathead minnow	Fish LC50	Mortality	Mortality	4	79.7	ECHA 2020
-	Water flea	Invertebrate LC50	Mortality	Mortality	2	64	ECHA 2020
Pseudokirchneriella subcapitata	Algae	Plant EC50	Growth	Growth	3	52.4	ECHA 2020

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time	Conc mg/L	Reference
Ictalurus punctatus	Channel catfish	Fish NOEC	Mortality	Mortality	9	17.3	ECHA 2020
Daphnia magna	Water flea	Invertebrate NOEC	Mortality	Mortality	21	10.8	ECHA 2020
Spirodella polyrrhiza	Duckweed	Plant NOEC	Growth	Growth	10	6.5	ECHA 2020
Spirodella polyrrhiza	Duckweed	Plant LOEC	Growth	Fronnd number	10	3.6	ECHA 2020

### Terrestrial Ecotoxicological Data

Acute Toxicity Data							
Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference	Units
Rat	Mammalian LD50	Mortality	Mortality		2550	ECHA 2020	mg/kg

Chronic toxicity data							
Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference	Units
Earthworm	1	Mortality	Mortality		315	ECHA 2020	mg/kg

<b>Name</b>	<b>Fatty acids, tall-oil, ethoxylated</b>
Synonyms	
CAS Number	61791-00-2
Molecular Formula	C(18-50)H(34-98)O(3-8)

Physical Properties	Value	Reference
PhaseState:	Liquid	ECHA 2018
Molecular Weight (g/mol):		0
Melting Point (°C):	-85.00	ECHA 2018
Boiling Point (°C):	172	ECHA 2018
Density / Specific Gravity (g/cm <sup>3</sup> ):	0.96	ECHA 2018
Vapour Pressure (mm Hg at 25°C):	3.79E-14	EPISUITE 2011 v4.1
Solubility (mg/L):	1.87E-02	EPISUITE 2011 v4.1
Henry's Law Constant (atm m <sup>3</sup> /mole):	4.06E-14	EPISUITE 2011 v4.1
Organic carbon partition coefficient (Koc):	3,321.00	EPISUITE 2011 v4.1
Log organic carbon partition coefficient (log Koc):	3.52	EPISUITE 2011 v4.1
Log octanol - water partition coefficient (log Kow):	5.94	ECHA 2018

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation):	2.6520	EPISUITE 2011 v4.1
Biowin 4 (Primary Biodegradation):	3.7109	EPISUITE 2011 v4.1
EPISUITE Ready Biodegradability:	Does not biodegrade fast	EPISUITE 2011 v4.1
Biowin 7 (Anaerobic Model Prediction):	0.1911	EPISUITE 2011 v4.1
Fugacity_Air: (%)	0.00000413	EPISUITE 2011 v4.1
Fugacity_Water: (%)	11	EPISUITE 2011 v4.1
Fugacity_Soil: (%)	87	EPISUITE 2011 v4.1
Fugacity_Sediment: (%)	2.02	EPISUITE 2011 v4.1
Bioconcentration factor (BCF):	164	EPISUITE 2011 v4.1
Biotransformation half - life (Days):	0.1547	EPISUITE 2011 v4.1

**Aquatic Ecotoxicological Data**

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Danio rerio	Zebrafish	Fish LC50	MOR	Mortality	4	>100	ECHA 2018
Daphnia magna	Water flea	Invertebrate EC50	MOR	Mortality/Immobilisation	2	12.41	ECHA 2018
Pseudokirchneriella subcapitata	Green algae	Plant EC50	GRO	Growth	3	39.7	ECHA 2018

**Terrestrial Ecotoxicological Data**

Acute Toxicity Data							
Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference	Units
Rat	Mammalian LD50	MOR	Mortality		10000	ECHA 2018	mg/kg
Earthworm	QSAR Earthworm LC50	MOR	Mortality	14	351	ECOSAR 2012	mg/L

Created By: Naomi Cooper

Date: 30/01/2020

Checked By: Carolyn Brumley

Date: 31/01/2020

Name	Hydrotreated light petroleum distillate
Synonyms	
CAS Number	64742-47-8
Molecular Formula	Complex combination of hydrocarbons

Physical Properties	Value	Reference
PhaseState:	Liquid	ECHA 2020
Molecular Weight (g/mol):		0
Melting Point (°C):	-9.60	EPISUITE 2011 v4.1
Boiling Point (°C):	216.3	EPISUITE 2011 v4.1
Density / Specific Gravity ():		
Vapour Pressure (mm Hg at 25°C):	2.36E-01	EPISUITE 2011 v4.1
Solubility (mg/L):	3.70E-03	EPISUITE 2011 v4.1
Henry's Law Constant (atm m <sup>3</sup> /mole):	9.35E+00	EPISUITE 2011 v4.1
Organic carbon partition coefficient (Koc):	4,818.00	EPISUITE 2011 v4.1
Log organic carbon partition coefficient (log Koc):	3.68	EPISUITE 2011 v4.1
Log octanol - water partition coefficient (log Kow):	6.1	EPISUITE 2011 v4.1

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation):	3.4194	EPISUITE 2011 v4.1
Biowin 4 (Primary Biodegradation):	4.1401	EPISUITE 2011 v4.1
EPISUITE Ready Biodegradability:	Biodegrades fast	EPISUITE 2011 v4.1
Biowin 7 (Anaerobic Model Prediction):	0.3014	EPISUITE 2011 v4.1
Fugacity_Air: (%)	22.4	EPISUITE 2011 v4.1
Fugacity_Water: (%)	69	EPISUITE 2011 v4.1
Fugacity_Soil: (%)	3	EPISUITE 2011 v4.1
Fugacity_Sediment: (%)	6.15	EPISUITE 2011 v4.1
Bioconcentration factor (BCF):	207.7	EPISUITE 2011 v4.1
Biotransformation half - life (Days):	5.026	EPISUITE 2011 v4.1

**Aquatic Ecotoxicological Data**

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Oncorhynchus mykiss	Rainbow trout	Fish LC50	MOR	Mortality	4	2	ECHA 2020
Daphnia magna	Water flea	Invertebrate LC50	MOR	Mortality/Immobilization	2	1.4	ECHA 2020
Raphidocelis subcapitata	Green algae	Plant EC50	GRO	Growth	3	1	ECHA 2020

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time	Conc mg/L	Reference
Daphnia magna	Water flea	Invertebrate NOEC	REP	Reproduction	21	0.48	ECHA 2020
Selenastrum capricornutum	Green algae	Plant NOEC	GRO	Growth	4	0.4	ECHA 2020
Daphnia magna	Water flea	Invertebrate LOEC	REP	Reproduction	21	1.2	ECHA 2020

**Terrestrial Ecotoxicological Data**

Acute Toxicity Data							
Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference	Units
Rat	Mammalian LD50	MOR	Mortality		>5000	ECHA 2020	mg/kg/bw
Earthworm	QSAR Earthworm LC50	MOR	Mortality	14	108	ECOSAR 2012	mg/L

Created By: Naomi Cooper

Date: 30/01/2020

Checked By: Carolyn Brumley

Date: 30/01/2020

Name	Alcohols C12-C15 ethoxylated
Synonyms	
CAS Number	68131-39-5
Molecular Formula	Cx-yAEn

Physical Properties	Value	Reference
PhaseState:	Liquid	ECHA 2020
Molecular Weight (g/mol):		0
Melting Point (°C):	7.22	ECHA 2020
Boiling Point (°C):	271	ECHA 2020
Density / Specific Gravity (g/cm <sup>3</sup> ):	0.93	ECHA 2020
Vapour Pressure (mm Hg at 25°C):	7.54E-11	EPISUITE 2011 v4.1
Solubility (mg/L):	7.00E+00	ECHA 2020
Henry's Law Constant (atm m <sup>3</sup> /mole):	5.51E-14	EPISUITE 2011 v4.1
Organic carbon partition coefficient (Koc):	150.40	EPISUITE 2011 v4.1
Log organic carbon partition coefficient (log Koc):	2.18	EPISUITE 2011 v4.1
Log octanol - water partition coefficient (log Kow):	5.06	ECHA 2020

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation):	2.7156	EPISUITE 2011 v4.1
Biowin 4 (Primary Biodegradation):	3.6109	EPISUITE 2011 v4.1
EPISUITE Ready Biodegradability:	Does not biodegrade fast	EPISUITE 2011 v4.1
Biowin 7 (Anaerobic Model Prediction):	-0.1689	EPISUITE 2011 v4.1
Fugacity_Air: (%)	0.0000000217	EPISUITE 2011 v4.1
Fugacity_Water: (%)	15	EPISUITE 2011 v4.1
Fugacity_Soil: (%)	84	EPISUITE 2011 v4.1
Fugacity_Sediment: (%)	0.143	EPISUITE 2011 v4.1
Bioconcentration factor (BCF):	81.07	EPISUITE 2011 v4.1
Biotransformation half - life (Days):	0.1392	EPISUITE 2011 v4.1

### Aquatic Ecotoxicological Data

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Oncorhynchus mykiss	Rainbow trout	Fish LC50	MOR	Mortality	4	1.03	ECOTOX 2020
Daphnia magna	Water flea	Invertebrate EC50	MOR	Mortality/Immobilization	2	0.14	ECHA 2020
	Green algae	Plant EC50	GRO	Growth	3	0.75	ECHA 2020

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time	Conc mg/L	Reference
Pimephales promelas	Fathead minnow	Fish NOEC	MOR	Mortality	10	0.11	ECHA 2020
	Water flea	Invertebrate NOEC	REP	Reproduction	21	0.77	ECHA 2020
Pseudokirchneriella subcapitata	Green algae	Plant NOEC	GRO	Growth	4	1	ECOTOX 2020
Daphnia magna	Water flea	Invertebrate LOEC	REP	Reproduction	21	0.187	ECOTOX 2020
Pseudokirchneriella subcapitata	Green algae	Plant LOEC	GRO	Growth	4	0.6	ECOTOX 2020
Lepomis macrochirus	Bluegill sunfish	Fish NOEC	MOR	Mortality	10	0.16	ECHA 2020

### Terrestrial Ecotoxicological Data

Acute Toxicity Data							
Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference	Units
Rat	Mammalian LD50	MOR	Mortality		>5000	ECHA 2020	mg/kg bw
Earthworms	QSAR Earthworm LC50	MOR	Mortality		>1000	ECHA 2020	mg/kg soil dw



Name	Reaction products of monoethanolamine and boric acid
Synonyms	
CAS Number	94095-04-2
Molecular Formula	C <sub>2</sub> H <sub>7</sub> NO.BH <sub>3</sub> O <sub>3</sub>

Physical Properties	Value	Reference
PhaseState:	Liquid	ECHA 2020
Molecular Weight (g/mol):		0
Melting Point (°C):		
Boiling Point (°C):		
Density / Specific Gravity (g/cm <sup>3</sup> ):	1.25	ECHA 2020
Vapour Pressure (mm Hg at 25°C):	0.00E+00	ECHA 2020
Solubility (mg/L):	2.50E+03	ECHA 2020
Henry's Law Constant (atm m <sup>3</sup> /mole):		
Organic carbon partition coefficient (Koc):	18.20	ECHA 2020
Log organic carbon partition coefficient (log Koc):	1.26	Calculated
Log octanol - water partition coefficient (log Kow):	-1.1	ECHA 2020

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation):		
Biowin 4 (Primary Biodegradation):		
EPISUITE Ready Biodegradability:		
Biowin 7 (Anaerobic Model Prediction):		
Fugacity_Air: (%)		
Fugacity_Water: (%)		
Fugacity_Soil: (%)		
Fugacity_Sediment: (%)		
Bioconcentration factor (BCF):		
Biotransformation half - life (Days):		

**Aquatic Ecotoxicological Data**

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Danio rerio	Zebrafish	Fish LC50	MOR	Mortality	4	>100	ECHA 2020
Daphnia magna	Water flea	Invertebrate EC50	MOR	Mortality/Immobilization	2	423	ECHA 2020
Pseudokirchneriella subcapitata	Green algae	Plant EC50	GRO	Growth	3	26	ECHA 2020

**Terrestrial Ecotoxicological Data**

Acute Toxicity Data							
Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference	Units
Rat	Mammalian LD50	MOR	Mortality		2000	ECHA 2020	mg/kg bw

Created By: Naomi Cooper

Date: 3/02/2020

Checked By: Carolyn Brumley

Date: 3/02/2020

Name	Acetic Acid
Synonyms	Glacial Acetic Acid, ethanoic acid
CAS Number	64-19-7
Molecular Formula	C2-H4-O2

Physical Properties	Value	Reference
PhaseState:	Liquid	MSDS, 2010
Molecular Weight (g/mol):	60.05	HSDB 2011
Melting Point (°C):	16.60	HSDB 2011
Boiling Point (°C):	117.9	HSDB 2011
Density / Specific Gravity (at 20oC):	1.05	HSDB 2011
Vapour Pressure (mm Hg at 25°C):	15.7	HSDB 2011
Solubility (mg/L):	475,900.00	EPISUITE 2011 v4.0
Henry's Law Constant (atm m3/mol):	0.0000001	HSDB 2011
Organic carbon partition coefficient (Koc):	1.00	EPISUITE 2011 v4.0
Log organic carbon partition coefficient (log Koc):	0.00	EPISUITE 2011 v4.0
Log octanol - water partition coefficient (log Kow):	-1.70E-01	HSDB 2011

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation):	3.4311	EPISUITE 2011 v4.0
Biowin 4 (Primary Biodegradation):	4.1467	EPISUITE 2011 v4.0
EPISUITE Ready Biodegradability:	Biodegrades fast	EPISUITE 2011 v4.0
Biowin 7 (Anaerobic Model Prediction):	0.9433	EPISUITE 2011 v4.0
Fugacity_Air: (%)	2.66	EPISUITE 2011 v4.0
Fugacity_Water: (%)	35	EPISUITE 2011 v4.0
Fugacity_Soil: (%)	62	EPISUITE 2011 v4.0
Fugacity_Sediment: (%)	0.0619	EPISUITE 2011 v4.0
Bioconcentration factor (BCF):	3.2	HSDB 2011
Biotransformation half - life (Days):	0.0762	EPISUITE 2011 v4.0

**Aquatic Ecotoxicological Data**

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Branchiura sowerbyi	Oligochaete	Invertebrate LC50	Mortality	Mortality	1	14.9	ECOTOX 2012
Cyprinus carpio	Common carp	Fish LC50	Mortality	Mortality	2	49	ECOTOX 2012

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Navicula seminulum	Diatom	Plant EC50	Population	Population growth	4	73.4	ECOTOX 2012

**Terrestrial Ecotoxicological Data**

SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference
	Rabbit	Mammalian LD50	Mortality	Mortality		600 mg/kg/bw	IUCLID 2012
	Earth worm	QSAR Earthworm LC50	Mortality	Mortality	14	1649 mg/L	ECOSAR 2012

Created By: Lisa Brookes

Date: 31/07/2012

Checked By: Kirsten Broadgate

Date: 31/08/2012

Name	Alcohols, C12-16, ethoxylated
Synonyms	NA
CAS Number	68551-12-2
Molecular Formula	

Physical Properties	Value	Reference
PhaseState:		
Molecular Weight (g/mol):		
Melting Point (°C):		
Boiling Point (°C):		
Density / Specific Gravity:		
Vapour Pressure (mm Hg at 25°C):		
Solubility (atm m <sup>3</sup> /mole):	0.01	HERA 2009
Henry's Law Constant:		
Organic carbon partition coefficient (Koc):		
Log organic carbon partition coefficient (log Koc):	6.65	HERA 2009
Log octanol - water partition coefficient (log Kow):		

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation) (Enter		
Biowin 4 (Primary Biodegradation) (Enter Unit):		
EPISUITE Ready Biodegradability:		
Biowin 7 (Anaerobic Model Prediction):		
Fugacity_Air: (%)		
Fugacity_Water: (%)		
Fugacity_Soil: (%)		
Fugacity_Sediment: (%)		
Bioconcentration factor (BCF):	387.5	HERA 2009
Biotransformation half - life (Days):		

**Aquatic Ecotoxicological Data**

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Scenedesmus subspicatus	Algae	Plant EC50	Population	Growth	3	0.05	HERA 2009
Scenedesmus subspicatus	Algae	Plant EC50	Population	Growth	3	0.035	HERA 2009
Daphnia magna	Water flea	Invertebrate NOEC			2	1	HERA 2009
Daphnia magna	Water flea	Invertebrate LC50			2	0.29	HERA 2009
Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Selenastrum capricornutum	Algae	Plant NOEC	Population	Growth	3	0.5	HERA 2009

Created By: Lisa Brookes

Date: 31/07/2012

Checked By: Kirsten Broadgate

Date: 31/08/2012

Name	Aluminium oxide
Synonyms	Alumina, aluminium sesquioxide, aluminium trioxide
CAS Number	1344-28-1
Molecular Formula	Al <sub>2</sub> O <sub>3</sub>

Physical Properties	Value	Reference
PhaseState:	White crystalline powder	HSDB 2012
Molecular Weight (g/mol):	101.961	HSDB 2012
Melting Point (°C):	2,030.00	HSDB 2012
Boiling Point (°C):	3000	HSDB 2012
Solubility (mg/L):	0.98	IUCLID 2012

Other Relevant Factors	Value	Reference
<b>Reactivity</b>		
Species:		
Reaction type:	Hazardous reactivity and incompatibilities with strong acids, strong bases, chlorine trifluoride, ethylene oxide, halogenated hydrocarbon, oxygen difluoride, sodium nitrate, vinyl compounds.	HSDB 2012
<b>pH / Acidity</b>		
acid / alkaline		
pH (10% solution)		



Project number: 127666004

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### Terrestrial Ecotoxicological Data

SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference
	Rat	Mammalian LD50	Mortality	Mortality		>2000 mg/kg	ECHA 2012

Created By: Lisa Brookes

Date: 31/07/2012

Checked By: Kirsten Broadgate

Date: 31/08/2012



Name	Amine oxides, cocoalkyldimethyl
Synonyms	Amines, coco alkyldimethyl, noxide; coco alkyldimethylamine oxide
CAS Number	61788-90-7
Molecular Formula	C14H31N01

Physical Properties	Value	Reference
PhaseState:	Solid	HSDB 2012
Molecular Weight (g/mol):	229.41	EPISUITE 2011 v4.1
Melting Point (°C):	167.95	EPISUITE 2011 v4.1
Boiling Point (°C):	426.62	EPISUITE 2011 v4.1
Density / Specific Gravity (Enter Unit):		
Vapour Pressure (mm Hg at 25°C):	0.000000157	EPISUITE 2011 v4.1
Solubility (atm m <sup>3</sup> /mole):	3.13	EPISUITE 2011 v4.1
Henry's Law Constant:	0.0000000000661	EPISUITE 2011 v4.1
Organic carbon partition coefficient (Koc):	7,988.00	EPISUITE 2011 v4.1
Log organic carbon partition coefficient (log Koc):	3.90	Calculated
Log octanol - water partition coefficient (log Kow):	4.67E+00	EPISUITE 2011 v4.1

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation) (weeks)	2.9905	EPISUITE 2011 v4.1
Biowin 4 (Primary Biodegradation) (days):	3.7858	EPISUITE 2011 v4.1
EPISUITE Ready Biodegradability:	Biodegrades fast	EPISUITE 2011 v4.1
Biowin 7 (Anaerobic Model Prediction):	0.1278	EPISUITE 2011 v4.1
Fugacity_Air: (%)	0.00136	EPISUITE 2011 v4.1
Fugacity_Water: (%)	32	EPISUITE 2011 v4.1
Fugacity_Soil: (%)	81	EPISUITE 2011 v4.1
Fugacity_Sediment: (%)	3.66	EPISUITE 2011 v4.1
Bioconcentration factor (BCF):	23.77	EPISUITE 2011 v4.1
Biotransformation half - life (Days):	2.22	EPISUITE 2011 v4.1

**Aquatic Ecotoxicological Data**

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
	Daphnid	Invertebrate LC50	Mortality	Mortality	2	0.126	ECOSAR 2012
	Fish	Fish LC50	Mortality	Mortality	4	0.749	ECOSAR 2012

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
	Green algae	Plant EC50	Population	Population, general	4	0.056	ECOSAR 2012

**Terrestrial Ecotoxicological Data**

SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference
	Rat	Mammalian LD50	Mortality	Mortality		846 mg AO/kg bw	INCHEM 2012

Created By: Lisa Brookes

Date: 31/07/2012

Checked By: Kirsten Broadgate

Date: 31/08/2012

Name	Benzaldehyde
Synonyms	Artificial almond oil, benze carboxablehyde, benzoic aldehyde
CAS Number	100-52-7
Molecular Formula	C7H6O

Physical Properties	Value	Reference
PhaseState:	Colourless to yellow liquid	HSDB 2012
Molecular Weight (g/mol):	106.2	HSDB 2012
Melting Point (°C):	-26.00	HSDB 2012
Boiling Point (°C):	179.2	HSDB 2012
Density / Specific Gravity (at 15oC):	1.04	HSDB 2012
Vapour Pressure (mm Hg at 25°C):	0.127	HSDB 2012
Solubility (atm m <sup>3</sup> /mole):	6.95	HSDB 2012
Henry's Law Constant:	0.000026	HSDB 2012
Organic carbon partition coefficient (Koc):	34.00	HSDB 2012
Log organic carbon partition coefficient (log Koc):	1.53	Calculated
Log octanol - water partition coefficient (log Kow):	1.48E+00	HSDB 2012

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation) (weeks)	3.009	EPISUITE 2011 v4.1
Biowin 4 (Primary Biodegradation) (days):	3.8982	EPISUITE 2011 v4.1
EPISUITE Ready Biodegradability:	Biodegrades fast	EPISUITE 2011 v4.1
Biowin 7 (Anaerobic Model Prediction):	0.6997	EPISUITE 2011 v4.1
Fugacity_Air: (%)	2.72	EPISUITE 2011 v4.1
Fugacity_Water: (%)	39	EPISUITE 2011 v4.1
Fugacity_Soil: (%)	58	EPISUITE 2011 v4.1
Fugacity_Sediment: (%)	0.09	EPISUITE 2011 v4.1
Bioconcentration factor (BCF):	2.7	HSDB 2012
Biotransformation half - life (Days):	0.156	EPISUITE 2011 v4.1

**Aquatic Ecotoxicological Data**

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Lepomis macrochirus	Bluegill	Fish LC50	Mortality	Mortality	4	1.07	ECOTOX 2012
Daphnia magna	Water flea	Invertebrate LC50	Mortality	Mortality	2	9	ECOTOX 2012

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Pimephales promelas	Fathead minnow	Fish NOEC	Growth	Growth, general	7	0.22	ECOTOX 2012
Pimephales promelas	Fathead minnow	Fish MATC	Population	Biomass	7	0.310	ECOTOX 2012

**Terrestrial Ecotoxicological Data**

SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference
	Mouse	Mammalian LD50	Mortality	Mortality		27.8 mg/kg bw	INCHEM 2012

Created By: Lisa Brookes

Date: 31/07/2012

Checked By: Kirsten Broadgate

Date: 31/08/2012

Name	Chlorous Acid, Sodium Salt
Synonyms	Sodium chlorite, alcide LD,
CAS Number	7758-19-2
Molecular Formula	ClHO2.Na

Physical Properties	Value	Reference
PhaseState:	White crystals or crystalline powder	HSDB 2012
Molecular Weight (g/mol):	90.44	HSDB 2012
Melting Point (°C):		
Boiling Point (°C):		
Solubility (mg/L):	64,000.00	HSDB 2012

Other Relevant Factors	Value	Reference
<b>Reactivity</b>		
Species:		
Reaction type:		
<b>pH / Acidity</b>		
acid / alkaline		
pH (10% solution)		

### Aquatic Ecotoxicological Data

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Daphnia magna	Water flea	Invertebrate LC50	Intoxication	Immobilised	2	0.025	ECOTOX 2012
Ptychocheilus oregonesis	Northern Squawfish	Fish LC50	Mortality	Mortality	4	0.08	ECOTOX 2012

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Pseudokirchneriella subcapitata	Green algae	Plant EC50	Population	Population growth rate	4	0.904	ECOTOX 2012
Pseudokirchneriella subcapitata	Green algae	Plant NOEC	Population	Population growth rate	4	0.0904	ECOTOX 2012
Oncorhynchus mykiss	Rainbow trout	Fish NOEC	Growth	Weight	20	2.3	ECOTOX 2012
Oncorhynchus mykiss	Rainbow trout	Fish MATC	Growth	Length	20	6.6	ECOTOX 2012



Project number: 127666004

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### Terrestrial Ecotoxicological Data

SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference
	Rat	Mammalian LD50	Mortality	Mortality		165 mg/kg/bw	IUCLID 2012

Created By: Lisa Brookes

Date: 31/07/2012

Checked By: Kirsten Broadgate

Date: 31/08/2012

Name	Cinnamaldehyde
Synonyms	2 - propenal, 3 - phenyl; cinnamic aldehyde
CAS Number	104-55-2
Molecular Formula	C9H8O

Physical Properties	Value	Reference
PhaseState:	Yellowish oily liquid	HSDB 2012
Molecular Weight (g/mol):	132.15	HSDB 2012
Melting Point (°C):	-7.50	HSDB 2012
Boiling Point (°C):	253	HSDB 2012
Density / Specific Gravity (Enter Unit):	1.05	HSDB 2012
Vapour Pressure (mm Hg at 25°C):	0.0289	HSDB 2012
Solubility (atm m <sup>3</sup> /mole):	1,420.00	HSDB 2012
Henry's Law Constant:	0.0000035	HSDB 2012
Organic carbon partition coefficient (Koc):	37.00	HSDB 2012
Log organic carbon partition coefficient (log Koc):	1.57	Calculated
Log octanol - water partition coefficient (log Kow):	1.90E+00	HSDB 2012

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation) (weeks)	2.9514	EPISUITE 2011 v4.1
Biowin 4 (Primary Biodegradation) (days):	3.8586	EPISUITE 2011 v4.1
EPISUITE Ready Biodegradability:	Biodegrades fast	EPISUITE 2011 v4.1
Biowin 7 (Anaerobic Model Prediction):	0.5526	EPISUITE 2011 v4.1
Fugacity_Air: (%)	0.527	EPISUITE 2011 v4.1
Fugacity_Water: (%)	32	EPISUITE 2011 v4.1
Fugacity_Soil: (%)	68	EPISUITE 2011 v4.1
Fugacity_Sediment: (%)	0.107	EPISUITE 2011 v4.1
Bioconcentration factor (BCF):	8.33	HSDB 2012
Biotransformation half - life (Days):	0.2389	EPISUITE 2011 v4.1

**Aquatic Ecotoxicological Data**

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
	Fish	Fish LC50	Mortality	Mortality	4	0.201	ECOTOX 2012
	Daphnid	Invertebrate LC50	Mortality	Mortality	2	88.3	ECOTOX 2012

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
	Green algae	Plant EC50	Population	Population changes, general	4	53.5	ECOTOX 2012

**Terrestrial Ecotoxicological Data**

SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference
	Mouse	Mammalian LD50	Mortality	Mortality		200 mg/kg	HSDB 2012

Created By: Lisa Brookes

Date: 31/07/2012

Checked By: Kirsten Broadgate

Date: 31/08/2012



Name	Citric Acid
Synonyms	2-Hydroxytricarballic acid; 2-Hydroxy-1,2,3-propanetricarboxylic acid
CAS Number	77-92-9
Molecular Formula	C <sub>6</sub> H <sub>8</sub> O <sub>7</sub>

Physical Properties	Value	Reference
PhaseState:	Colourless, translucent crystals or powder	HSDB 2011
Molecular Weight (g/mol):	192.12	HSDB 2011
Melting Point (°C):	153.00	HSDB 2011
Boiling Point (°C):		
Density / Specific Gravity (at 20oC):	1.67	HSDB 2011
Vapour Pressure (mm Hg at 25°C):	0.000000017	HSDB 2011
Solubility (mg/L):	383,000.00	HSDB 2011
Henry's Law Constant (atm m <sup>3</sup> /mol):	0.000000000000043	HSDB 2011
Organic carbon partition coefficient (Koc):	3.10	HSDB 2011
Log organic carbon partition coefficient (log Koc):	1.00	EPISUITE 2011 v4.0
Log octanol - water partition coefficient (log Kow):	-1.64E+00	EPISUITE 2011 v4.0

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation):	3.6563	EPISUITE 2011 v4.0
Biowin 4 (Primary Biodegradation):	4.5738	EPISUITE 2011 v4.0
EPISUITE Ready Biodegradability:	Biodegrades fast	EPISUITE 2011 v4.0
Biowin 7 (Anaerobic Model Prediction):	1.1142	EPISUITE 2011 v4.0
Fugacity_Air: (%)	0.0000995	EPISUITE 2011 v4.0
Fugacity_Water: (%)	28	EPISUITE 2011 v4.0
Fugacity_Soil: (%)	72	EPISUITE 2011 v4.0
Fugacity_Sediment: (%)	0.0592	EPISUITE 2011 v4.0
Bioconcentration factor (BCF):	3.2	HSDB 2011
Biotransformation half - life (Days):	0.02	EPISUITE 2011 v4.0

**Aquatic Ecotoxicological Data**

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Leuciscus idus ssp. Melanotus	Carp	Fish LC50	Mortality	Mortality	2	440	ECOTOX 2012

**Terrestrial Ecotoxicological Data**

SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference
	Rat	Mammalian LD50	Mortality	Mortality		3000 mg/kg/bw	IUCLID 2012
	Earthworm	QSAR Earthworm LC50	Mortality	Mortality		8030 mg/L	ECOSAR 2012

Created By: Chelsea Papadopoulos      Date: 16/08/2012

Checked By: Kirsten Broadgate      Date: 31/08/2012

Name	Diethylene Glycol
Synonyms	Ethanol, 2,2 oxybis; diglycol; carbitol; 2,2 oxybisethanol;DEG
CAS Number	111-46-6
Molecular Formula	C34H62O6

Physical Properties	Value	Reference
PhaseState:	Odourless, colourless viscous, hygroscopic liquid	IPCS 2007
Molecular Weight (g/mol):	106.2	IPCS 2007
Melting Point (°C):	-6.50	IPCS 2007
Boiling Point (°C):	245	IPCS 2007
Density / Specific Gravity:	1.12	IPCS 2007
Vapour Pressure (mm Hg at 25°C):	0.0057	HSDB 2012
Solubility (mg/L):	1,000,000.00	RAIS 2009
Henry's Law Constant (atm m3/mol):	0.000000002	HSDB 2012
Organic carbon partition coefficient (Koc):	1.00	HSDB 2012
Log organic carbon partition coefficient (log Koc):	0.00	Calculated
Log octanol - water partition coefficient (log Kow):	-1.47E+00	HSDB 2012

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation):	3.2759	EPISUITE 2011 v4.1
Biowin 4 (Primary Biodegradation):	3.9438	EPISUITE 2011 v4.1
EPISUITE Ready Biodegradability:	Biodegrades fast	EPISUITE 2011 v4.1
Biowin 7 (Anaerobic Model Prediction):	0.9483	EPISUITE 2011 v4.1
Fugacity_Air: (%)	0.0677	EPISUITE 2011 v4.1
Fugacity_Water: (%)	34	EPISUITE 2011 v4.1
Fugacity_Soil: (%)	66	EPISUITE 2011 v4.1
Fugacity_Sediment: (%)	0.0599	EPISUITE 2011 v4.1
Bioconcentration factor (BCF):	3	HSDB 2012
Biotransformation half - life (Days):	0.004877	EPISUITE 2011 v4.1

**Aquatic Ecotoxicological Data**

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Carassius auratus	Goldfish	Fish LC50	Mortality	Mortality	1	5000	ECOTOX 2012
Daphnia magna	Water flea	Invertebrate LC50	Mortality Mortality	Mortality	1	10000	ECOTOX 2012

**Terrestrial Ecotoxicological Data**

SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference
	Cat	Mammalian LD50	Mortality	Mortality		3300 mg/kg bw	HSDB 2012
	Earthworm	QSAR Earthworm LC50	Mortality	Mortality	14	422.92 3 mg/L	ECOSAR 2012

Created By: Lisa Brookes

Date: 31/07/2012

Checked By: Kirsten Broadgate

Date: 31/08/2012

Name	Hydrochloric Acid
Synonyms	Anhydrous hydrochloric acid, chlorohydric acid, dilute hydrochloric acid, hydrochloric acid gas, muriatic acid
CAS Number	7647-01-0
Molecular Formula	HCl

Physical Properties	Value	Reference
PhaseState:	Liquid	Merck, 1996
Molecular Weight (g/mol):	36.46	HSDB 2011
Melting Point (°C):	-114.22	HSDB 2011
Boiling Point (°C):	-85.05	HSDB 2011
Solubility (mg/L):	825,000.00	IUCLID 2000a

Other Relevant Factors	Value	Reference
<b>Reactivity</b>		
Species:		
Reaction type:		
<b>pH / Acidity</b>		
acid / alkaline		
pH (10% solution)		

### Aquatic Ecotoxicological Data

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Gambusia affinis	Western Mosquito fish	Fish LC50	Mortality	Mortality	1	282	ECOTOX 2012

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Lemna minor	Duckweed	Plant EC50	Growth	Weight	10	182.3	ECOTOX 2012



Project number: 127666004

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### Terrestrial Ecotoxicological Data

SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference
	Rat	Mammalian LD50	Mortality	Mortality		50 mg/kg/bw	INCHEM 2012

Created By: Chelsea Papadopoulos

Date: 16/08/2012

Checked By: Carolyn Brumley

Date: 31/08/2012

Name	Iron oxide
Synonyms	Ferric oxide, anhydrous ferric oxide, iron (III) oxide, diiron trioxide, iron trioxide, ferric sesquioxide
CAS Number	1309-37-1
Molecular Formula	Fe <sub>2</sub> O <sub>3</sub>

Physical Properties	Value	Reference
PhaseState:	Reddish brown hexagonal crystals	HSDB 2012
Molecular Weight (g/mol):	159.69	16
Melting Point (°C):	1,565.00	IUCLID 2012
Boiling Point (°C):		
Solubility (mg/L):	0.00	IUCLID 2012

Other Relevant Factors	Value	Reference
<b>Reactivity</b>		
Species:		
Reaction type:	Violent reaction when heated with powdered aluminum, calcium disilicide, magnesium, metal acetylides (e.g., calcium acetylide + iron (III) chloride (on ignition), cesium acetylide (incandescent reaction when warmed), rubidium acetylide).	HSDB 2012
<b>pH / Acidity</b>		
acid / alkaline	pH 5-6 at 100 g/l at 20oC	IUCLID 2012
pH (10% solution)		

### Aquatic Ecotoxicological Data

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Cloeon dipterum	Mayfly	Invertebrate LC50	Mortality	Mortality	1	40	ECOSAR 2012



Project number: 127666004

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### Terrestrial Ecotoxicological Data

SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference
	Rat	Mammalian LD50	Mortality	Mortality		>10000 mg/kg	HSDB 2012

Created By: Lisa Brookes

Date: 31/07/2012

Checked By: Carolyn Brumley

Date: 31/08/2012



Name	Methanol
Synonyms	Methyl alcohol; carbinol; wood spirit; wood alcohol
CAS Number	67-56-1
Molecular Formula	CH4O

Physical Properties	Value	Reference
PhaseState:	Colourless liquid	HSDB 2011
Molecular Weight (g/mol):	32.04	HSDB 2011
Melting Point (°C):	-97.80	HSDB 2011
Boiling Point (°C):	64.7	HSDB 2011
Density / Specific Gravity (at 25 degrees):	0.79	HSDB 2011
Vapour Pressure (mm Hg at 25°C):	127	HSDB 2011
Solubility (mg/L):	1,000,000.00	EPISUITE 2011 v4.0
Henry's Law Constant (atm m3/mol):	0.00000455	HSDB 2011
Organic carbon partition coefficient (Koc):	1.00	HSDB 2011
Log organic carbon partition coefficient (log Koc):	0.00	EPISUITE 2011 v4.0
Log octanol - water partition coefficient (log Kow):	-7.70E-01	HSDB 2011

Persistence / Bioaccumulation	Value	Reference
Biowin 3 (Ultimate Survey Biodegradation):	3.2883	EPISUITE 2011 v4.0
Biowin 4 (Primary Biodegradation):	3.931	EPISUITE 2011 v4.0
EPISUITE Ready Biodegradability:	Biodegrades fast	EPISUITE 2011 v4.0
Biowin 7 (Anaerobic Model Prediction):	0.8893	EPISUITE 2011 v4.0
Fugacity_Air: (%)	10.3	EPISUITE 2011 v4.0
Fugacity_Water: (%)	39	EPISUITE 2011 v4.0
Fugacity_Soil: (%)	50	EPISUITE 2011 v4.0
Fugacity_Sediment: (%)	0.0695	EPISUITE 2011 v4.0
Bioconcentration factor (BCF):	10	HSDB 2011
Biotransformation half - life (Days):	0.021	EPISUITE 2011 v4.0

**Aquatic Ecotoxicological Data**

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Anodonta imbecillis	Mussel	Invertebrate LC50	Mortality	Mortality	2	37.02	ECOTOX 2012
Pimephales promelas	Fathead Minnow	Fish LC50	Mortality	Mortality	4	>100	ECOTOX 2012

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Oreochromis mossambicus	Mozambique Tilapia	Fish NOEC	Reproduction	Fecundity	90	23.75	ECOTOX 2012
Algae	Algae	Plant NOEC	Population	Abundance	90	23.75	ECOTOX 2012
Oreochromis mossambicus	Mozambique Tilapia	Fish LOEC	Reproduction	Fecundity	90	47.49	ECOTOX 2012
Algae	Algae	Plant LOEC	Population	Abundance	90	47.49	ECOTOX 2012
Pseudokirchneriella subcapitata	Green algae	Plant EC50	Population	Population growth rate	2	>60.4	ECOTOX 2012

**Terrestrial Ecotoxicological Data**

SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference
	Rat	Mammalian LD50	Mortality	Mortality		5628 mg/kg	HSDB 2012
	Earthworm	QSAR Earthworm LC50	Mortality	Mortality	14	104.45 mg/L	ECOSAR 2012

Created By: Chelsea Papadopoulos      Date: 16/08/2012

Checked By: Carolyn Brumley      Date: 31/08/2012

Name	Sodium Carbonate
Synonyms	Soda ash, Solvay soda, bisodium carbonate, carbonic acid, crystal carbonate, disodium carbonate, sodium carbonate
CAS Number	497-19-8
Molecular Formula	Na <sub>2</sub> CO <sub>3</sub>

Physical Properties	Value	Reference
PhaseState:	White powder	HSDB 2011
Molecular Weight (g/mol):	105.99	HSDB 2011
Melting Point (°C):	851.00	HSDB 2011
Boiling Point (°C):		
Solubility (mg/L):	215,000.00	IPCS, 2011

Other Relevant Factors	Value	Reference
<b>Reactivity</b>		
Species:		
Reaction type:		
<b>pH / Acidity</b>		
acid / alkaline		
pH (10% solution)		

### Aquatic Ecotoxicological Data

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Amphipoda	Scud Order	Invertebrate LC50	Mortality	Mortality	3	67	ECOTOX 2012
Poecilia latipinna	Sailfin Molly	Fish LC50	Mortality	Mortality	2.1	297	ECOTOX 2012
Ceriodaphnia dubia	Water flea	Invertebrate EC50	Intoxication	Immobilisation	2	199.82	ECOTOX 2012

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Navicula seminulum	Diatom	Plant EC50	Population	Population growth rate	4	242	ECOTOX 2012
Daphnia magna	Water flea	Invertebrate LC50	Intoxication	Immobilisation	4.2	265	ECOTOX 2012
Daphnia magna	Water flea	Invertebrate EC50	Intoxication	Immobilisation	4.2	524	ECOTOX 2012



Project number: 127666004

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### Terrestrial Ecotoxicological Data

SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference
	Rat	Mammalian LD50	Mortality	Mortality		2800 mg/kg bw	INCHEM 2012
	Earthworm	QSAR Earthworm LC50	Mortality	Mortality	14	194.054 mg/L	ECOSAR 2012

Created By: Chelsea Papadopoulos

Date: 16/08/2012

Checked By: Carolyn Brumley

Date: 31/08/2012

Name	Sodium Chloride
Synonyms	Salt
CAS Number	7647-14-5
Molecular Formula	NaCl

Physical Properties	Value	Reference
Phase/State:	Colourless transparent crystals or white crystalline powder	HSDB 2011
Molecular Weight (g/mol):	58.44	HSDB 2011
Melting Point (°C):	801.00	HSDB 2011
Boiling Point (°C):		
Solubility (mg/L):	3,570,000.00	HSDB 2011

Other Relevant Factors	Value	Reference
<b>Reactivity</b>		
Species:		
Reaction type:		
<b>pH / Acidity</b>		
acid / alkaline		
pH (10% solution)		

### Aquatic Ecotoxicological Data

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Ceriodaphnia dubia	Water flea	Invertebrate LC50	Mortality	Mortality	7	280	ECOTOX 2012
Daphnia magna	Water flea	Invertebrate EC50	Intoxication	Immobilisation	1	402.6	ECOTOX 2012
Morone saxatilis	Striped bass	Fish LC50	Mortality	Mortality	3	1000	ECOTOX 2012

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Nitzschia linearis	Diatom	Plant LC	Population	Population growth	5	2430	ECOTOX 2012
Stenonema modestum	Mayfly	Invertebrate NOEC	Mortality	Mortality	14	2.7	ECOTOX 2012
Stenonema modestum	Mayfly	Invertebrate LOEC	Mortality	Mortality	14	3.5	ECOTOX 2011
Pimephales promelas	Fathead minnow	Fish MATC	Mortality	Survival	33	298	EPISUITE 2011 v4.1
Kirchneriella sp.	Green algae	Plant LOEC	Population	Population doubling time	91.32	1900	ECOTOX 2011



Project number: 127666004

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### Terrestrial Ecotoxicological Data

SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference
	Rat	Mammalian LD50	Mortality	Mortality		3000 mg/kg bw	HSDB 2012

Created By: Chelsea Papadopoulos

Date: 16/08/2012

Checked By: Carolyn Brummley

Date: 31/08/2012

Name	Sodium Hydroxide
Synonyms	Sodium hydroxide
CAS Number	1310-73-2
Molecular Formula	NaOH

Physical Properties	Value	Reference
PhaseState:	White orthogonal crystals	HSDB 2011
Molecular Weight (g/mol):	40	HSDB 2011
Melting Point (°C):	323.00	HSDB 2011
Boiling Point (°C):	1388	HSDB 2011
Solubility (mg/L):	1,110,000.00	HSDB 2011

Other Relevant Factors	Value	Reference
<b>Reactivity</b>		
Species:	OH-/NaOH	HSDB 2011
Reaction type:	Acid/base	HSDB 2011
<b>pH / Acidity</b>		
acid / alkaline	Alkaline	HSDB 2011
pH (10% solution)	11	HSDB 2011

### Aquatic Ecotoxicological Data

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Ceriodaphnia dubia	Water flea	Invertebrate EC50	Intoxication	Immobilisation	2	40.38	ECOTOX 2011
Gambusia affinis	Western mosquitofish	Fish LC50	Mortality	Mortality	1	125	ECOTOX 2011



Project number: 127666004

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Created By: Lisa Brookes

Date: 31/07/2012

Checked By: Kirsten Broadgate

Date: 31/08/2012



Name	Sodium Iodide
Synonyms	Sodium monoiodide
CAS Number	7681-82-5
Molecular Formula	Na+I-

Physical Properties	Value	Reference
PhaseState:	Crystals	HSDB 2012
Molecular Weight (g/mol):	149.92	HSDB 2012
Melting Point (°C):	651.00	HSDB 2012
Boiling Point (°C):	1304	HSDB 2012
Solubility (mg/L):	184,000.00	HSDB 2012

Other Relevant Factors	Value	Reference
<b>Reactivity</b>		
Species:		
Reaction type:		
<b>pH / Acidity</b>		
acid / alkaline		
pH (10% solution)		

### Aquatic Ecotoxicological Data

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Daphnia magna	Water flea	Invertebrate LC50	Mortality	Mortality	2	0.17	ECOTOX 2011
Oncorhynchus mykiss	Rainbow trout	Fish LC50	Mortality	Mortality	4	860	ECOTOX 2011



Project number: 127666004

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### Terrestrial Ecotoxicological Data

SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference
	Mouse	Mammalian LD50	Mortality	Mortality		1000 mg/kg bw	ECHA 2012

Created By: Lisa Brookes

Date: 31/07/2012

Checked By: Kirsten Broadgate

Date: 31/08/2012

Name	Titanium Dioxide
Synonyms	Titanium Peroxide, Titanium White, Titanium Oxide
CAS Number	13463-67-7
Molecular Formula	TiO <sub>2</sub>

Physical Properties	Value	Reference
PhaseState:	Colourless to white crystalline powder	IPCS 2002
Molecular Weight (g/mol):	79.9	IPCS 2002
Melting Point (°C):	1,855.00	IPCS 2002
Boiling Point (°C):	2500	IPCS 2002
Solubility (mg/L):		

Other Relevant Factors	Value	Reference
<b>Reactivity</b>		
Species:		
Reaction type:		
<b>pH / Acidity</b>		
acid / alkaline		
pH (10% solution)		

### Aquatic Ecotoxicological Data

Acute toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Ceriodaphnia dubia	Water flea	Invertebrate LC50	Mortality	Mortality	2	3	ECOTOX 2012
Danio rerio	Zebra danio	Fish LC50	Mortality	Mortality	2	10	ECOTOX 2012

Chronic toxicity data							
SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc mg/L	Reference
Chironomus riparius	Midge	Invertebrate NOEC	Growth	Biomass	4	1	ECOTOX 2012
Pseudokirchneriella subcapitata	Green algae	Plant NOEC	Growth	Growth rate	3	0.984	ECOTOX 2012
Pseudokirchneriella subcapitata	Green algae	Plant EC50	Growth	Growth rate	3	5.83	ECOTOX 2012



Project number: 127666004

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**Terrestrial Ecotoxicological Data**

SpeciesName	Common Name	Endpoint	Effect	Effect Measure	Test Time (Days)	Conc	Reference
	Rat	Mammalian LD50	Mortality	Mortality		>10000 mg/kg bw	IUCLID 2012
	Mouse	Mammalian LD50	Mortality	Mortality		>10000 mg/kg bw	IUCLID 2012

Created By: Lisa Brookes

Date: 31/07/2012

Checked By: Carolyn Brumley

Date: 31/08/2012

**APPENDIX F**

# Flowback Fluid Analytical Results





			OPP														Phenols														PAH																			
			Endrin	γ-BHC	Heptachlor	Heptachlor & heptachlor epoxide (Sum)	Heptachlor epoxide	Hexachlorobenzene	Chlorfenvinphos	Chlorpyrifos	Chlorpyrifos-methyl	Diazinon	Dichlorvos	Dimethoate	Ethion	Fenthion	Malathion	Phosphos-ethyl	Prothios	2,4,5-Trichlorophenol	2,4,6-Trichlorophenol	2,4-Dichlorophenol	2,4-Dimethylphenol	2,6-Dichlorophenol	2-Chlorophenol	2-Methylphenol	2-Nitrophenol	3 & 4-Methylphenol	4-Chloro-3-methylphenol	Pentachlorophenol	Phenol	2-(Acetylamino)fluorene	2-Chloronaphthalene	2-Methylnaphthalene	3-Methylcholanthrene	7,12-Dimethylbenz(a)anthracene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(b)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Chrysene	Dibenz(a,h)anthracene					
EGL			0.002	0.002	0.002		0.002	0.004	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002		
ANZECC 2000 Freshwater 95%			0.00002	0.00002	0.00009				0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	
CCME (2008)																																																		
NHMRC 2008																																																		
NHMRC 2011						0.0003	0.0003		0.005	0.01		0.003	0.001	0.05	0.003			0.0005																																
DERM Queensland BTEX Standards <sup>[6]</sup>																																																		
Adopted Criteria 1 <sup>[5]</sup>																																																		
Adopted Criteria 2 <sup>[9]</sup>																																																		
Verbruggen (2004)-Lab Filtered <sup>[1]</sup>																																																		
Verbruggen (2004)-Total <sup>[2]</sup>																																																		
<b>Field Identification</b>	<b>Laboratory ID</b>	<b>Sample Comments</b>																																																
<b>Halliburton Fracturing Fluid</b>																																																		
Crosslink Gel	EM1210744	Fracturing fluids with distilled water	<0.002	<0.002	<0.002	-	<0.002	<0.004	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002			
FR Water	EM1210744	Fracturing fluids with distilled water	<0.01	<0.01	<0.01	-	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
<b>Site Water</b>																																																		
Tindlipie Pad Clean	EM1209245	Fracture fluid make up water from pond	<0.002	<0.002	<0.002	-	<0.002	<0.004	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.006	<0.002	<0.002	<0.002	<0.002	<0.004	<0.002	<0.004	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002			
Tindlipie Pad Pit Circ	EM1209245	Flare pit water prior to flowback	<0.02	<0.02	<0.02	-	<0.02	<0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02			
<b>Fracturing Flowback Fluids</b>																																																		
Tindlipie Pad 4-9-2012 Sample1	EM1210360	Flowback water	<0.2	<0.2	<0.2	-	<0.2	<0.4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		
Tindlipie Pad 4-9-2012 Sample2	EM1210360	Flowback water	<0.2	<0.2	<0.2	-	<0.2	<0.4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		
TPPF-FPWF 27/08/2012	EM1209924	Tindlipie Pad Pit Flowback - frac pit water post flowback	<0.01	<0.01	-	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	

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 BTEX - benzene, toluene, ethylbenzene, xylenes  
 VOC - Volatile Organic Compounds  
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		VOC																																																
		Xylene (o)	Xylenes (m & p)	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichloroethane	1,2-Dichloropropane	1,3-Dichloropropane	2,2-Dichloropropane	2-Chlorotoluene	2-Hexanone	4-Chlorotoluene	4-Methyl-2-pentanone	Bromobenzene	Bromodichloromethane	Bromoforn	Bromomethane	Carbon disulfide	Carbon tetrachloride	Chlorobenzene	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-Dichloroethene	cis-1,3-Dichloropropene	cis-1,4-Dichloro-2-butene	Dibromomethane	Dichlorodifluoromethane	Hexachlorobutadiene	Hexachloroethane	Iodomethane	Isobutanol								
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L						
EGL		0.002	0.002	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.002	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.05	0.005	0.005	0.005	0.005	0.005	0.05	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005				
ANZECC 2000 Freshwater 95%		0.35					6.5					0.17																																						
CCME (2008)																																																		
NHMRC 2008									0.03						0.003														0.003	0.3																				
NHMRC 2011									0.03						0.003														0.003	0.01	0.25		0.25																	
DERM Queensland BTEX Standards <sup>[6]</sup>		0.35	0.275																																															
Adopted Criteria 1 <sup>[5]</sup>																																																		
Adopted Criteria 2 <sup>[9]</sup>																																																		
Verbruggen (2004)-Lab Filtered <sup>[1]</sup>																																																		
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<b>Fracturing Flowback Fluids</b>																																																		
Tindlipie Pad 4-9-2012 Sample1	EM1210360	2.48	13	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
Tindlipie Pad 4-9-2012 Sample2	EM1210360	1.63	8.13	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
TPPF-FPWF 27/08/2012	EM1209924	1.35	7.21	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		

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 BTEX - benzene, toluene, ethylbenzene, xylenes  
 VOC - Volatile Organic Compounds  
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															Other - Group 1																																	
	Methyl Ethyl Ketone	Pentachloroethane	Tetrachloroethane	trans-1,2-dichloroethene	trans-1,3-dichloropropene	trans-1,4-dichloro-2-butene	Trichloroethene	Trichlorofluoromethane	Vinyl acetate	Vinyl chloride	1,3,5-Trinitrobenzene	1-Naphthylamine	2,4-Dinitrobenzene	2,6-Dinitrobenzene	3-Nitroaniline	4-Chloroaniline	4-Nitroaniline	Aniline	Azobenzene	Bis(2-ethylhexyl) phthalate	Bury/benzyl phthalate	Carbazole	Chlorobenzilate	Diethyl phthalate	Dimethyl phthalate	Di-n-butyl phthalate	Di-n-octyl phthalate	Nitrobenzene	n-Nitrosodiethylamine	n-Nitrosodipropylamine	n-Nitrosodiphenylamine & Diphenylamine	n-Nitrosodimethylamine	Pronamide	Aromatic >C10-C12	Aromatic >C12-C16	Aromatic >C16-C16 [7]	Aromatic >C16-C21	Aromatic >C21-C35 [4]	Aromatic >C16-C35 [7]	Aromatic >C16-C35 [9]	Aromatic >C5-C7	Aromatic >C7-C8	Aromatic >C8-C10	4,4'-DDT				
mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L			
EGL	0.05	0.005	0.005	0.005	0.005	0.005	0.05	0.05	0.05	0.05	0.002	0.002	0.004	0.004	0.004	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002		
ANZECC 2000 Freshwater 95%																																																
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NHMRC 2008			0.05							0.0003																																						
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Tindipie Pad 4-9-2012 Sample1	EM1210360	Flowback water																																														
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	Other - Group 2										Other - Group 3										Solvents					
	Aliphatic >C10-C12	Aliphatic >C12-C16 <sup>[4]</sup>	Aliphatic >C16-C21 <sup>[4]</sup>	Aliphatic >C21-C35	Aliphatic >C35-C8 <sup>[7]</sup>	Aliphatic >C6-C8	Aliphatic >C8-C10	Aliphatic >C8-16 <sup>[7]</sup>	Benzo(a)pyrene (TEGs)	Formaldehyde	Free Chlorine	Iodide	Reactive Phosphorus (as P)	Silica	n-Butanol	% 2-Fluorobiphenyl (surrogate)	2-methyl-5-nitroaniline	2-Nitroaniline	Anionic surfactants (as MBAS)	Non-ionic surfactants (as CTAS)	1-Butanol	1-Propanol	2-Propanol	Ethanol	Isophorone	
mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
EQI	0.05	0.05	0.05	0.05	0.02	0.02	0.02	0.002	0.1	0.02	0.01	0.01	0.1			0.002	0.004	0.1	5	0.05	0.05	0.05	0.05	0.002		
ANZECC 2000 Freshwater 95%																										
CCME (2008)	0.00118	0.000074				0.0465	0.0076																		1.4	
NHMRC 2008												0.1														
NHMRC 2011									0.5		0.5		80													
DERM Queensland BTEX Standards <sup>[10]</sup>																										
Adopted Criteria 1 <sup>[9]</sup>								0.3																		
Adopted Criteria 2 <sup>[9]</sup>																										
Verbruggen (2004)-Lab Filtered <sup>[1]</sup>	0.0024	0.0013	0.071		0.33	0.074	0.0094																			
Verbruggen (2004)-Total <sup>[1]</sup>	0.16	1.7	0.6		0.42	0.17	0.094																			
<b>Field Identification</b>	<b>Laboratory ID</b>	<b>Sample Comments</b>																								
<b>Halliburton Fracturing Fluid</b>																										
Crosslink Gel	EM1210744	Fracturing fluids with distilled water																								
FR Water	EM1210744	1.98	<0.05	<0.05	<0.05	0.038	<0.02	0.155	1.005	<0.002	-	-	-	-	-	-	<0.002	<0.004	-	-	<0.125	<0.125	4.15	0.163	<0.002	
		1.98	<0.05	<0.05	<0.05	<0.2	0.218	19.2	21.18	<0.01	<0.1	0.26	<0.01	0.07	<0.1	-	<0.01	<0.02	<0.1	105	<0.125	<0.125	4.27	0.138	<0.01	
<b>Site Water</b>																										
Tindlipie Pad Clean	EM1209245	Fracture fluid make up water from pond																								
Tindlipie Pad Pit Circ	EM1209245	Flare pit water prior to flowback																								
		<0.05	<0.05	0.132	0.264	<0.02	0.02	<0.02	<0.05	-	0.2	0.08	0.168	<0.01	83.8	-	-	<0.002	<0.004	0.5	<5	<0.05	<0.05	<0.05	<0.05	<0.002
		1.34	10.1	13.2	5.7	0.086	0.162	0.698	12.128	-	3.5	0.11	<0.02	0.08	92.6	-	-	<0.02	<0.04	0.1	7	<0.05	<0.05	3.34	0.492	<0.02
<b>Fracturing Flowback Fluids</b>																										
Tindlipie Pad 4-9-2012 Sample1	EM1210360	Flowback water																								
Tindlipie Pad 4-9-2012 Sample2	EM1210360	Flowback water																								
TPPF-FPWF 27/08/2012	EM1209924	Tindlipie Pad Pit Flowback - frac pit water post flowback																								
		18	53.6	32.5	24.9	6.3	71.4	103	174.6	<0.2	4.6	<0.02	1.42	0.11	141	-	-	<0.2	<0.4	0.1	17	<0.25	24.9	3.95	2.46	<0.2
		19.3	54.2	32.6	24.2	3.89	22	47.1	120.6	<0.2	4.8	<0.02	1.61	0.12	135	-	-	<0.2	<0.4	0.1	21	<0.25	25.6	4.07	2.44	<0.2
		5.18	12.5	11.6	4.75	3.44	24.1	47.4	65.08	<0.01	2.9	0.3	1.29	0.09	12.6	<0.25	-	<0.01	<0.02	0.1	<5	-	22.8	2.84	1.36	<0.01

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<sup>[6]</sup> This criteria has been adopted from NHMRC (2011) base on o-, p-, and m-xylene(s)  
<sup>[7]</sup> Based on health and do not include evaluation of oranoleptic properties  
<sup>[8]</sup> Must also examine PAHs if Benzo(a)pyrene = 0.00001 mg/L (NHMRC 2011)  
<sup>[9]</sup> Criteria values have been sourced from WHO (2005), NHMRC (2011) and TPHCWG (1997)  
<sup>[10]</sup> Criteria values have been sourced from the Australian Drinking Water Guidelines (2011) and the Australia and New Zealar  
 Guidelines for Fresh and Marine Water Quality (2000). The value for xylenes (m and p) was determined from the sum of the v

Abbreviations:  
 < - less than laboratory limit of reporting  
 - - not analysed  
 LOR - Laboratory Limit of Reporting  
 EQI - Effective Quantitative Limit  
 ug/L - micrograms per litre  
 mg/L - miligrams per litre  
 TPH - Total Petroleum Hydrocarbons  
 PCB - Polychlorinated Biphenyls  
 OCP - Organochlorine Pesticides  
 OPP - Organophosphorus Pesticides  
 MAH - Monocyclic Aromatic Hydrocarbons  
 PAH - Polycyclic Aromatic Hydrocarbons  
 BTEX - benzene, toluene, ethylbenzene, xylenes  
 VOC - Volatile Organic Compounds  
 SVOC - Semi-Volatile Organic Compounds



## Environmental Division

### CERTIFICATE OF ANALYSIS

Work Order	: <b>EM1209245</b>	Page	: 1 of 13
Client	: <b>SANTOS LTD</b>	Laboratory	: Environmental Division Melbourne
Contact	: MR BARRY RITCHIE	Contact	: Jodie Hancock
Address	: GROUND FLOOR SANTOS CENTRE 60 FLINDERS STREET ADELAIDE SA, AUSTRALIA 5001	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: barry.ritchie@santos.com	E-mail	: Jodie.Hancock@alsenviro.com
Telephone	: +61 08 8116 5000	Telephone	: +61 7 3243 7128
Facsimile	: +61 08 8116 5050	Facsimile	: +61 7 3243 7218
Project	: HFRA Fluids Sampling - Extended Analysis	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: 879002/538	Date Samples Received	: 14-AUG-2012
C-O-C number	: ----	Issue Date	: 28-AUG-2012
Sampler	: TD / AJ	No. of samples received	: 2
Site	: ----	No. of samples analysed	: 2
Quote number	: EN/039/11		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits



## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

- ED009X - Iodide LOR raised for sample ID Tindilpie Pad Pit Circ due to matrix interferences.
- EG020F: Positive mercury results for EM1209245-001 have been confirmed by re-preparation and re-analysis.
- EK025G: Free cyanide was analysed by Free cyanide by Segmented Flow analyser Method (EK025SF).
- EK026G: Total cyanide was analysed by Total cyanide by Segmented Flow analyser Method (EK026SF).
- EP050: The MBAS reported is calculated as LAS, mol wt 342.
- EP071: Poor matrix spike recovery for sample EM1209245-002 due to sample heterogeneity. Insufficient sample available for re-extraction and analysis.
- EP074: Sample EM1209245-002 has LOR raised for n-Butylbenzene due to matrix interference.
- EP075: EM1209245-002 Particular sample required dilution prior to analysis due to matrix interferences. LOR values have been adjusted accordingly.
- EP075: LOR raised for 1,4-Dichlorobenzene due to laboratory background.
- EP075: Matrix spike not determined due to matrix interferences.
- EP075: 'Sum of PAH' is the sum of the USEPA 16 priority PAHs
- Ionic Balance out of acceptable limits due to analytes not quantified in this report.
- Ionic balances were calculated using: major anions - chloride, alkalinity and sulfate; and major cations - calcium, magnesium, potassium and sodium.
- MBAS, CTAS, Bromide & Iodide and Alcohols conducted by ALS Sydney, NATA accreditation no. 825, site no 10911.
- Samples were filtered through a 0.45um filter prior to the dissolved metals analysis.



NATA Accredited Laboratory 825

Accredited for compliance with  
ISO/IEC 17025.

## Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics
Nancy Wang	Senior Semivolatile Instrument Chemist	Melbourne Organics
Nanthini Coilparampil	Laboratory Manager - Inorganics	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Sarah Millington	Senior Inorganic Chemist	Sydney Inorganics
Varsha Ho Wing	Non-Metals Team Leader	Melbourne Inorganics



## Analytical Results

Sub-Matrix: WATER

Client sample ID

				"Tindilpie Pad Clean" frac make up water from pond	"Tindilpie Pad Pit Circ" Pit water prior to flowback	---	---	---
				13-AUG-2012 08:00	13-AUG-2012 07:30	---	---	---
				EM1209245-001	EM1209245-002	---	---	---
Compound	CAS Number	LOR	Unit					
<b>EA005: pH</b>								
pH Value	---	0.01	pH Unit	8.36	8.52	---	---	---
<b>EA006: Sodium Adsorption Ratio (SAR)</b>								
Sodium Absorption Ratio	---	0.01	-	113	108	---	---	---
<b>EA015: Total Dissolved Solids</b>								
Total Dissolved Solids @180°C	GIS-210-010	10	mg/L	3610	5490	---	---	---
<b>EA065: Total Hardness as CaCO3</b>								
Total Hardness as CaCO3	---	1	mg/L	24	91	---	---	---
<b>ED009: Anions</b>								
Bromide	24959-67-9	0.010	mg/L	6.24	12.0	---	---	---
Iodide	20461-54-5	0.010	mg/L	0.168	<0.020	---	---	---
<b>ED037P: Alkalinity by PC Titrator</b>								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	---	---	---
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	206	16	---	---	---
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	1590	2230	---	---	---
Total Alkalinity as CaCO3	---	1	mg/L	1790	2240	---	---	---
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</b>								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	24	23	---	---	---
<b>ED045G: Chloride Discrete analyser</b>								
Chloride	16887-00-6	1	mg/L	992	1800	---	---	---
<b>ED093F: Dissolved Major Cations</b>								
Calcium	7440-70-2	1	mg/L	8	30	---	---	---
Magnesium	7439-95-4	1	mg/L	1	4	---	---	---
Sodium	7440-23-5	1	mg/L	1280	2370	---	---	---
Potassium	7440-09-7	1	mg/L	38	75	---	---	---
<b>EG020F: Dissolved Metals by ICP-MS</b>								
Aluminium	7429-90-5	0.01	mg/L	0.01	0.42	---	---	---
Arsenic	7440-38-2	0.001	mg/L	<0.001	0.020	---	---	---
Barium	7440-39-3	0.001	mg/L	1.97	6.13	---	---	---
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	---	---	---
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.0002	---	---	---
Cobalt	7440-48-4	0.001	mg/L	<0.001	0.004	---	---	---
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	---	---	---
Copper	7440-50-8	0.001	mg/L	0.002	0.189	---	---	---
Manganese	7439-96-5	0.001	mg/L	0.004	0.180	---	---	---



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

				"Tindilpie Pad Clean" frac make up water from pond	"Tindilpie Pad Pit Circ" Pit water prior to flowback	---	---	---
				13-AUG-2012 08:00	13-AUG-2012 07:30	---	---	---
				EM1209245-001	EM1209245-002	---	---	---
Compound	CAS Number	LOR	Unit					
<b>EG020F: Dissolved Metals by ICP-MS - Continued</b>								
Nickel	7440-02-0	0.001	mg/L	<0.001	0.028	---	---	---
Lead	7439-92-1	0.001	mg/L	<0.001	0.091	---	---	---
Vanadium	7440-62-2	0.01	mg/L	<0.01	0.02	---	---	---
Zinc	7440-66-6	0.005	mg/L	0.014	0.141	---	---	---
Lithium	7439-93-2	0.001	mg/L	0.447	0.872	---	---	---
Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.035	---	---	---
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	---	---	---
Strontium	7440-24-6	0.001	mg/L	0.626	1.29	---	---	---
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	---	---	---
Uranium	7440-61-1	0.001	mg/L	<0.001	0.001	---	---	---
Boron	7440-42-8	0.05	mg/L	4.74	55.5	---	---	---
Iron	7439-89-6	0.05	mg/L	<0.05	15.6	---	---	---
<b>EG035F: Dissolved Mercury by FIMS</b>								
Mercury	7439-97-6	0.0001	mg/L	0.0002	<0.0001	---	---	---
<b>EG052F: Dissolved Silica by ICPAES</b>								
Silica	7631-86-9	0.1	mg/L	83.8	92.6	---	---	---
<b>EK011: Chlorine - Free</b>								
Free Chlorine	----	0.02	mg/L	0.08	0.11	---	---	---
<b>EK025G: Free cyanide by Discrete Analyser</b>								
Free Cyanide	----	0.004	mg/L	<0.004	<0.004	---	---	---
<b>EK026G: Total Cyanide By Discrete Analyser</b>								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	---	---	---
<b>EK040P: Fluoride by PC Titrator</b>								
Fluoride	16984-48-8	0.1	mg/L	3.2	2.5	---	---	---
<b>EK055G: Ammonia as N by Discrete Analyser</b>								
Ammonia as N	7664-41-7	0.01	mg/L	0.20	23.4	---	---	---
<b>EK057G: Nitrite as N by Discrete Analyser</b>								
Nitrite as N	----	0.01	mg/L	<0.01	0.46	---	---	---
<b>EK058G: Nitrate as N by Discrete Analyser</b>								
Nitrate as N	14797-55-8	0.01	mg/L	0.03	0.01	---	---	---
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>								
Nitrite + Nitrate as N	----	0.01	mg/L	0.03	0.47	---	---	---
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>								





## Analytical Results

Sub-Matrix: WATER

Client sample ID

				"Tindilpie Pad Clean" frac make up water from pond	"Tindilpie Pad Pit Circ" Pit water prior to flowback	---	---	---
				13-AUG-2012 08:00	13-AUG-2012 07:30	---	---	---
				EM1209245-001	EM1209245-002	---	---	---
Compound	CAS Number	LOR	Unit					
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser - Continued</b>								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	3.6	182	---	---	---
<b>EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser</b>								
Total Nitrogen as N	----	0.1	mg/L	3.6	182	---	---	---
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>								
Total Phosphorus as P	----	0.01	mg/L	1.38	1.39	---	---	---
<b>EK071G: Reactive Phosphorus as P by discrete analyser</b>								
Reactive Phosphorus as P	----	0.01	mg/L	<0.01	0.08	---	---	---
<b>EN055: Ionic Balance</b>								
Total Anions	----	0.01	meq/L	64.2	96.0	---	---	---
Total Cations	----	0.01	meq/L	57.1	107	---	---	---
Ionic Balance	----	0.01	%	5.91	5.29	---	---	---
<b>EP005: Total Organic Carbon (TOC)</b>								
Total Organic Carbon	----	1	mg/L	<1	1080	---	---	---
<b>EP010: Formaldehyde</b>								
Formaldehyde	50-00-0	0.1	mg/L	0.2	3.5	---	---	---
<b>EP041A: Nonionic Surfactants</b>								
Nonionic Surfactants as CTAS	----	5	mg/L	<5	7	---	---	---
<b>EP050: Anionic Surfactants as MBAS</b>								
Anionic Surfactants as MBAS	----	0.1	mg/L	0.5	0.1	---	---	---
<b>EP074A: Monocyclic Aromatic Hydrocarbons</b>								
Benzene	71-43-2	1	µg/L	2	65	---	---	---
Toluene	108-88-3	2	µg/L	4	148	---	---	---
Ethylbenzene	100-41-4	2	µg/L	<2	11	---	---	---
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	80	---	---	---
Styrene	100-42-5	5	µg/L	<5	<5	---	---	---
ortho-Xylene	95-47-6	2	µg/L	<2	23	---	---	---
Isopropylbenzene	98-82-8	5	µg/L	<5	<5	---	---	---
n-Propylbenzene	103-65-1	5	µg/L	<5	<5	---	---	---
1.3.5-Trimethylbenzene	108-67-8	5	µg/L	<5	10	---	---	---
sec-Butylbenzene	135-98-8	5	µg/L	<5	<5	---	---	---
1.2.4-Trimethylbenzene	95-63-6	5	µg/L	<5	32	---	---	---
tert-Butylbenzene	98-06-6	5	µg/L	<5	<5	---	---	---
p-Isopropyltoluene	99-87-6	5	µg/L	<5	110	---	---	---
n-Butylbenzene	104-51-8	5	µg/L	<5	<10	---	---	---



## Analytical Results

Sub-Matrix: WATER

Client sample ID

				"Tindilpie Pad Clean" frac make up water from pond	"Tindilpie Pad Pit Circ" Pit water prior to flowback	----	----	----
				13-AUG-2012 08:00	13-AUG-2012 07:30	----	----	----
				EM1209245-001	EM1209245-002	----	----	----
Compound	CAS Number	LOR	Unit					
<b>EP074A: Monocyclic Aromatic Hydrocarbons - Continued</b>								
<b>EP074B: Oxygenated Compounds</b>								
Vinyl Acetate	108-05-4	50	µg/L	<50	<50	----	----	----
2-Butanone (MEK)	78-93-3	50	µg/L	<50	<50	----	----	----
4-Methyl-2-pentanone (MIBK)	108-10-1	50	µg/L	<50	<50	----	----	----
2-Hexanone (MBK)	591-78-6	50	µg/L	<50	<50	----	----	----
<b>EP074C: Sulfonated Compounds</b>								
Carbon disulfide	75-15-0	5	µg/L	<5	<5	----	----	----
<b>EP074D: Fumigants</b>								
2,2-Dichloropropane	594-20-7	5	µg/L	<5	<5	----	----	----
1,2-Dichloropropane	78-87-5	5	µg/L	<5	<5	----	----	----
cis-1,3-Dichloropropylene	10061-01-5	5	µg/L	<5	<5	----	----	----
trans-1,3-Dichloropropylene	10061-02-6	5	µg/L	<5	<5	----	----	----
1,2-Dibromoethane (EDB)	106-93-4	5	µg/L	<5	<5	----	----	----
<b>EP074E: Halogenated Aliphatic Compounds</b>								
Dichlorodifluoromethane	75-71-8	50	µg/L	<50	<50	----	----	----
Chloromethane	74-87-3	50	µg/L	<50	<50	----	----	----
Vinyl chloride	75-01-4	50	µg/L	<50	<50	----	----	----
Bromomethane	74-83-9	50	µg/L	<50	<50	----	----	----
Chloroethane	75-00-3	50	µg/L	<50	<50	----	----	----
Trichlorofluoromethane	75-69-4	50	µg/L	<50	<50	----	----	----
1,1-Dichloroethene	75-35-4	5	µg/L	<5	<5	----	----	----
Iodomethane	74-88-4	5	µg/L	<5	<5	----	----	----
trans-1,2-Dichloroethene	156-60-5	5	µg/L	<5	<5	----	----	----
1,1-Dichloroethane	75-34-3	5	µg/L	<5	<5	----	----	----
cis-1,2-Dichloroethene	156-59-2	5	µg/L	<5	<5	----	----	----
1,1,1-Trichloroethane	71-55-6	5	µg/L	<5	<5	----	----	----
1,1-Dichloropropylene	563-58-6	5	µg/L	<5	<5	----	----	----
Carbon Tetrachloride	56-23-5	5	µg/L	<5	<5	----	----	----
1,2-Dichloroethane	107-06-2	5	µg/L	<5	<5	----	----	----
Trichloroethene	79-01-6	5	µg/L	<5	<5	----	----	----
Dibromomethane	74-95-3	5	µg/L	<5	<5	----	----	----
1,1,2-Trichloroethane	79-00-5	5	µg/L	<5	<5	----	----	----
1,3-Dichloropropane	142-28-9	5	µg/L	<5	<5	----	----	----
Tetrachloroethene	127-18-4	5	µg/L	<5	<5	----	----	----



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

				"Tindilpie Pad Clean" frac make up water from pond	"Tindilpie Pad Pit Circ" Pit water prior to flowback	---	---	---
				13-AUG-2012 08:00	13-AUG-2012 07:30	---	---	---
				EM1209245-001	EM1209245-002	---	---	---
Compound	CAS Number	LOR	Unit					
<b>EP074E: Halogenated Aliphatic Compounds - Continued</b>								
1.1.1.2-Tetrachloroethane	630-20-6	5	µg/L	<5	<5	---	---	---
trans-1.4-Dichloro-2-butene	110-57-6	5	µg/L	<5	<5	---	---	---
cis-1.4-Dichloro-2-butene	1476-11-5	5	µg/L	<5	<5	---	---	---
1.1.2.2-Tetrachloroethane	79-34-5	5	µg/L	<5	<5	---	---	---
1.2.3-Trichloropropane	96-18-4	5	µg/L	<5	<5	---	---	---
Pentachloroethane	76-01-7	5	µg/L	<5	<5	---	---	---
1.2-Dibromo-3-chloropropane	96-12-8	5	µg/L	<5	<5	---	---	---
<b>EP074F: Halogenated Aromatic Compounds</b>								
Chlorobenzene	108-90-7	5	µg/L	<5	<5	---	---	---
Bromobenzene	108-86-1	5	µg/L	<5	<5	---	---	---
2-Chlorotoluene	95-49-8	5	µg/L	<5	<5	---	---	---
4-Chlorotoluene	106-43-4	5	µg/L	<5	<5	---	---	---
1.2.3-Trichlorobenzene	87-61-6	5	µg/L	<5	<5	---	---	---
<b>EP074G: Trihalomethanes</b>								
Chloroform	67-66-3	5	µg/L	<5	<5	---	---	---
Bromodichloromethane	75-27-4	5	µg/L	<5	<5	---	---	---
Dibromochloromethane	124-48-1	5	µg/L	<5	<5	---	---	---
Bromoform	75-25-2	5	µg/L	<5	<5	---	---	---
<b>EP075A: Phenolic Compounds</b>								
Phenol	108-95-2	2	µg/L	<2	88	---	---	---
2-Chlorophenol	95-57-8	2	µg/L	<2	<20	---	---	---
2-Methylphenol	95-48-7	2	µg/L	<2	<20	---	---	---
3- & 4-Methylphenol	1319-77-3	4	µg/L	<4	<40	---	---	---
2-Nitrophenol	88-75-5	2	µg/L	<2	<20	---	---	---
2.4-Dimethylphenol	105-67-9	2	µg/L	6	<20	---	---	---
2.4-Dichlorophenol	120-83-2	2	µg/L	<2	<20	---	---	---
2.6-Dichlorophenol	87-65-0	2	µg/L	<2	<20	---	---	---
4-Chloro-3-Methylphenol	59-50-7	2	µg/L	<2	<20	---	---	---
2.4.6-Trichlorophenol	88-06-2	2	µg/L	<2	<20	---	---	---
2.4.5-Trichlorophenol	95-95-4	2	µg/L	<2	<20	---	---	---
Pentachlorophenol	87-86-5	4	µg/L	<4	<40	---	---	---
<b>EP075B: Polynuclear Aromatic Hydrocarbons</b>								
Naphthalene	91-20-3	2	µg/L	<2	<20	---	---	---
2-Methylnaphthalene	91-57-6	2	µg/L	<2	36	---	---	---



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

				"Tindilpie Pad Clean" frac make up water from pond	"Tindilpie Pad Pit Circ" Pit water prior to flowback	---	---	---
				13-AUG-2012 08:00	13-AUG-2012 07:30	---	---	---
				EM1209245-001	EM1209245-002	---	---	---
Compound	CAS Number	LOR	Unit					
<b>EP075B: Polynuclear Aromatic Hydrocarbons - Continued</b>								
2-Chloronaphthalene	91-58-7	2	µg/L	<2	<20	---	---	---
Acenaphthylene	208-96-8	2	µg/L	<2	<20	---	---	---
Acenaphthene	83-32-9	2	µg/L	<2	<20	---	---	---
Fluorene	86-73-7	2	µg/L	<2	<20	---	---	---
Phenanthrene	85-01-8	2	µg/L	<2	<20	---	---	---
Anthracene	120-12-7	2	µg/L	<2	<20	---	---	---
Fluoranthene	206-44-0	2	µg/L	<2	<20	---	---	---
Pyrene	129-00-0	2	µg/L	<2	<20	---	---	---
N-2-Fluorenyl Acetamide	53-96-3	2	µg/L	<2	<20	---	---	---
Benz(a)anthracene	56-55-3	2	µg/L	<2	<20	---	---	---
Chrysene	218-01-9	2	µg/L	<2	<20	---	---	---
Benzo(b) & Benzo(k)fluoranthene	205-99-2 207-08-9	4	µg/L	<4	<40	---	---	---
7.12-Dimethylbenz(a)anthracene	57-97-6	2	µg/L	<2	<20	---	---	---
Benzo(a)pyrene	50-32-8	2	µg/L	<2	<20	---	---	---
3-Methylcholanthrene	56-49-5	2	µg/L	<2	<20	---	---	---
Indeno(1.2.3.cd)pyrene	193-39-5	2	µg/L	<2	<20	---	---	---
Dibenz(a.h)anthracene	53-70-3	2	µg/L	<2	<20	---	---	---
Benzo(g.h.i)perylene	191-24-2	2	µg/L	<2	<20	---	---	---
^ Sum of PAHs	----	2	µg/L	<2	<20	---	---	---
<b>EP075C: Phthalate Esters</b>								
Dimethyl phthalate	131-11-3	2	µg/L	<2	<20	---	---	---
Diethyl phthalate	84-66-2	2	µg/L	<2	<20	---	---	---
Di-n-butyl phthalate	84-74-2	2	µg/L	<2	<20	---	---	---
Butyl benzyl phthalate	85-68-7	2	µg/L	<2	<20	---	---	---
bis(2-ethylhexyl) phthalate	117-81-7	5	µg/L	<10	<100	---	---	---
Di-n-octylphthalate	117-84-0	2	µg/L	<2	<20	---	---	---
<b>EP075D: Nitrosamines</b>								
N-Nitrosomethylethylamine	10595-95-6	2	µg/L	<2	<20	---	---	---
N-Nitrosodiethylamine	55-18-5	2	µg/L	<2	<20	---	---	---
N-Nitrosopyrrolidine	930-55-2	4	µg/L	<4	<40	---	---	---
N-Nitrosomorpholine	59-89-2	2	µg/L	<2	<20	---	---	---
N-Nitrosodi-n-propylamine	621-64-7	2	µg/L	<2	<20	---	---	---
N-Nitrosopiperidine	100-75-4	2	µg/L	<2	<20	---	---	---
N-Nitrosodibutylamine	924-16-3	2	µg/L	<2	<20	---	---	---



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

				"Tindilpie Pad Clean" frac make up water from pond	"Tindilpie Pad Pit Circ" Pit water prior to flowback	---	---	---
				13-AUG-2012 08:00	13-AUG-2012 07:30	---	---	---
				EM1209245-001	EM1209245-002	---	---	---
Compound	CAS Number	LOR	Unit					
<b>EP075D: Nitrosamines - Continued</b>								
N-Nitrosodiphenyl & Diphenylamine	86-30-6 122-39-4	4	µg/L	<4	<40	---	---	---
Methapyrilene	91-80-5	2	µg/L	<2	<20	---	---	---
<b>EP075E: Nitroaromatics and Ketones</b>								
2-Picoline	109-06-8	2	µg/L	<2	<20	---	---	---
Acetophenone	98-86-2	2	µg/L	<2	<20	---	---	---
Nitrobenzene	98-95-3	2	µg/L	<2	<20	---	---	---
Isophorone	78-59-1	2	µg/L	<2	<20	---	---	---
2,6-Dinitrotoluene	606-20-2	4	µg/L	<4	<40	---	---	---
2,4-Dinitrotoluene	121-14-2	4	µg/L	<4	<40	---	---	---
1-Naphthylamine	134-32-7	2	µg/L	<2	<20	---	---	---
4-Nitroquinoline-N-oxide	56-57-5	2	µg/L	<2	<20	---	---	---
5-Nitro-o-toluidine	99-55-8	2	µg/L	<2	<20	---	---	---
Azobenzene	103-33-3	2	µg/L	<2	<20	---	---	---
1,3,5-Trinitrobenzene	99-35-4	2	µg/L	<2	<20	---	---	---
Phenacetin	62-44-2	2	µg/L	<2	<20	---	---	---
4-Aminobiphenyl	92-67-1	2	µg/L	<2	<20	---	---	---
Pentachloronitrobenzene	82-68-8	2	µg/L	<2	<20	---	---	---
Pronamide	23950-58-5	2	µg/L	<2	<20	---	---	---
Dimethylaminoazobenzene	60-11-7	2	µg/L	<2	<20	---	---	---
Chlorobenzilate	510-15-6	2	µg/L	<2	<20	---	---	---
<b>EP075F: Haloethers</b>								
Bis(2-chloroethyl) ether	111-44-4	2	µg/L	<2	<20	---	---	---
Bis(2-chloroethoxy) methane	111-91-1	2	µg/L	<2	<20	---	---	---
4-Chlorophenyl phenyl ether	7005-72-3	2	µg/L	<2	<20	---	---	---
4-Bromophenyl phenyl ether	101-55-3	2	µg/L	<2	<20	---	---	---
<b>EP075G: Chlorinated Hydrocarbons</b>								
1,3-Dichlorobenzene	541-73-1	2	µg/L	<2	<20	---	---	---
1,4-Dichlorobenzene	106-46-7	2	µg/L	<4	<20	---	---	---
1,2-Dichlorobenzene	95-50-1	2	µg/L	<2	<20	---	---	---
Hexachloroethane	67-72-1	2	µg/L	<2	<20	---	---	---
1,2,4-Trichlorobenzene	120-82-1	2	µg/L	<2	<20	---	---	---
Hexachloropropylene	1888-71-7	2	µg/L	<2	<20	---	---	---
Hexachlorobutadiene	87-68-3	2	µg/L	<2	<20	---	---	---



## Analytical Results

Sub-Matrix: WATER

Client sample ID

"Tindilpie Pad Clean"  
frac make up water  
from pond

"Tindilpie Pad Pit Circ"  
Pit water prior to  
flowback

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---

Client sampling date / time

13-AUG-2012 08:00

13-AUG-2012 07:30

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Compound	CAS Number	LOR	Unit	EM1209245-001	EM1209245-002	---	---	---
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### EP075G: Chlorinated Hydrocarbons - Continued

Hexachlorocyclopentadiene	77-47-4	10	µg/L	<10	<100	---	---	---
Pentachlorobenzene	608-93-5	2	µg/L	<2	<20	---	---	---
Hexachlorobenzene (HCB)	118-74-1	4	µg/L	<4	<40	---	---	---

### EP075H: Anilines and Benzidines

Aniline	62-53-3	2	µg/L	<2	<20	---	---	---
4-Chloroaniline	106-47-8	2	µg/L	<2	<20	---	---	---
2-Nitroaniline	88-74-4	4	µg/L	<4	<40	---	---	---
3-Nitroaniline	99-09-2	4	µg/L	<4	<40	---	---	---
Dibenzofuran	132-64-9	2	µg/L	<2	<20	---	---	---
4-Nitroaniline	100-01-6	2	µg/L	<2	<20	---	---	---
Carbazole	86-74-8	2	µg/L	<2	<20	---	---	---
3,3'-Dichlorobenzidine	91-94-1	2	µg/L	<2	<20	---	---	---

### EP075I: Organochlorine Pesticides

alpha-BHC	319-84-6	2	µg/L	<2	<20	---	---	---
beta-BHC	319-85-7	2	µg/L	<2	<20	---	---	---
gamma-BHC	58-89-9	2	µg/L	<2	<20	---	---	---
delta-BHC	319-86-8	2	µg/L	<2	<20	---	---	---
Heptachlor	76-44-8	2	µg/L	<2	<20	---	---	---
Aldrin	309-00-2	2	µg/L	<2	<20	---	---	---
Heptachlor epoxide	1024-57-3	2	µg/L	<2	<20	---	---	---
alpha-Endosulfan	959-98-8	2	µg/L	<2	<20	---	---	---
4,4'-DDE	72-55-9	2	µg/L	<2	<20	---	---	---
Dieldrin	60-57-1	2	µg/L	<2	<20	---	---	---
Endrin	72-20-8	2	µg/L	<2	<20	---	---	---
beta-Endosulfan	33213-65-9	2	µg/L	<2	<20	---	---	---
4,4'-DDD	72-54-8	2	µg/L	<2	<20	---	---	---
Endosulfan sulfate	1031-07-8	2	µg/L	<2	<20	---	---	---
4,4'-DDT	50-29-3	4	µg/L	<4	<40	---	---	---

### EP075J: Organophosphorus Pesticides

Dichlorvos	62-73-7	2	µg/L	<2	<20	---	---	---
Dimethoate	60-51-5	2	µg/L	<2	<20	---	---	---
Diazinon	333-41-5	2	µg/L	<2	<20	---	---	---
Chlorpyrifos-methyl	5598-13-0	2	µg/L	<2	<20	---	---	---
Malathion	121-75-5	2	µg/L	<2	<20	---	---	---



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

				"Tindilpie Pad Clean" frac make up water from pond	"Tindilpie Pad Pit Circ" Pit water prior to flowback	---	---	---
				13-AUG-2012 08:00	13-AUG-2012 07:30	---	---	---
Compound	CAS Number	LOR	Unit	EM1209245-001	EM1209245-002	---	---	---
<b>EP075J: Organophosphorus Pesticides - Continued</b>								
Fenthion	55-38-9	2	µg/L	<2	<20	---	---	---
Chlorpyrifos	2921-88-2	2	µg/L	<2	<20	---	---	---
Pirimphos-ethyl	23505-41-1	2	µg/L	<2	<20	---	---	---
Chlorfenvinphos	470-90-6	2	µg/L	<2	<20	---	---	---
Prothiofos	34643-46-4	2	µg/L	<2	<20	---	---	---
Ethion	563-12-2	2	µg/L	<2	<20	---	---	---
<b>EP117: Alcohols</b>								
Ethanol	64-17-5	50	µg/L	<50	492	---	---	---
Isopropanol	67-63-0	50	µg/L	<50	3340	---	---	---
n-Propanol	71-23-8	50	µg/L	<50	<50	---	---	---
Isobutanol	78-83-1	50	µg/L	<50	<50	---	---	---
n-Butanol	71-36-3	50	µg/L	<50	<50	---	---	---
<b>RIVM Aliphatic Hydrocarbon Fractions</b>								
Aliphatic >C5-C6	----	20	µg/L	<20	86	---	---	---
Aliphatic >C6-C8	TPHCWG-ALV2	20	µg/L	20	162	---	---	---
Aliphatic >C8-C10	TPHCWG-ALV3	20	µg/L	<20	688	---	---	---
Aliphatic >C10-C12	TPHCWG-ALE1	50	µg/L	<50	1340	---	---	---
Aliphatic >C12-C16	TPHCWG-ALE2	50	µg/L	<50	10100	---	---	---
Aliphatic >C16-C21	----	50	µg/L	132	13200	---	---	---
Aliphatic >C21-C35	----	50	µg/L	264	5700	---	---	---
<b>RIVM Aromatic Hydrocarbon Fractions</b>								
Aromatic >C5-C7	----	5	µg/L	<5	70	---	---	---
Aromatic >C7-C8	TPHCWG-ARV2	5	µg/L	<5	164	---	---	---
Aromatic >C8-C10	TPHCWG-ARV3	5	µg/L	<5	142	---	---	---
Aromatic >C10-C12	TPHCWG-ARE1	50	µg/L	<50	2240	---	---	---
Aromatic >C12-C16	TPHCWG-ARE2	50	µg/L	<50	2180	---	---	---
Aromatic >C16-C21	TPHCWG-ARE3	50	µg/L	<50	2860	---	---	---
Aromatic >C21-C35	TPHCWG-ARE4	50	µg/L	99	871	---	---	---
<b>EP074S: VOC Surrogates</b>								
1,2-Dichloroethane-D4	17060-07-0	0.1	%	116	108	---	---	---
Toluene-D8	2037-26-5	0.1	%	117	124	---	---	---
4-Bromofluorobenzene	460-00-4	0.1	%	117	106	---	---	---
<b>EP075S: Acid Extractable Surrogates</b>								
2-Fluorophenol	367-12-4	0.1	%	33.3	Not Determined	---	---	---



## Analytical Results

Sub-Matrix: **WATER**

Client sample ID

Client sample ID	"Tindilpie Pad Clean" frac make up water from pond	"Tindilpie Pad Pit Circ" Pit water prior to flowback	---	---	---
13-AUG-2012 08:00		13-AUG-2012 07:30	---	---	---
EM1209245-001	EM1209245-002		---	---	---

Client sampling date / time

Compound	CAS Number	LOR	Unit	EM1209245-001	EM1209245-002	---	---	---
<b>EP075S: Acid Extractable Surrogates - Continued</b>								
Phenol-d6	13127-88-3	0.1	%	27.5	Not Determined	---	---	---
2-Chlorophenol-D4	93951-73-6	0.1	%	60.2	Not Determined	---	---	---
2,4,6-Tribromophenol	118-79-6	0.1	%	76.8	Not Determined	---	---	---
<b>EP075T: Base/Neutral Extractable Surrogates</b>								
Nitrobenzene-D5	4165-60-0	0.1	%	68.2	Not Determined	---	---	---
1,2-Dichlorobenzene-D4	2199-69-1	0.1	%	54.8	Not Determined	---	---	---
2-Fluorobiphenyl	321-60-8	0.1	%	71.9	Not Determined	---	---	---
Anthracene-d10	1719-06-8	0.1	%	83.8	Not Determined	---	---	---
4-Terphenyl-d14	1718-51-0	0.1	%	81.1	Not Determined	---	---	---
<b>EP079/EP070S:TPH Surrogates - semivolatile speciation</b>								
2-Fluorobiphenyl	321-60-8	0.1	%	98.1	94.1	---	---	---
2-Bromonaphthalene	580-13-2	0.1	%	98.0	103	---	---	---





## Surrogate Control Limits

Sub-Matrix: WATER		Recovery Limits (%)	
Compound	CAS Number	Low	High
<b>EP074S: VOC Surrogates</b>			
1,2-Dichloroethane-D4	17060-07-0	72	132
Toluene-D8	2037-26-5	74	128
4-Bromofluorobenzene	460-00-4	70	132
<b>EP075S: Acid Extractable Surrogates</b>			
2-Fluorophenol	367-12-4	10	83
Phenol-d6	13127-88-3	10	49
2-Chlorophenol-D4	93951-73-6	20.3	101
2,4,6-Tribromophenol	118-79-6	19.5	134
<b>EP075T: Base/Neutral Extractable Surrogates</b>			
Nitrobenzene-D5	4165-60-0	18.2	114
1,2-Dichlorobenzene-D4	2199-69-1	18.8	100
2-Fluorobiphenyl	321-60-8	25.3	122
Anthracene-d10	1719-06-8	35	137
4-Terphenyl-d14	1718-51-0	32	136
<b>EP079/EP070S:TPH Surrogates - semivolatile speciation</b>			
2-Fluorobiphenyl	321-60-8	77	127
2-Bromonaphthalene	580-13-2	67	123



Environmental Division

**QUALITY CONTROL REPORT**

<b>Work Order</b>	<b>: EM1209245</b>	<b>Page</b>	: 1 of 24
<b>Client</b>	<b>: SANTOS LTD</b>	<b>Laboratory</b>	: Environmental Division Melbourne
<b>Contact</b>	<b>: MR BARRY RITCHIE</b>	<b>Contact</b>	: Jodie Hancock
<b>Address</b>	<b>: GROUND FLOOR SANTOS CENTRE 60 FLINDERS STREET ADELAIDE SA, AUSTRALIA 5001</b>	<b>Address</b>	: 4 Westall Rd Springvale VIC Australia 3171
<b>E-mail</b>	<b>: barry.ritchie@santos.com</b>	<b>E-mail</b>	: Jodie.Hancock@alsenviro.com
<b>Telephone</b>	<b>: +61 08 8116 5000</b>	<b>Telephone</b>	: +61 7 3243 7128
<b>Facsimile</b>	<b>: +61 08 8116 5050</b>	<b>Facsimile</b>	: +61 7 3243 7218
<b>Project</b>	<b>: HFRA Fluids Sampling - Extended Analysis</b>	<b>QC Level</b>	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
<b>Site</b>	<b>: ----</b>	<b>Date Samples Received</b>	: 14-AUG-2012
<b>C-O-C number</b>	<b>: ----</b>	<b>Issue Date</b>	: 28-AUG-2012
<b>Sampler</b>	<b>: TD / AJ</b>	<b>No. of samples received</b>	: 2
<b>Order number</b>	<b>: 879002/538</b>	<b>No. of samples analysed</b>	: 2
<b>Quote number</b>	<b>: EN/039/11</b>		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits



NATA Accredited Laboratory 825

Accredited for compliance with  
ISO/IEC 17025.

**Signatories**

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics
Nancy Wang	Senior Semivolatile Instrument Chemist	Melbourne Organics
Nanthini Coilparampil	Laboratory Manager - Inorganics	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Sarah Millington	Senior Inorganic Chemist	Sydney Inorganics
Varsha Ho Wing	Non-Metals Team Leader	Melbourne Inorganics



## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key :  
Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot  
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.  
LOR = Limit of reporting  
RPD = Relative Percentage Difference  
# = Indicates failed QC



## Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:- No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:- 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EA005: pH (QC Lot: 2450578)</b>									
EM1209174-001	Anonymous	EA005: pH Value	----	0.01	pH Unit	7.96	7.95	0.1	0% - 20%
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EA005: pH Value	----	0.01	pH Unit	8.36	8.38	0.2	0% - 20%
<b>EA015: Total Dissolved Solids (QC Lot: 2451186)</b>									
EM1209209-001	Anonymous	EA015H: Total Dissolved Solids @180°C	GIS-210-010	10	mg/L	220	224	1.8	0% - 20%
EM1209268-003	Anonymous	EA015H: Total Dissolved Solids @180°C	GIS-210-010	10	mg/L	634	638	0.6	0% - 20%
<b>ED009: Anions (QC Lot: 2451265)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	ED009-X: Bromide	24959-67-9	0.010	mg/L	6.24	6.02	3.6	0% - 20%
		ED009-X: Iodide	20461-54-5	0.010	mg/L	0.168	0.195	14.9	0% - 50%
ES1219844-007	Anonymous	ED009-X: Bromide	24959-67-9	0.010	mg/L	0.163	0.193	16.8	0% - 50%
		ED009-X: Iodide	20461-54-5	0.010	mg/L	<0.010	<0.010	0.0	No Limit
<b>ED037P: Alkalinity by PC Titrator (QC Lot: 2450243)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	206	226	9.5	0% - 20%
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	1590	1560	1.6	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	1790	1790	0.3	0% - 20%
EM1209281-004	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	90	91	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	90	91	0.0	0% - 20%
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 2450176)</b>									
EM1209245-002	"Tindilpie Pad Pit Circ" Pit water prior to flowback	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	23	28	19.5	0% - 20%
<b>ED045G: Chloride Discrete analyser (QC Lot: 2450175)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	ED045G: Chloride	16887-00-6	1	mg/L	992	979	1.3	0% - 20%
<b>ED093F: Dissolved Major Cations (QC Lot: 2450171)</b>									
EM1209070-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	61	59	3.8	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	20	19	0.0	0% - 50%
		ED093F: Sodium	7440-23-5	1	mg/L	148	139	5.8	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	8010	7690	4.0	0% - 20%
EM1209232-009	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	461	512	10.4	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	253	277	9.2	0% - 20%



Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>ED093F: Dissolved Major Cations (QC Lot: 2450171) - continued</b>									
EM1209232-009	Anonymous	ED093F: Sodium	7440-23-5	1	mg/L	2720	2980	9.0	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	17	18	5.6	0% - 50%
<b>ED093F: Dissolved Major Cations (QC Lot: 2450177)</b>									
EM1209245-002	"Tindilpie Pad Pit Circ" Pit water prior to flowback	ED093F: Calcium	7440-70-2	1	mg/L	30	29	5.4	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	4	4	0.0	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	2370	2250	5.2	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	75	69	7.6	0% - 20%
<b>EG020F: Dissolved Metals by ICP-MS (QC Lot: 2451813)</b>									
EM1209234-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	3.61	3.65	1.1	0% - 20%
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.072	0.072	0.0	0% - 20%
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	0.058	0.055	5.5	0% - 20%
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.077	0.076	1.6	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	0.055	0.051	7.4	0% - 20%
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	13.8	13.6	1.7	0% - 20%
		EG020A-F: Copper	7440-50-8	0.001	mg/L	14.9	14.9	0.4	0% - 20%
		EG020A-F: Lead	7439-92-1	0.001	mg/L	0.016	0.016	0.0	0% - 50%
		EG020A-F: Lithium	7439-93-2	0.001	mg/L	0.040	0.038	4.3	0% - 20%
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.566	0.542	4.3	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.002	0.002	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	11.6	11.9	2.4	0% - 20%
		EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	140	150	6.7	0% - 20%
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	22.9	22.1	3.9	0% - 20%
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	0.05	0.04	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	1.04	1.01	3.3	0% - 20%
EG020A-F: Boron	7440-42-8	0.05	mg/L	3.48	3.36	3.6	0% - 20%		
EG020A-F: Iron	7439-89-6	0.05	mg/L	183	175	4.5	0% - 20%		
EM1209265-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.002	0.001	0.0	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.018	0.013	30.5	0% - 50%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.003	0.003	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.002	0.002	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	0.005	0.005	0.0	No Limit
		EG020A-F: Lithium	7439-93-2	0.001	mg/L	0.003	0.002	0.0	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.305	0.299	1.9	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.017	0.017	0.0	0% - 50%

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 Work Order : EM1209245  
 Client : SANTOS LTD  
 Project : HFRA Fluids Sampling - Extended Analysis



Sub-Matrix: **WATER**

Laboratory Duplicate (DUP) Report

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EG020F: Dissolved Metals by ICP-MS (QC Lot: 2451813) - continued</b>									
EM1209265-001	Anonymous	EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.033	0.031	6.4	0% - 20%
		EG020A-F: Tin	7440-31-5	0.001	mg/L	0.002	0.002	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.011	0.012	0.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.06	0.06	0.0	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.41	0.42	3.1	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.25	0.18	29.5	No Limit
<b>EG020F: Dissolved Metals by ICP-MS (QC Lot: 2451814)</b>									
EM1209234-001	Anonymous	EG020B-F: Strontium	7440-24-6	0.001	mg/L	15.3	15.7	2.5	0% - 20%
		EG020B-F: Uranium	7440-61-1	0.001	mg/L	15.4	17.3	11.7	0% - 20%
EM1209271-001	Anonymous	EG020B-F: Strontium	7440-24-6	0.001	mg/L	0.568	0.579	1.9	0% - 20%
		EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
<b>EG035F: Dissolved Mercury by FIMS (QC Lot: 2451815)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EG035F: Mercury	7439-97-6	0.0001	mg/L	0.0002	0.0003	0.0	No Limit
EM1209271-004	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
<b>EK025G: Free cyanide by Discrete Analyser (QC Lot: 2451312)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EK025G: Free Cyanide	----	0.004	mg/L	<0.004	<0.004	0.0	No Limit
<b>EK026G: Total Cyanide By Discrete Analyser (QC Lot: 2450067)</b>									
EB1220870-001	Anonymous	EK026G: Total Cyanide	57-12-5	0.004	mg/L	0.019	0.019	0.0	No Limit
EM1209210-032	Anonymous	EK026G: Total Cyanide	57-12-5	0.004	mg/L	0.007	<0.004	49.2	No Limit
<b>EK040P: Fluoride by PC Titrator (QC Lot: 2450242)</b>									
EM1209228-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.2	0.2	0.0	No Limit
<b>EK055G: Ammonia as N by Discrete Analyser (QC Lot: 2450475)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.20	0.19	0.0	0% - 50%
EM1209290-008	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.10	0.14	30.0	0% - 50%
<b>EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2450172)</b>									
EM1209229-001	Anonymous	EK057G: Nitrite as N	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EM1209230-006	Anonymous	EK057G: Nitrite as N	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2450473)</b>									
EM1209168-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.02	0.02	0.0	No Limit
EM1209281-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2450356)</b>									
EM1209230-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.8	1.0	19.2	0% - 50%
EM1209230-010	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.7	0.8	0.0	No Limit
<b>EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2450357)</b>									



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)	
<b>EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2450357) - continued</b>										
EM1209230-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.18	0.15	15.6	0% - 50%	
EM1209230-010	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.14	0.14	0.0	0% - 50%	
<b>EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 2450173)</b>										
EM1209229-001	Anonymous	EK071G: Reactive Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit	
<b>EP005: Total Organic Carbon (TOC) (QC Lot: 2450355)</b>										
EM1209171-002	Anonymous	EP005: Total Organic Carbon	----	1	mg/L	27	28	3.6	0% - 20%	
EM1209190-004	Anonymous	EP005: Total Organic Carbon	----	1	mg/L	11	11	0.0	0% - 50%	
<b>EP010: Formaldehyde (QC Lot: 2450192)</b>										
EM1209245-002	"Tindilpie Pad Pit Circ" Pit water prior to flowback	EP010: Formaldehyde	50-00-0	0.1	mg/L	3.5	3.4	0.0	0% - 20%	
<b>EP041A: Nonionic Surfactants (QC Lot: 2457642)</b>										
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP041A: Nonionic Surfactants as CTAS	----	5	mg/L	<5	<5	0.0	No Limit	
<b>EP050: Anionic Surfactants as MBAS (QC Lot: 2455526)</b>										
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP050: Anionic Surfactants as MBAS		0.1	mg/L	0.5	0.5	0.0	No Limit	
EP1206741-002	Anonymous	EP050: Anionic Surfactants as MBAS		0.1	mg/L	1.0	1.0	0.0	0% - 50%	
<b>EP074A: Monocyclic Aromatic Hydrocarbons (QC Lot: 2450015)</b>										
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP074: Benzene	71-43-2	1	µg/L	2	2	0.0	No Limit	
		EP074: Toluene	108-88-3	2	µg/L	4	4	0.0	No Limit	
		EP074: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit	
		EP074: meta- & para-Xylene	108-38-3	2	µg/L	<2	<2	0.0	No Limit	
			106-42-3							
		EP074: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit	
		EP074: Styrene	100-42-5	5	µg/L	<5	<5	0.0	No Limit	
		EP074: Isopropylbenzene	98-82-8	5	µg/L	<5	<5	0.0	No Limit	
		EP074: n-Propylbenzene	103-65-1	5	µg/L	<5	<5	0.0	No Limit	
		EP074: 1.3.5-Trimethylbenzene	108-67-8	5	µg/L	<5	<5	0.0	No Limit	
		EP074: sec-Butylbenzene	135-98-8	5	µg/L	<5	<5	0.0	No Limit	
		EP074: 1.2.4-Trimethylbenzene	95-63-6	5	µg/L	<5	<5	0.0	No Limit	
		EP074: tert-Butylbenzene	98-06-6	5	µg/L	<5	<5	0.0	No Limit	
		EP074: p-Isopropyltoluene	99-87-6	5	µg/L	<5	<5	0.0	No Limit	
EP074: n-Butylbenzene	104-51-8	5	µg/L	<5	<5	0.0	No Limit			
<b>EP074B: Oxygenated Compounds (QC Lot: 2450015)</b>										
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP074: Vinyl Acetate	108-05-4	50	µg/L	<50	<50	0.0	No Limit	
		EP074: 2-Butanone (MEK)	78-93-3	50	µg/L	<50	<50	0.0	No Limit	
		EP074: 4-Methyl-2-pentanone (MIBK)	108-10-1	50	µg/L	<50	<50	0.0	No Limit	



Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP074B: Oxygenated Compounds (QC Lot: 2450015) - continued</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP074: 2-Hexanone (MBK)	591-78-6	50	µg/L	<50	<50	0.0	No Limit
<b>EP074C: Sulfonated Compounds (QC Lot: 2450015)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP074: Carbon disulfide	75-15-0	5	µg/L	<5	<5	0.0	No Limit
<b>EP074D: Fumigants (QC Lot: 2450015)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP074: 2,2-Dichloropropane	594-20-7	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,2-Dichloropropane	78-87-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: cis-1,3-Dichloropropylene	10061-01-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: trans-1,3-Dichloropropylene	10061-02-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,2-Dibromoethane (EDB)	106-93-4	5	µg/L	<5	<5	0.0	No Limit
<b>EP074E: Halogenated Aliphatic Compounds (QC Lot: 2450015)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP074: 1,1-Dichloroethene	75-35-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: Iodomethane	74-88-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: trans-1,2-Dichloroethene	156-60-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,1-Dichloroethane	75-34-3	5	µg/L	<5	<5	0.0	No Limit
		EP074: cis-1,2-Dichloroethene	156-59-2	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,1,1-Trichloroethane	71-55-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,1-Dichloropropylene	563-58-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: Carbon Tetrachloride	56-23-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,2-Dichloroethane	107-06-2	5	µg/L	<5	<5	0.0	No Limit
		EP074: Trichloroethene	79-01-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: Dibromomethane	74-95-3	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,1,2-Trichloroethane	79-00-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,3-Dichloropropane	142-28-9	5	µg/L	<5	<5	0.0	No Limit
		EP074: Tetrachloroethene	127-18-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,1,1,2-Tetrachloroethane	630-20-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: trans-1,4-Dichloro-2-butene	110-57-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: cis-1,4-Dichloro-2-butene	1476-11-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,1,2,2-Tetrachloroethane	79-34-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,2,3-Trichloropropane	96-18-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: Pentachloroethane	76-01-7	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,2-Dibromo-3-chloropropane	96-12-8	5	µg/L	<5	<5	0.0	No Limit
		EP074: Dichlorodifluoromethane	75-71-8	50	µg/L	<50	<50	0.0	No Limit
		EP074: Chloromethane	74-87-3	50	µg/L	<50	<50	0.0	No Limit
EP074: Vinyl chloride	75-01-4	50	µg/L	<50	<50	0.0	No Limit		
EP074: Bromomethane	74-83-9	50	µg/L	<50	<50	0.0	No Limit		





Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP074E: Halogenated Aliphatic Compounds (QC Lot: 2450015) - continued</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP074: Chloroethane	75-00-3	50	µg/L	<50	<50	0.0	No Limit
		EP074: Trichlorofluoromethane	75-69-4	50	µg/L	<50	<50	0.0	No Limit
<b>EP074F: Halogenated Aromatic Compounds (QC Lot: 2450015)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP074: Chlorobenzene	108-90-7	5	µg/L	<5	<5	0.0	No Limit
		EP074: Bromobenzene	108-86-1	5	µg/L	<5	<5	0.0	No Limit
		EP074: 2-Chlorotoluene	95-49-8	5	µg/L	<5	<5	0.0	No Limit
		EP074: 4-Chlorotoluene	106-43-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,2,3-Trichlorobenzene	87-61-6	5	µg/L	<5	<5	0.0	No Limit
<b>EP074G: Trihalomethanes (QC Lot: 2450015)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP074: Chloroform	67-66-3	5	µg/L	<5	<5	0.0	No Limit
		EP074: Bromodichloromethane	75-27-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: Dibromochloromethane	124-48-1	5	µg/L	<5	<5	0.0	No Limit
		EP074: Bromoform	75-25-2	5	µg/L	<5	<5	0.0	No Limit
<b>EP075A: Phenolic Compounds (QC Lot: 2449947)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP075: Phenol	108-95-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2-Chlorophenol	95-57-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2-Methylphenol	95-48-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2-Nitrophenol	88-75-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2,4-Dimethylphenol	105-67-9	2	µg/L	6	7	0.0	No Limit
		EP075: 2,4-Dichlorophenol	120-83-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2,6-Dichlorophenol	87-65-0	2	µg/L	<2	<2	0.0	No Limit
		EP075: 4-Chloro-3-Methylphenol	59-50-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2,4,6-Trichlorophenol	88-06-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2,4,5-Trichlorophenol	95-95-4	2	µg/L	<2	<2	0.0	No Limit
		EP075: 3- & 4-Methylphenol	1319-77-3	4	µg/L	<4	<4	0.0	No Limit
		EP075: Pentachlorophenol	87-86-5	4	µg/L	<4	<4	0.0	No Limit
<b>EP075B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2449947)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP075: Naphthalene	91-20-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2-Methylnaphthalene	91-57-6	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2-Chloronaphthalene	91-58-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: Acenaphthylene	208-96-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: Acenaphthene	83-32-9	2	µg/L	<2	<2	0.0	No Limit
		EP075: Fluorene	86-73-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: Phenanthrene	85-01-8	2	µg/L	<2	<2	0.0	No Limit



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP075B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2449947) - continued</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP075: Anthracene	120-12-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: Fluoranthene	206-44-0	2	µg/L	<2	<2	0.0	No Limit
		EP075: Pyrene	129-00-0	2	µg/L	<2	<2	0.0	No Limit
		EP075: N-2-Fluorenyl Acetamide	53-96-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: Benz(a)anthracene	56-55-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: Chrysene	218-01-9	2	µg/L	<2	<2	0.0	No Limit
		EP075: 7,12-Dimethylbenz(a)anthracene	57-97-6	2	µg/L	<2	<2	0.0	No Limit
		EP075: Benzo(a)pyrene	50-32-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: 3-Methylcholanthrene	56-49-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: Indeno(1,2,3-cd)pyrene	193-39-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: Dibenz(a,h)anthracene	53-70-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: Benzo(g,h,i)perylene	191-24-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: Sum of PAHs	----	2	µg/L	<2	<2	0.0	No Limit
		EP075: Benzo(b) & Benzo(k)fluoranthene	205-99-2 207-08-9	4	µg/L	<4	<4	0.0	No Limit
<b>EP075C: Phthalate Esters (QC Lot: 2449947)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP075: Dimethyl phthalate	131-11-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: Diethyl phthalate	84-66-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: Di-n-butyl phthalate	84-74-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: Butyl benzyl phthalate	85-68-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: Di-n-octylphthalate	117-84-0	2	µg/L	<2	<2	0.0	No Limit
		EP075: bis(2-ethylhexyl) phthalate	117-81-7	5	µg/L	<10	<10	0.0	No Limit
<b>EP075D: Nitrosamines (QC Lot: 2449947)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP075: N-Nitrosomethylethylamine	10595-95-6	2	µg/L	<2	<2	0.0	No Limit
		EP075: N-Nitrosodiethylamine	55-18-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: N-Nitrosomorpholine	59-89-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: N-Nitrosodi-n-propylamine	621-64-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: N-Nitrosopiperidine	100-75-4	2	µg/L	<2	<2	0.0	No Limit
		EP075: N-Nitrosodibutylamine	924-16-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: Methapyrilene	91-80-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: N-Nitrosopyrrolidine	930-55-2	4	µg/L	<4	<4	0.0	No Limit
		EP075: N-Nitrosodiphenyl & Diphenylamine	86-30-6 122-39-4	4	µg/L	<4	<4	0.0	No Limit
<b>EP075E: Nitroaromatics and Ketones (QC Lot: 2449947)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP075: 2-Picoline	109-06-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: Acetophenone	98-86-2	2	µg/L	<2	<2	0.0	No Limit



Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP075E: Nitroaromatics and Ketones (QC Lot: 2449947) - continued</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP075: Nitrobenzene	98-95-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: Isophorone	78-59-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: 1-Naphthylamine	134-32-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: 4-Nitroquinoline-N-oxide	56-57-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: 5-Nitro-o-toluidine	99-55-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: Azobenzene	103-33-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: 1,3,5-Trinitrobenzene	99-35-4	2	µg/L	<2	<2	0.0	No Limit
		EP075: Phenacetin	62-44-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: 4-Aminobiphenyl	92-67-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: Pentachloronitrobenzene	82-68-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: Pronamide	23950-58-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: Dimethylaminoazobenzene	60-11-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: Chlorobenzilate	510-15-6	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2,6-Dinitrotoluene	606-20-2	4	µg/L	<4	<4	0.0	No Limit
EP075: 2,4-Dinitrotoluene	121-14-2	4	µg/L	<4	<4	0.0	No Limit		
<b>EP075F: Haloethers (QC Lot: 2449947)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP075: Bis(2-chloroethyl) ether	111-44-4	2	µg/L	<2	<2	0.0	No Limit
		EP075: Bis(2-chloroethoxy) methane	111-91-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: 4-Chlorophenyl phenyl ether	7005-72-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: 4-Bromophenyl phenyl ether	101-55-3	2	µg/L	<2	<2	0.0	No Limit
<b>EP075G: Chlorinated Hydrocarbons (QC Lot: 2449947)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP075: Hexachlorocyclopentadiene	77-47-4	10	µg/L	<10	<10	0.0	No Limit
		EP075: 1,4-Dichlorobenzene	106-46-7	2	µg/L	<4	<4	0.0	No Limit
		EP075: 1,3-Dichlorobenzene	541-73-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: 1,2-Dichlorobenzene	95-50-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: Hexachloroethane	67-72-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: 1,2,4-Trichlorobenzene	120-82-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: Hexachloropropylene	1888-71-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: Hexachlorobutadiene	87-68-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: Pentachlorobenzene	608-93-5	2	µg/L	<2	<2	0.0	No Limit
EP075: Hexachlorobenzene (HCB)	118-74-1	4	µg/L	<4	<4	0.0	No Limit		
<b>EP075H: Anilines and Benzidines (QC Lot: 2449947)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP075: Aniline	62-53-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: 4-Chloroaniline	106-47-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: Dibenzofuran	132-64-9	2	µg/L	<2	<2	0.0	No Limit



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP075H: Anilines and Benzidines (QC Lot: 2449947) - continued</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP075: 4-Nitroaniline	100-01-6	2	µg/L	<2	<2	0.0	No Limit
		EP075: Carbazole	86-74-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: 3,3'-Dichlorobenzidine	91-94-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2-Nitroaniline	88-74-4	4	µg/L	<4	<4	0.0	No Limit
		EP075: 3-Nitroaniline	99-09-2	4	µg/L	<4	<4	0.0	No Limit
<b>EP075I: Organochlorine Pesticides (QC Lot: 2449947)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP075: alpha-BHC	319-84-6	2	µg/L	<2	<2	0.0	No Limit
		EP075: beta-BHC	319-85-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: gamma-BHC	58-89-9	2	µg/L	<2	<2	0.0	No Limit
		EP075: delta-BHC	319-86-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: Heptachlor	76-44-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: Aldrin	309-00-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: Heptachlor epoxide	1024-57-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: alpha-Endosulfan	959-98-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: 4,4'-DDE	72-55-9	2	µg/L	<2	<2	0.0	No Limit
		EP075: Dieldrin	60-57-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: Endrin	72-20-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: beta-Endosulfan	33213-65-9	2	µg/L	<2	<2	0.0	No Limit
		EP075: 4,4'-DDD	72-54-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: Endosulfan sulfate	1031-07-8	2	µg/L	<2	<2	0.0	No Limit
EP075: 4,4'-DDT	50-29-3	4	µg/L	<4	<4	0.0	No Limit		
<b>EP075J: Organophosphorus Pesticides (QC Lot: 2449947)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP075: Dichlorvos	62-73-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: Dimethoate	60-51-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: Diazinon	333-41-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: Chlorpyrifos-methyl	5598-13-0	2	µg/L	<2	<2	0.0	No Limit
		EP075: Malathion	121-75-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: Fenthion	55-38-9	2	µg/L	<2	<2	0.0	No Limit
		EP075: Chlorpyrifos	2921-88-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: Pirimphos-ethyl	23505-41-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: Chlorfenvinphos	470-90-6	2	µg/L	<2	<2	0.0	No Limit
		EP075: Prothiofos	34643-46-4	2	µg/L	<2	<2	0.0	No Limit
		EP075: Ethion	563-12-2	2	µg/L	<2	<2	0.0	No Limit
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QC Lot: 2449949)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP070-CWG: Aliphatic >C10-C12	TPHCWG-ALE1	50	µg/L	<50	<50	0.0	No Limit



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QC Lot: 2449949) - continued</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP070-CWG: Aliphatic >C12-C16	TPHCWG-ALE2	50	µg/L	<50	<50	0.0	No Limit
		EP070-CWG: Aliphatic >C16-C21	----	50	µg/L	132	60	74.6	No Limit
		EP070-CWG: Aliphatic >C21-C35	----	50	µg/L	264	150	54.6	No Limit
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QC Lot: 2450016)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP079-CWG: Aliphatic >C5-C6	----	20	µg/L	<20	<20	0.0	No Limit
		EP079-CWG: Aliphatic >C6-C8	TPHCWG-ALV2	20	µg/L	20	<20	0.0	No Limit
		EP079-CWG: Aliphatic >C8-C10	TPHCWG-ALV3	20	µg/L	<20	<20	0.0	No Limit
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QC Lot: 2449949)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP070-CWG: Aromatic >C10-C12	TPHCWG-ARE1	50	µg/L	<50	<50	0.0	No Limit
		EP070-CWG: Aromatic >C12-C16	TPHCWG-ARE2	50	µg/L	<50	<50	0.0	No Limit
		EP070-CWG: Aromatic >C16-C21	TPHCWG-ARE3	50	µg/L	<50	<50	0.0	No Limit
		EP070-CWG: Aromatic >C21-C35	TPHCWG-ARE4	50	µg/L	99	60	48.6	No Limit
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QC Lot: 2450016)</b>									
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP079-CWG: Aromatic >C5-C7	----	5	µg/L	<5	<5	0.0	No Limit
		EP079-CWG: Aromatic >C7-C8	TPHCWG-ARV 2	5	µg/L	<5	<5	0.0	No Limit
		EP079-CWG: Aromatic >C8-C10	TPHCWG-ARV 3	5	µg/L	<5	<5	0.0	No Limit
<b>EP117: Alcohols (QC Lot: 2459340)</b>									
EB1221352-001	Anonymous	EP117: Ethanol	64-17-5	50	µg/L	<50	<50	0.0	No Limit
		EP117: Isopropanol	67-63-0	50	µg/L	<50	<50	0.0	No Limit
		EP117: n-Propanol	71-23-8	50	µg/L	<50	<50	0.0	No Limit
		EP117: Isobutanol	78-83-1	50	µg/L	<50	<50	0.0	No Limit
		EP117: n-Butanol	71-36-3	50	µg/L	<50	<50	0.0	No Limit
EM1209271-004	Anonymous	EP117: Ethanol	64-17-5	50	µg/L	<50	<50	0.0	No Limit
		EP117: Isopropanol	67-63-0	50	µg/L	<50	<50	0.0	No Limit
		EP117: n-Propanol	71-23-8	50	µg/L	<50	<50	0.0	No Limit
		EP117: Isobutanol	78-83-1	50	µg/L	<50	<50	0.0	No Limit
		EP117: n-Butanol	71-36-3	50	µg/L	<50	<50	0.0	No Limit



## Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: WATER

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
Method: Compound	CAS Number	LOR	Unit	Result	Spike Concentration	Spike Recovery (%) LCS	Recovery Limits (%) Low High	
<b>EA015: Total Dissolved Solids (QCLot: 2451186)</b>								
EA015H: Total Dissolved Solids @180°C	GIS-210-010	10	mg/L	<10	2000 mg/L	100	98	104
<b>ED009: Anions (QCLot: 2451265)</b>								
ED009-X: Bromide	24959-67-9	0.01	mg/L	<0.010	2 mg/L	99.4	88	112
ED009-X: Iodide	20461-54-5	0.01	mg/L	<0.010	0.5 mg/L	91.4	75	127
<b>ED037P: Alkalinity by PC Titrator (QCLot: 2450243)</b>								
ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	----	200 mg/L	96.5	77	127
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2450176)</b>								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	12.5 mg/L	102	81	125
<b>ED045G: Chloride Discrete analyser (QCLot: 2450175)</b>								
ED045G: Chloride	16887-00-6	1	mg/L	<1	1000 mg/L	97.4	89	117
<b>ED093F: Dissolved Major Cations (QCLot: 2450171)</b>								
ED093F: Calcium	7440-70-2	1	mg/L	<1	5 mg/L	98.3	83	129
ED093F: Magnesium	7439-95-4	1	mg/L	<1	5 mg/L	96.9	80	124
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	91.1	77	125
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	91.0	77	123
<b>ED093F: Dissolved Major Cations (QCLot: 2450177)</b>								
ED093F: Calcium	7440-70-2	1	mg/L	<1	5 mg/L	103	83	129
ED093F: Magnesium	7439-95-4	1	mg/L	<1	5 mg/L	103	80	124
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	102	77	125
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	100	77	123
<b>EG020F: Dissolved Metals by ICP-MS (QCLot: 2451813)</b>								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	91.6	80	120
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	88.4	87	109
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	91.9	70	124
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	96.0	88	110
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	97.2	88	110
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	88.1	86	112
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	98.1	87	111
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	88.8	86	108
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	91.0	90	110
EG020A-F: Lithium	7439-93-2	0.001	mg/L	<0.001	0.1 mg/L	87.8	60	130
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	89.3	87	111
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	93.6	84	108



Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
				Result	Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
						LCS	Low	High
<b>EG020F: Dissolved Metals by ICP-MS (QCLot: 2451813) - continued</b>								
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	87.5	86	112
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	89.8	83	111
EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	0.1 mg/L	98.3	83	111
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	89.8	85	113
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	88.7	86	120
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.1 mg/L	112	61	133
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	85.1	79	119
<b>EG020F: Dissolved Metals by ICP-MS (QCLot: 2451814)</b>								
EG020B-F: Strontium	7440-24-6	0.001	mg/L	<0.001	0.1 mg/L	89.7	88	108
EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	----	----	----	----
<b>EG035F: Dissolved Mercury by FIMS (QCLot: 2451815)</b>								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.0100 mg/L	103	71	125
<b>EK025G: Free cyanide by Discrete Analyser (QCLot: 2451312)</b>								
EK025G: Free Cyanide	----	0.004	mg/L	<0.004	0.2 mg/L	101	73	111
<b>EK026G: Total Cyanide By Discrete Analyser (QCLot: 2450067)</b>								
EK026G: Total Cyanide	57-12-5	0.004	mg/L	<0.004	0.2 mg/L	97.9	85	125
<b>EK040P: Fluoride by PC Titrator (QCLot: 2450242)</b>								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	102	78	120
<b>EK055G: Ammonia as N by Discrete Analyser (QCLot: 2450475)</b>								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	98.3	76	122
<b>EK057G: Nitrite as N by Discrete Analyser (QCLot: 2450172)</b>								
EK057G: Nitrite as N	----	0.01	mg/L	<0.01	0.5 mg/L	96.3	84	112
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2450473)</b>								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	90.8	73	127
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2450356)</b>								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	108	63	117
<b>EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2450357)</b>								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	98.0	73	117
<b>EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2450173)</b>								
EK071G: Reactive Phosphorus as P	----	0.01	mg/L	<0.01	0.5 mg/L	97.2	84	108
<b>EP005: Total Organic Carbon (TOC) (QCLot: 2450355)</b>								
EP005: Total Organic Carbon	----	1	mg/L	<1	10 mg/L	101	81	111
<b>EP010: Formaldehyde (QCLot: 2450192)</b>								
EP010: Formaldehyde	50-00-0	0.1	mg/L	<0.1	5.0 mg/L	101	91	117
<b>EP041A: Nonionic Surfactants (QCLot: 2457642)</b>								
EP041A: Nonionic Surfactants as CTAS	----	5	mg/L	<5	10 mg/L	100	81.1	110



Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike Concentration	Spike Recovery (%)		Recovery Limits (%)	
						LCS	Low	High	
<b>EP050: Anionic Surfactants as MBAS (QCLot: 2455526)</b>									
EP050: Anionic Surfactants as MBAS		0.1	mg/L	<0.1	1 mg/L	90.0	83.2	115	
<b>EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 2450015)</b>									
EP074: Benzene	71-43-2	1	µg/L	<1	20 µg/L	108	79	121	
EP074: Toluene	108-88-3	2	µg/L	<2	20 µg/L	108	80	124	
EP074: Ethylbenzene	100-41-4	2	µg/L	<2	20 µg/L	105	79	121	
EP074: meta- & para-Xylene	108-38-3	2	µg/L	<2	40 µg/L	110	80	122	
	106-42-3								
EP074: Styrene	100-42-5	5	µg/L	<5	20 µg/L	104	74	122	
EP074: ortho-Xylene	95-47-6	2	µg/L	<2	20 µg/L	107	81	123	
EP074: Isopropylbenzene	98-82-8	5	µg/L	<5	20 µg/L	114	80	120	
EP074: n-Propylbenzene	103-65-1	5	µg/L	<5	20 µg/L	96.6	70	120	
EP074: 1,3,5-Trimethylbenzene	108-67-8	5	µg/L	<5	20 µg/L	91.4	71	119	
EP074: sec-Butylbenzene	135-98-8	5	µg/L	<5	20 µg/L	100	72	120	
EP074: 1,2,4-Trimethylbenzene	95-63-6	5	µg/L	<5	20 µg/L	88.5	73	119	
EP074: tert-Butylbenzene	98-06-6	5	µg/L	<5	20 µg/L	99.4	73	119	
EP074: p-Isopropyltoluene	99-87-6	5	µg/L	<5	20 µg/L	96.8	71	121	
EP074: n-Butylbenzene	104-51-8	5	µg/L	<5	20 µg/L	93.1	65	121	
<b>EP074B: Oxygenated Compounds (QCLot: 2450015)</b>									
EP074: Vinyl Acetate	108-05-4	50	µg/L	<50	200 µg/L	118	57	131	
EP074: 2-Butanone (MEK)	78-93-3	50	µg/L	<50	200 µg/L	92.0	69	135	
EP074: 4-Methyl-2-pentanone (MIBK)	108-10-1	50	µg/L	<50	200 µg/L	95.9	68	136	
EP074: 2-Hexanone (MBK)	591-78-6	50	µg/L	<50	200 µg/L	77.4	68	138	
<b>EP074C: Sulfonated Compounds (QCLot: 2450015)</b>									
EP074: Carbon disulfide	75-15-0	5	µg/L	<5	20 µg/L	114	67	127	
<b>EP074D: Fumigants (QCLot: 2450015)</b>									
EP074: 2,2-Dichloropropane	594-20-7	5	µg/L	<5	20 µg/L	102	59	128	
EP074: 1,2-Dichloropropane	78-87-5	5	µg/L	<5	20 µg/L	96.7	77	121	
EP074: cis-1,3-Dichloropropylene	10061-01-5	5	µg/L	<5	20 µg/L	# 68.4	70	118	
EP074: trans-1,3-Dichloropropylene	10061-02-6	5	µg/L	<5	20 µg/L	# 60.9	66	120	
EP074: 1,2-Dibromoethane (EDB)	106-93-4	5	µg/L	<5	20 µg/L	102	78	124	
<b>EP074E: Halogenated Aliphatic Compounds (QCLot: 2450015)</b>									
EP074: Dichlorodifluoromethane	75-71-8	50	µg/L	<50	200 µg/L	105	58	148	
EP074: Chloromethane	74-87-3	50	µg/L	<50	200 µg/L	104	62	142	
EP074: Vinyl chloride	75-01-4	50	µg/L	<50	200 µg/L	99.0	61	141	
EP074: Bromomethane	74-83-9	50	µg/L	<50	200 µg/L	102	57	131	
EP074: Chloroethane	75-00-3	50	µg/L	<50	200 µg/L	127	64	138	
EP074: Trichlorofluoromethane	75-69-4	50	µg/L	<50	200 µg/L	122	67	131	
EP074: 1,1-Dichloroethene	75-35-4	5	µg/L	<5	20 µg/L	# 127	71	125	





Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
				Result	Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
					LCS	Low	High	
<b>EP074E: Halogenated Aliphatic Compounds (QCLot: 2450015) - continued</b>								
EP074: Iodomethane	74-88-4	5	µg/L	<5	20 µg/L	82.1	61	135
EP074: trans-1,2-Dichloroethene	156-60-5	5	µg/L	<5	20 µg/L	119	75	121
EP074: 1,1-Dichloroethane	75-34-3	5	µg/L	<5	20 µg/L	# 122	77	121
EP074: cis-1,2-Dichloroethene	156-59-2	5	µg/L	<5	20 µg/L	119	78	122
EP074: 1,1,1-Trichloroethane	71-55-6	5	µg/L	<5	20 µg/L	104	70	120
EP074: 1,1-Dichloropropylene	563-58-6	5	µg/L	<5	20 µg/L	121	74	122
EP074: Carbon Tetrachloride	56-23-5	5	µg/L	<5	20 µg/L	92.4	57	123
EP074: 1,2-Dichloroethane	107-06-2	5	µg/L	<5	20 µg/L	111	75	125
EP074: Trichloroethene	79-01-6	5	µg/L	<5	20 µg/L	99.6	77	121
EP074: Dibromomethane	74-95-3	5	µg/L	<5	20 µg/L	91.7	76	122
EP074: 1,1,2-Trichloroethane	79-00-5	5	µg/L	<5	20 µg/L	111	78	126
EP074: 1,3-Dichloropropane	142-28-9	5	µg/L	<5	20 µg/L	105	79	125
EP074: Tetrachloroethene	127-18-4	5	µg/L	<5	20 µg/L	113	76	122
EP074: 1,1,1,2-Tetrachloroethane	630-20-6	5	µg/L	<5	20 µg/L	72.6	65	119
EP074: trans-1,4-Dichloro-2-butene	110-57-6	5	µg/L	<5	20 µg/L	85.7	46	126
EP074: cis-1,4-Dichloro-2-butene	1476-11-5	5	µg/L	<5	20 µg/L	81.4	54	132
EP074: 1,1,2,2-Tetrachloroethane	79-34-5	5	µg/L	<5	20 µg/L	97.7	75	131
EP074: 1,2,3-Trichloropropane	96-18-4	5	µg/L	<5	20 µg/L	100	75	133
EP074: Pentachloroethane	76-01-7	5	µg/L	<5	20 µg/L	56.7	46	118
EP074: 1,2-Dibromo-3-chloropropane	96-12-8	5	µg/L	<5	20 µg/L	64.8	54	124
<b>EP074F: Halogenated Aromatic Compounds (QCLot: 2450015)</b>								
EP074: Chlorobenzene	108-90-7	5	µg/L	<5	20 µg/L	106	81	121
EP074: Bromobenzene	108-86-1	5	µg/L	<5	20 µg/L	84.3	75	119
EP074: 2-Chlorotoluene	95-49-8	5	µg/L	<5	20 µg/L	93.2	73	121
EP074: 4-Chlorotoluene	106-43-4	5	µg/L	<5	20 µg/L	92.0	72	120
EP074: 1,2,3-Trichlorobenzene	87-61-6	5	µg/L	<5	20 µg/L	83.5	69	123
<b>EP074G: Trihalomethanes (QCLot: 2450015)</b>								
EP074: Chloroform	67-66-3	5	µg/L	<5	20 µg/L	113	77	121
EP074: Bromodichloromethane	75-27-4	5	µg/L	<5	20 µg/L	71.9	69	117
EP074: Dibromochloromethane	124-48-1	5	µg/L	<5	20 µg/L	72.7	59	119
EP074: Bromoform	75-25-2	5	µg/L	<5	20 µg/L	67.6	49	121
<b>EP075A: Phenolic Compounds (QCLot: 2449947)</b>								
EP075: Phenol	108-95-2	2	µg/L	<2	10 µg/L	33.0	10	65
EP075: 2-Chlorophenol	95-57-8	2	µg/L	<2	10 µg/L	79.8	29.8	108
EP075: 2-Methylphenol	95-48-7	2	µg/L	<2	10 µg/L	80.5	21.9	110
EP075: 3- & 4-Methylphenol	1319-77-3	2	µg/L	----	20 µg/L	69.1	10	108
		4	µg/L	<4	----	----	----	----
EP075: 2-Nitrophenol	88-75-5	2	µg/L	<2	10 µg/L	88.5	31.2	123
EP075: 2,4-Dimethylphenol	105-67-9	2	µg/L	<2	10 µg/L	101	36	124



Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike Concentration	Spike Recovery (%)		Recovery Limits (%)	
						LCS	Low	High	
<b>EP075A: Phenolic Compounds (QCLot: 2449947) - continued</b>									
EP075: 2,4-Dichlorophenol	120-83-2	2	µg/L	<2	10 µg/L	85.2	31.2	125	
EP075: 2,6-Dichlorophenol	87-65-0	2	µg/L	<2	10 µg/L	83.2	33	123	
EP075: 4-Chloro-3-Methylphenol	59-50-7	2	µg/L	<2	10 µg/L	86.6	39	125	
EP075: 2,4,6-Trichlorophenol	88-06-2	2	µg/L	<2	10 µg/L	81.7	23.9	134	
EP075: 2,4,5-Trichlorophenol	95-95-4	2	µg/L	<2	10 µg/L	81.3	31.6	136	
EP075: Pentachlorophenol	87-86-5	2	µg/L	----	10 µg/L	66.9	47	153	
		4	µg/L	<4	----	----	----	----	
<b>EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 2449947)</b>									
EP075: Naphthalene	91-20-3	2	µg/L	<2	10 µg/L	95.7	33	117	
EP075: 2-Methylnaphthalene	91-57-6	2	µg/L	<2	10 µg/L	85.2	33	123	
EP075: 2-Chloronaphthalene	91-58-7	2	µg/L	<2	10 µg/L	85.3	22.6	133	
EP075: Acenaphthylene	208-96-8	2	µg/L	<2	10 µg/L	85.9	35	131	
EP075: Acenaphthene	83-32-9	2	µg/L	<2	10 µg/L	91.8	37	127	
EP075: Fluorene	86-73-7	2	µg/L	<2	10 µg/L	92.1	39	133	
EP075: Phenanthrene	85-01-8	2	µg/L	<2	10 µg/L	94.5	42	134	
EP075: Anthracene	120-12-7	2	µg/L	<2	10 µg/L	94.9	41	135	
EP075: Fluoranthene	206-44-0	2	µg/L	<2	10 µg/L	93.0	40	146	
EP075: Pyrene	129-00-0	2	µg/L	<2	10 µg/L	93.8	42	142	
EP075: N-2-Fluorenyl Acetamide	53-96-3	2	µg/L	<2	10 µg/L	101	40	146	
EP075: Benz(a)anthracene	56-55-3	2	µg/L	<2	10 µg/L	91.5	41	143	
EP075: Chrysene	218-01-9	2	µg/L	<2	10 µg/L	92.4	40	146	
EP075: Benzo(b) & Benzo(k)fluoranthene	205-99-2	4	µg/L	<4	20 µg/L	105	21	151	
	207-08-9								
EP075: 7,12-Dimethylbenz(a)anthracene	57-97-6	2	µg/L	<2	10 µg/L	98.4	39	151	
EP075: Benzo(a)pyrene	50-32-8	2	µg/L	<2	10 µg/L	107	39	141	
EP075: 3-Methylcholanthrene	56-49-5	2	µg/L	<2	10 µg/L	101	33	139	
EP075: Indeno(1,2,3-cd)pyrene	193-39-5	2	µg/L	<2	10 µg/L	103	31.5	139	
EP075: Dibenz(a,h)anthracene	53-70-3	2	µg/L	<2	10 µg/L	102	30.1	140	
EP075: Benzo(g,h,i)perylene	191-24-2	2	µg/L	<2	10 µg/L	107	29.5	138	
<b>EP075C: Phthalate Esters (QCLot: 2449947)</b>									
EP075: Dimethyl phthalate	131-11-3	2	µg/L	<2	10 µg/L	89.7	41	141	
EP075: Diethyl phthalate	84-66-2	2	µg/L	<2	10 µg/L	101	45	139	
EP075: Di-n-butyl phthalate	84-74-2	2	µg/L	<2	10 µg/L	104	42	150	
EP075: Butyl benzyl phthalate	85-68-7	2	µg/L	<2	10 µg/L	104	36	152	
EP075: bis(2-ethylhexyl) phthalate	117-81-7	10	µg/L	<10	----	----	----	----	
		20	µg/L	----	10 µg/L	139	42	158	
EP075: Di-n-octylphthalate	117-84-0	2	µg/L	<2	10 µg/L	116	43	141	
<b>EP075D: Nitrosamines (QCLot: 2449947)</b>									
EP075: N-Nitrosomethylethylamine	10595-95-6	2	µg/L	<2	10 µg/L	62.5	10	109	



Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike	Spike Recovery (%)		Recovery Limits (%)	
					Concentration	LCS	Low	High	
<b>EP075D: Nitrosamines (QCLot: 2449947) - continued</b>									
EP075: N-Nitrosodiethylamine	55-18-5	2	µg/L	<2	10 µg/L	83.2	23.5	124	
EP075: N-Nitrosopyrrolidine	930-55-2	4	µg/L	<4	10 µg/L	62.5	18.8	97	
EP075: N-Nitrosomorpholine	59-89-2	2	µg/L	<2	10 µg/L	69.3	18.3	94	
EP075: N-Nitrosodi-n-propylamine	621-64-7	2	µg/L	<2	10 µg/L	101	30.6	129	
EP075: N-Nitrosopiperidine	100-75-4	2	µg/L	<2	10 µg/L	88.6	32	126	
EP075: N-Nitrosodibutylamine	924-16-3	2	µg/L	<2	10 µg/L	95.7	29.1	135	
EP075: N-Nitrosodiphenyl & Diphenylamine	86-30-6 122-39-4	4	µg/L	<4	10 µg/L	90.6	39	139	
EP075: Methapyrilene	91-80-5	2	µg/L	<2	10 µg/L	# 22.0	28.1	70	
<b>EP075E: Nitroaromatics and Ketones (QCLot: 2449947)</b>									
EP075: 2-Picoline	109-06-8	2	µg/L	<2	10 µg/L	# 12.4	28.4	57	
EP075: Acetophenone	98-86-2	2	µg/L	<2	10 µg/L	93.3	34	126	
EP075: Nitrobenzene	98-95-3	2	µg/L	<2	10 µg/L	98.1	36	120	
EP075: Isophorone	78-59-1	2	µg/L	<2	10 µg/L	99.3	38	124	
EP075: 2,6-Dinitrotoluene	606-20-2	4	µg/L	<4	10 µg/L	87.5	38	142	
EP075: 2,4-Dinitrotoluene	121-14-2	4	µg/L	<4	10 µg/L	89.2	44	138	
EP075: 1-Naphthylamine	134-32-7	2	µg/L	<2	10 µg/L	59.2	29.8	152	
EP075: 4-Nitroquinoline-N-oxide	56-57-5	2	µg/L	<2	10 µg/L	91.9	25.9	168	
EP075: 5-Nitro-o-toluidine	99-55-8	2	µg/L	<2	10 µg/L	95.7	26.2	138	
EP075: Azobenzene	103-33-3	2	µg/L	<2	10 µg/L	106	43	135	
EP075: 1,3,5-Trinitrobenzene	99-35-4	2	µg/L	<2	10 µg/L	79.4	10	158	
EP075: Phenacetin	62-44-2	2	µg/L	<2	10 µg/L	88.2	37	131	
EP075: 4-Aminobiphenyl	92-67-1	2	µg/L	<2	10 µg/L	59.6	10	150	
EP075: Pentachloronitrobenzene	82-68-8	2	µg/L	<2	10 µg/L	92.0	38	146	
EP075: Pronamide	23950-58-5	2	µg/L	<2	10 µg/L	102	45	139	
EP075: Dimethylaminoazobenzene	60-11-7	2	µg/L	<2	10 µg/L	86.6	37	147	
EP075: Chlorobenzilate	510-15-6	2	µg/L	<2	10 µg/L	89.1	42	148	
<b>EP075F: Haloethers (QCLot: 2449947)</b>									
EP075: Bis(2-chloroethyl) ether	111-44-4	2	µg/L	<2	10 µg/L	106	10	142	
EP075: Bis(2-chloroethoxy) methane	111-91-1	2	µg/L	<2	10 µg/L	96.1	34	126	
EP075: 4-Chlorophenyl phenyl ether	7005-72-3	2	µg/L	<2	10 µg/L	87.2	39	133	
EP075: 4-Bromophenyl phenyl ether	101-55-3	2	µg/L	<2	10 µg/L	84.5	39	137	
<b>EP075G: Chlorinated Hydrocarbons (QCLot: 2449947)</b>									
EP075: 1,4-Dichlorobenzene	106-46-7	2	µg/L	<4	10 µg/L	# 114	23	109	
EP075: 1,3-Dichlorobenzene	541-73-1	2	µg/L	<2	10 µg/L	84.5	19.8	112	
EP075: 1,2-Dichlorobenzene	95-50-1	2	µg/L	<2	10 µg/L	84.1	25.2	109	
EP075: Hexachloroethane	67-72-1	2	µg/L	<2	10 µg/L	79.8	17.4	115	
EP075: 1,2,4-Trichlorobenzene	120-82-1	2	µg/L	<2	10 µg/L	83.4	25.7	112	
EP075: Hexachloropropylene	1888-71-7	2	µg/L	<2	10 µg/L	79.2	19.1	115	



Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike	Spike Recovery (%)		Recovery Limits (%)	
					Concentration	LCS	Low	High	
<b>EP075G: Chlorinated Hydrocarbons (QCLot: 2449947) - continued</b>									
EP075: Hexachlorobutadiene	87-68-3	2	µg/L	<2	10 µg/L	80.6	21.1	117	
EP075: Hexachlorocyclopentadiene	77-47-4	10	µg/L	<10	10 µg/L	71.8	10	120	
EP075: Pentachlorobenzene	608-93-5	2	µg/L	<2	10 µg/L	82.0	36	130	
EP075: Hexachlorobenzene (HCB)	118-74-1	4	µg/L	<4	20 µg/L	82.4	11.1	135	
<b>EP075H: Anilines and Benzidines (QCLot: 2449947)</b>									
EP075: Aniline	62-53-3	2	µg/L	<2	10 µg/L	62.0	19.8	96	
EP075: 4-Chloroaniline	106-47-8	2	µg/L	<2	10 µg/L	37.3	16.4	130	
EP075: 2-Nitroaniline	88-74-4	4	µg/L	<4	10 µg/L	86.1	38	138	
EP075: 3-Nitroaniline	99-09-2	4	µg/L	<4	10 µg/L	60.7	10	135	
EP075: Dibenzofuran	132-64-9	2	µg/L	<2	10 µg/L	90.5	39	129	
EP075: 4-Nitroaniline	100-01-6	2	µg/L	<2	10 µg/L	80.5	22.8	133	
EP075: Carbazole	86-74-8	2	µg/L	<2	10 µg/L	95.4	44	138	
EP075: 3,3'-Dichlorobenzidine	91-94-1	2	µg/L	<2	10 µg/L	105	14.6	107	
<b>EP075I: Organochlorine Pesticides (QCLot: 2449947)</b>									
EP075: alpha-BHC	319-84-6	2	µg/L	<2	10 µg/L	98.7	41	143	
EP075: beta-BHC	319-85-7	2	µg/L	<2	10 µg/L	103	39	145	
EP075: gamma-BHC	58-89-9	2	µg/L	<2	10 µg/L	101	39	143	
EP075: delta-BHC	319-86-8	2	µg/L	<2	10 µg/L	103	42	142	
EP075: Heptachlor	76-44-8	2	µg/L	<2	10 µg/L	85.5	39	139	
EP075: Aldrin	309-00-2	2	µg/L	<2	10 µg/L	92.8	40	142	
EP075: Heptachlor epoxide	1024-57-3	2	µg/L	<2	10 µg/L	79.4	37	147	
EP075: alpha-Endosulfan	959-98-8	2	µg/L	<2	10 µg/L	104	42	146	
EP075: 4,4'-DDE	72-55-9	2	µg/L	<2	10 µg/L	91.7	41	141	
EP075: Dieldrin	60-57-1	2	µg/L	<2	10 µg/L	96.9	42	144	
EP075: Endrin	72-20-8	2	µg/L	<2	10 µg/L	90.9	41	145	
EP075: beta-Endosulfan	33213-65-9	2	µg/L	<2	10 µg/L	101	42	146	
EP075: 4,4'-DDD	72-54-8	2	µg/L	<2	10 µg/L	96.4	40	148	
EP075: Endosulfan sulfate	1031-07-8	2	µg/L	<2	10 µg/L	104	38	152	
EP075: 4,4'-DDT	50-29-3	4	µg/L	<4	10 µg/L	92.5	33	145	
<b>EP075J: Organophosphorus Pesticides (QCLot: 2449947)</b>									
EP075: Dichlorvos	62-73-7	2	µg/L	<2	10 µg/L	95.2	38	132	
EP075: Dimethoate	60-51-5	2	µg/L	<2	10 µg/L	91.6	36	138	
EP075: Diazinon	333-41-5	2	µg/L	<2	10 µg/L	106	43	141	
EP075: Chlorpyrifos-methyl	5598-13-0	2	µg/L	<2	10 µg/L	83.9	43	141	
EP075: Malathion	121-75-5	2	µg/L	<2	10 µg/L	98.5	44	148	
EP075: Fenthion	55-38-9	2	µg/L	<2	10 µg/L	85.8	42	144	
EP075: Chlorpyrifos	2921-88-2	2	µg/L	<2	10 µg/L	97.3	42	142	
EP075: Pirimphos-ethyl	23505-41-1	2	µg/L	<2	10 µg/L	101	44	142	
EP075: Chlorfenvinphos	470-90-6	2	µg/L	<2	10 µg/L	93.2	44	146	



Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike Concentration	Spike Recovery (%)		Recovery Limits (%)	
						LCS	Low	High	
<b>EP075J: Organophosphorus Pesticides (QCLot: 2449947) - continued</b>									
EP075: Prothiofos	34643-46-4	2	µg/L	<2	10 µg/L	98.5	40	142	
EP075: Ethion	563-12-2	2	µg/L	<2	10 µg/L	82.5	42	146	
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QCLot: 2449949)</b>									
EP070-CWG: Aliphatic >C10-C12	TPHCWG-AL E1	50	µg/L	<50	2505 µg/L	75.0	70	130	
EP070-CWG: Aliphatic >C12-C16	TPHCWG-AL E2	50	µg/L	<50	10590 µg/L	83.2	70	130	
EP070-CWG: Aliphatic >C16-C21	----	50	µg/L	<50	9345 µg/L	97.2	70	130	
EP070-CWG: Aliphatic >C21-C35	----	50	µg/L	<50	2253 µg/L	93.6	70	130	
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QCLot: 2450016)</b>									
EP079-CWG: Aliphatic >C5-C6	----	20	µg/L	<20	50 µg/L	73.5	70	130	
EP079-CWG: Aliphatic >C6-C8	TPHCWG-AL V2	20	µg/L	<20	100 µg/L	102	70	130	
EP079-CWG: Aliphatic >C8-C10	TPHCWG-AL V3	20	µg/L	<20	120 µg/L	78.3	70	130	
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QCLot: 2449949)</b>									
EP070-CWG: Aromatic >C10-C12	TPHCWG-AR E1	50	µg/L	<50	750 µg/L	83.4	70	130	
EP070-CWG: Aromatic >C12-C16	TPHCWG-AR E2	50	µg/L	<50	3174 µg/L	95.2	70	130	
EP070-CWG: Aromatic >C16-C21	TPHCWG-AR E3	50	µg/L	<50	2607 µg/L	86.8	70	130	
EP070-CWG: Aromatic >C21-C35	TPHCWG-AR E4	50	µg/L	<50	606 µg/L	86.9	70	130	
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QCLot: 2450016)</b>									
EP079-CWG: Aromatic >C5-C7	----	1	µg/L	<1	20 µg/L	84.1	70	130	
EP079-CWG: Aromatic >C7-C8	TPHCWG-AR V2	2	µg/L	<2	20 µg/L	101	70	130	
EP079-CWG: Aromatic >C8-C10	TPHCWG-AR V3	2	µg/L	<2	180 µg/L	89.6	70	130	
<b>EP117: Alcohols (QCLot: 2459340)</b>									
EP117: Ethanol	64-17-5	50	µg/L	<50	100 µg/L	105	73	121	
EP117: Isopropanol	67-63-0	50	µg/L	<50	100 µg/L	103	73	113	
EP117: n-Propanol	71-23-8	50	µg/L	<50	100 µg/L	107	68	116	
EP117: Isobutanol	78-83-1	50	µg/L	<50	100 µg/L	107	67	117	
EP117: n-Butanol	71-36-3	50	µg/L	<50	100 µg/L	110	65	119	



## Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

					Matrix Spike (MS) Report		
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
					MS	Low	High
<b>ED009: Anions (QCLot: 2451265)</b>							
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	ED009-X: Bromide	24959-67-9	0.2 mg/L	# Not Determined	70	130
		ED009-X: Iodide	20461-54-5	1 mg/L	92.8	70	130
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2450176)</b>							
EM1209245-002	"Tindilpie Pad Pit Circ" Pit water prior to flowback	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	10 mg/L	106	70	130
<b>ED045G: Chloride Discrete analyser (QCLot: 2450175)</b>							
EM1209245-002	"Tindilpie Pad Pit Circ" Pit water prior to flowback	ED045G: Chloride	16887-00-6	400 mg/L	# Not Determined	70	130
<b>EG020F: Dissolved Metals by ICP-MS (QCLot: 2451813)</b>							
EM1209234-001	Anonymous	EG020A-F: Arsenic	7440-38-2	0.2 mg/L	106	89	139
		EG020A-F: Beryllium	7440-41-7	0.2 mg/L	71.3	64	138
		EG020A-F: Barium	7440-39-3	0.2 mg/L	108	80	122
		EG020A-F: Cadmium	7440-43-9	0.05 mg/L	# Not Determined	75	131
		EG020A-F: Chromium	7440-47-3	0.2 mg/L	77.9	70	130
		EG020A-F: Cobalt	7440-48-4	0.2 mg/L	# Not Determined	77	129
		EG020A-F: Copper	7440-50-8	0.2 mg/L	# Not Determined	71	127
		EG020A-F: Lead	7439-92-1	0.2 mg/L	94.0	71	123
		EG020A-F: Manganese	7439-96-5	0.2 mg/L	68.6	66	132
		EG020A-F: Nickel	7440-02-0	0.2 mg/L	# Not Determined	73	129
		EG020A-F: Vanadium	7440-62-2	0.2 mg/L	# Not Determined	70	130
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	# Not Determined	68	136
<b>EG035F: Dissolved Mercury by FIMS (QCLot: 2451815)</b>							
EM1209245-002	"Tindilpie Pad Pit Circ" Pit water prior to flowback	EG035F: Mercury	7439-97-6	0.0100 mg/L	106	70	130
<b>EK025G: Free cyanide by Discrete Analyser (QCLot: 2451312)</b>							
EM1209245-002	"Tindilpie Pad Pit Circ" Pit water prior to flowback	EK025G: Free Cyanide	----	0.2 mg/L	78.9	70	130
<b>EK026G: Total Cyanide By Discrete Analyser (QCLot: 2450067)</b>							
EB1220875-001	Anonymous	EK026G: Total Cyanide	57-12-5	0.2 mg/L	75.1	70	130
<b>EK040P: Fluoride by PC Titrator (QCLot: 2450242)</b>							
EM1209228-002	Anonymous	EK040P: Fluoride	16984-48-8	50 mg/L	106	70	130
<b>EK055G: Ammonia as N by Discrete Analyser (QCLot: 2450475)</b>							
EM1209290-003	Anonymous	EK055G: Ammonia as N	7664-41-7	0.5 mg/L	96.8	70	130

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 Client : SANTOS LTD  
 Project : HFRA Fluids Sampling - Extended Analysis



Sub-Matrix: WATER				Matrix Spike (MS) Report			
				Spike Concentration	Spike Recovery (%) MS	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number		Low	High	
<b>EK057G: Nitrite as N by Discrete Analyser (QCLot: 2450172)</b>							
EM1209229-002	Anonymous	EK057G: Nitrite as N	----	0.5 mg/L	112	70 130	
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2450473)</b>							
EM1209168-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	102	70 130	
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2450356)</b>							
EM1209230-002	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	94.1	70 130	
<b>EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2450357)</b>							
EM1209230-002	Anonymous	EK067G: Total Phosphorus as P	----	1 mg/L	109	70 130	
<b>EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2450173)</b>							
EM1209229-002	Anonymous	EK071G: Reactive Phosphorus as P	----	0.5 mg/L	114	70 130	
<b>EP005: Total Organic Carbon (TOC) (QCLot: 2450355)</b>							
EM1209171-003	Anonymous	EP005: Total Organic Carbon	----	100 mg/L	90.3	70 130	
<b>EP010: Formaldehyde (QCLot: 2450192)</b>							
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP010: Formaldehyde	50-00-0	2.5 mg/L	95.6	70 130	
<b>EP041A: Nonionic Surfactants (QCLot: 2457642)</b>							
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP041A: Nonionic Surfactants as CTAS	----	5 mg/L	# Not Determined	70 130	
<b>EP050: Anionic Surfactants as MBAS (QCLot: 2455526)</b>							
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP050: Anionic Surfactants as MBAS		1.0 mg/L	110	70 130	
<b>EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 2450015)</b>							
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP074: Benzene	71-43-2	20 µg/L	83.9	64 121	
		EP074: Toluene	108-88-3	20 µg/L	103	63 125	
<b>EP074E: Halogenated Aliphatic Compounds (QCLot: 2450015)</b>							
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP074: 1,1-Dichloroethene	75-35-4	20 µg/L	63.8	52 104	
		EP074: Trichloroethene	79-01-6	20 µg/L	83.4	59 120	
<b>EP074F: Halogenated Aromatic Compounds (QCLot: 2450015)</b>							
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP074: Chlorobenzene	108-90-7	20 µg/L	103	63 132	
<b>EP075A: Phenolic Compounds (QCLot: 2449947)</b>							
EM1209245-002	"Tindilpie Pad Pit Circ" Pit water prior to flowback	EP075: Phenol	108-95-2	10 µg/L	# Not Determined	10 51	
		EP075: 2-Chlorophenol	95-57-8	10 µg/L	# Not Determined	26.1 104	
		EP075: 2-Nitrophenol	88-75-5	10 µg/L	# Not Determined	34 118	
		EP075: 4-Chloro-3-Methylphenol	59-50-7	10 µg/L	# Not Determined	24.9 135	
		EP075: Pentachlorophenol	87-86-5	10 µg/L	# Not Determined	29.9 194	
<b>EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 2449947)</b>							

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 Project : HFRA Fluids Sampling - Extended Analysis



Sub-Matrix: WATER

				Matrix Spike (MS) Report			
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Spike	Spike Recovery (%)	Recovery Limits (%)	
				Concentration	MS	Low	High
<b>EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 2449947) - continued</b>							
EM1209245-002	"Tindilpie Pad Pit Circ" Pit water prior to flowback	EP075: Acenaphthene	83-32-9	10 µg/L	# Not Determined	27	133
		EP075: Pyrene	129-00-0	10 µg/L	# Not Determined	28.1	146
<b>EP075D: Nitrosamines (QCLot: 2449947)</b>							
EM1209245-002	"Tindilpie Pad Pit Circ" Pit water prior to flowback	EP075: N-Nitrosodi-n-propylamine	621-64-7	10 µg/L	# Not Determined	22.8	125
<b>EP075E: Nitroaromatics and Ketones (QCLot: 2449947)</b>							
EM1209245-002	"Tindilpie Pad Pit Circ" Pit water prior to flowback	EP075: 2,4-Dinitrotoluene	121-14-2	10 µg/L	# Not Determined	27.9	138
<b>EP075G: Chlorinated Hydrocarbons (QCLot: 2449947)</b>							
EM1209245-002	"Tindilpie Pad Pit Circ" Pit water prior to flowback	EP075: 1,4-Dichlorobenzene	106-46-7	10 µg/L	# Not Determined	22.1	112
		EP075: 1,2,4-Trichlorobenzene	120-82-1	10 µg/L	# Not Determined	15.3	117
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QCLot: 2449949)</b>							
EM1209245-002	"Tindilpie Pad Pit Circ" Pit water prior to flowback	EP070-CWG: Aliphatic >C10-C12	TPHCWG-AL E1	2505 µg/L	# 19.5	70	130
		EP070-CWG: Aliphatic >C12-C16	TPHCWG-AL E2	10590 µg/L	# 25.1	70	130
		EP070-CWG: Aliphatic >C16-C21	----	9345 µg/L	# 31.2	70	130
		EP070-CWG: Aliphatic >C21-C35	----	2253 µg/L	# 25.8	70	130
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QCLot: 2450016)</b>							
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP079-CWG: Aliphatic >C5-C6	----	70 µg/L	89.4	70	130
		EP079-CWG: Aliphatic >C6-C8	TPHCWG-AL V2	120 µg/L	99.6	70	130
		EP079-CWG: Aliphatic >C8-C10	TPHCWG-AL V3	120 µg/L	# 131	70	130
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QCLot: 2449949)</b>							
EM1209245-002	"Tindilpie Pad Pit Circ" Pit water prior to flowback	EP070-CWG: Aromatic >C10-C12	TPHCWG-AR E1	750 µg/L	# 33.0	70	130
		EP070-CWG: Aromatic >C12-C16	TPHCWG-AR E2	3174 µg/L	# 32.9	70	130
		EP070-CWG: Aromatic >C16-C21	TPHCWG-AR E3	2607 µg/L	# 33.2	70	130
		EP070-CWG: Aromatic >C21-C35	TPHCWG-AR E4	606 µg/L	# 25.5	70	130
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QCLot: 2450016)</b>							
EM1209245-001	"Tindilpie Pad Clean" frac make up water from pond	EP079-CWG: Aromatic >C5-C7	----	20 µg/L	73.9	70	130
		EP079-CWG: Aromatic >C7-C8	TPHCWG-AR V2	20 µg/L	97.1	70	130



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 Work Order : EM1209245  
 Client : SANTOS LTD  
 Project : HFRA Fluids Sampling - Extended Analysis



Sub-Matrix: WATER

				<i>Matrix Spike (MS) Report</i>			
<i>Laboratory sample ID</i>	<i>Client sample ID</i>	<i>Method: Compound</i>	<i>CAS Number</i>	<i>Spike</i>	<i>Spike Recovery (%)</i>	<i>Recovery Limits (%)</i>	
				<i>Concentration</i>	<i>MS</i>	<i>Low</i>	<i>High</i>
<b>EP117: Alcohols (QCLot: 2459340)</b>							
EB1221352-001	Anonymous	EP117: Ethanol	64-17-5	100 µg/L	96.7	70	130
		EP117: Isopropanol	67-63-0	100 µg/L	105	70	130
		EP117: n-Propanol	71-23-8	100 µg/L	114	70	130
		EP117: Isobutanol	78-83-1	100 µg/L	111	70	130
		EP117: n-Butanol	71-36-3	100 µg/L	108	70	130



## Environmental Division

### INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: <b>EM1209245</b>	Page	: 1 of 15
Client	: SANTOS LTD	Laboratory	: Environmental Division Melbourne
Contact	: MR BARRY RITCHIE	Contact	: Jodie Hancock
Address	: GROUND FLOOR SANTOS CENTRE 60 FLINDERS STREET ADELAIDE SA, AUSTRALIA 5001	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: barry.ritchie@santos.com	E-mail	: Jodie.Hancock@alsenviro.com
Telephone	: +61 08 8116 5000	Telephone	: +61 7 3243 7128
Facsimile	: +61 08 8116 5050	Facsimile	: +61 7 3243 7218
Project	: HFRA Fluids Sampling - Extended Analysis	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----	Date Samples Received	: 14-AUG-2012
C-O-C number	: ----	Issue Date	: 28-AUG-2012
Sampler	: TD / AJ	No. of samples received	: 2
Order number	: 879002/538	No. of samples analysed	: 2
Quote number	: EN/039/11		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

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## Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **WATER**

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis			
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
<b>EA005: pH</b>								
Clear Plastic Bottle - Natural "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	----	----	----	15-AUG-2012	13-AUG-2012	*
<b>EA006: Sodium Adsorption Ratio (SAR)</b>								
Clear Plastic Bottle - Natural "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	---	20-AUG-2012	----	16-AUG-2012	20-AUG-2012	✓
<b>EA015: Total Dissolved Solids</b>								
Clear Plastic Bottle - Natural "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	----	----	----	16-AUG-2012	20-AUG-2012	✓
<b>ED009: Anions</b>								
Clear Plastic Bottle - Natural "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	----	----	----	17-AUG-2012	10-SEP-2012	✓
<b>ED037P: Alkalinity by PC Titrator</b>								
Clear Plastic Bottle - Natural "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	---	27-AUG-2012	----	15-AUG-2012	27-AUG-2012	✓
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</b>								
Clear Plastic Bottle - Natural "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	---	10-SEP-2012	----	16-AUG-2012	10-SEP-2012	✓
<b>ED045G: Chloride Discrete analyser</b>								
Clear Plastic Bottle - Natural "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	---	10-SEP-2012	----	16-AUG-2012	10-SEP-2012	✓
<b>ED093F: Dissolved Major Cations</b>								
Clear Plastic Bottle - Natural "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	---	20-AUG-2012	----	16-AUG-2012	20-AUG-2012	✓
<b>EG020F: Dissolved Metals by ICP-MS</b>								
Clear Plastic Bottle - Natural "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	---	09-FEB-2013	----	16-AUG-2012	09-FEB-2013	✓
<b>EG035F: Dissolved Mercury by FIMS</b>								
Clear Plastic Bottle - Natural "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	---	10-SEP-2012	----	16-AUG-2012	10-SEP-2012	✓
<b>EK011: Chlorine - Free</b>								
Clear Plastic Bottle - Natural "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	----	----	----	14-AUG-2012	13-AUG-2012	*



Matrix: **WATER**

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis			
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
<b>EK025G: Free cyanide by Discrete Analyser</b>								
White Plastic Bottle-NaOH "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	16-AUG-2012	27-AUG-2012	✓	16-AUG-2012	27-AUG-2012	✓
<b>EK026G: Total Cyanide By Discrete Analyser</b>								
White Plastic Bottle-NaOH "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	27-AUG-2012	✓	15-AUG-2012	27-AUG-2012	✓
<b>EK040P: Fluoride by PC Titrator</b>								
Clear Plastic Bottle - Natural "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	---	10-SEP-2012	----	15-AUG-2012	10-SEP-2012	✓
<b>EK055G: Ammonia as N by Discrete Analyser</b>								
Clear Plastic Bottle - Sulfuric Acid "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	---	10-SEP-2012	----	16-AUG-2012	10-SEP-2012	✓
<b>EK057G: Nitrite as N by Discrete Analyser</b>								
Clear Plastic Bottle - Natural "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	---	15-AUG-2012	----	15-AUG-2012	15-AUG-2012	✓
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>								
Clear Plastic Bottle - Sulfuric Acid "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	---	10-SEP-2012	----	16-AUG-2012	10-SEP-2012	✓
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>								
Clear Plastic Bottle - Sulfuric Acid "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	16-AUG-2012	10-SEP-2012	✓	16-AUG-2012	10-SEP-2012	✓
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>								
Clear Plastic Bottle - Sulfuric Acid "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	16-AUG-2012	10-SEP-2012	✓	16-AUG-2012	10-SEP-2012	✓
<b>EK071G: Reactive Phosphorus as P by discrete analyser</b>								
Clear Plastic Bottle - Natural "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	---	15-AUG-2012	----	15-AUG-2012	15-AUG-2012	✓
<b>EP005: Total Organic Carbon (TOC)</b>								
Amber TOC Vial - Sulfuric Acid "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	----	----	----	15-AUG-2012	10-SEP-2012	✓
<b>EP010: Formaldehyde</b>								
Clear Plastic Bottle - Natural "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	----	----	----	14-AUG-2012	15-AUG-2012	✓
<b>EP041A: Nonionic Surfactants</b>								
Pres. with Formaldehyde on receipt "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	----	----	----	20-AUG-2012	10-SEP-2012	✓
<b>EP050: Anionic Surfactants as MBAS</b>								
Pres. with Formaldehyde on receipt "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	----	----	----	17-AUG-2012	17-AUG-2012	✓
<b>EP074A: Monocyclic Aromatic Hydrocarbons</b>								
Amber VOC Vial - Sulfuric Acid "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	27-AUG-2012	✓	15-AUG-2012	27-AUG-2012	✓



Matrix: **WATER**

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis			
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
<b>EP074B: Oxygenated Compounds</b>								
<b>Amber VOC Vial - Sulfuric Acid</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	27-AUG-2012	✓	15-AUG-2012	27-AUG-2012	✓
<b>EP074C: Sulfonated Compounds</b>								
<b>Amber VOC Vial - Sulfuric Acid</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	27-AUG-2012	✓	15-AUG-2012	27-AUG-2012	✓
<b>EP074D: Fumigants</b>								
<b>Amber VOC Vial - Sulfuric Acid</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	27-AUG-2012	✓	15-AUG-2012	27-AUG-2012	✓
<b>EP074E: Halogenated Aliphatic Compounds</b>								
<b>Amber VOC Vial - Sulfuric Acid</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	27-AUG-2012	✓	15-AUG-2012	27-AUG-2012	✓
<b>EP074F: Halogenated Aromatic Compounds</b>								
<b>Amber VOC Vial - Sulfuric Acid</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	27-AUG-2012	✓	15-AUG-2012	27-AUG-2012	✓
<b>EP074G: Trihalomethanes</b>								
<b>Amber VOC Vial - Sulfuric Acid</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	27-AUG-2012	✓	15-AUG-2012	27-AUG-2012	✓
<b>EP075A: Phenolic Compounds</b>								
<b>Amber Glass Bottle - Unpreserved</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	20-AUG-2012	✓	20-AUG-2012	24-SEP-2012	✓
<b>EP075B: Polynuclear Aromatic Hydrocarbons</b>								
<b>Amber Glass Bottle - Unpreserved</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	20-AUG-2012	✓	20-AUG-2012	24-SEP-2012	✓
<b>EP075C: Phthalate Esters</b>								
<b>Amber Glass Bottle - Unpreserved</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	20-AUG-2012	✓	20-AUG-2012	24-SEP-2012	✓
<b>EP075D: Nitrosamines</b>								
<b>Amber Glass Bottle - Unpreserved</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	20-AUG-2012	✓	20-AUG-2012	24-SEP-2012	✓
<b>EP075E: Nitroaromatics and Ketones</b>								
<b>Amber Glass Bottle - Unpreserved</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	20-AUG-2012	✓	20-AUG-2012	24-SEP-2012	✓
<b>EP075F: Haloethers</b>								
<b>Amber Glass Bottle - Unpreserved</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	20-AUG-2012	✓	20-AUG-2012	24-SEP-2012	✓
<b>EP075G: Chlorinated Hydrocarbons</b>								
<b>Amber Glass Bottle - Unpreserved</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	20-AUG-2012	✓	20-AUG-2012	24-SEP-2012	✓
<b>EP075H: Anilines and Benzidines</b>								
<b>Amber Glass Bottle - Unpreserved</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	20-AUG-2012	✓	20-AUG-2012	24-SEP-2012	✓



Matrix: WATER

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis			
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
<b>EP075I: Organochlorine Pesticides</b>								
<b>Amber Glass Bottle - Unpreserved</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	20-AUG-2012	✓	20-AUG-2012	24-SEP-2012	✓
<b>EP075J: Organophosphorus Pesticides</b>								
<b>Amber Glass Bottle - Unpreserved</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	20-AUG-2012	✓	20-AUG-2012	24-SEP-2012	✓
<b>EP117: Alcohols</b>								
<b>Amber VOC Vial - Sulfuric Acid</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	----	----	----	21-AUG-2012	27-AUG-2012	✓
<b>RIVM Aliphatic Hydrocarbon Fractions</b>								
<b>Amber Glass Bottle - Unpreserved</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	17-AUG-2012	20-AUG-2012	✓	21-AUG-2012	24-SEP-2012	✓
<b>Amber VOC Vial - Sulfuric Acid</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	27-AUG-2012	✓	15-AUG-2012	27-AUG-2012	✓
<b>RIVM Aromatic Hydrocarbon Fractions</b>								
<b>Amber Glass Bottle - Unpreserved</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	17-AUG-2012	20-AUG-2012	✓	21-AUG-2012	24-SEP-2012	✓
<b>Amber VOC Vial - Sulfuric Acid</b> "Tindilpie Pad Clean" - frac make up water from pond,	"Tindilpie Pad Pit Circ" - Pit water prior to flowback	13-AUG-2012	15-AUG-2012	27-AUG-2012	✓	15-AUG-2012	27-AUG-2012	✓



## Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER** Evaluation: \* = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Regular	Actual	Expected	Evaluation	
<b>Laboratory Duplicates (DUP)</b>							
Alcohols by HS-GC-MS	EP117	2	11	18.2	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Alkalinity by PC Titrator	ED037-P	2	10	20.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Ammonia as N by Discrete analyser	EK055G	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Anionic Surfactants as MBAS	EP050	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	6	16.7	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	19	10.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite B	EG020B-F	2	16	12.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	1	9	11.1	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Formaldehyde	EP010	1	2	50.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Free CN by Discrete Analyser	EK025G	1	2	50.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	3	25	12.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	16	12.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nonionic Surfactants as CTAS	EP041A	1	2	50.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
pH	EA005	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	6	16.7	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Semivolatile Organic Compounds	EP075	1	2	50.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Standard Anions -by IC (Extended Method)	ED009-X	2	13	15.4	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	6	16.7	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Cyanide By Discrete Analyser	EK026G	2	12	16.7	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	18	11.1	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	2	13	15.4	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	2	18	11.1	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Speciation (TPH CWG RIVM fractions)	EP070-CWG	1	2	50.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	1	2	50.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Organic Compounds	EP074	1	2	50.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
<b>Laboratory Control Samples (LCS)</b>							
Alcohols by HS-GC-MS	EP117	1	11	9.1	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Alkalinity by PC Titrator	ED037-P	1	10	10.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Ammonia as N by Discrete analyser	EK055G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Anionic Surfactants as MBAS	EP050	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	6	33.3	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	5.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	16	6.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	1	9	11.1	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Formaldehyde	EP010	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement



Matrix: **WATER** Evaluation: \* = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Regular	Actual	Expected	Evaluation	
<b>Analytical Methods</b>							
<b>Laboratory Control Samples (LCS) - Continued</b>							
Free CN by Discrete Analyser	EK025G	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	2	25	8.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	16	6.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nonionic Surfactants as CTAS	EP041A	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	6	16.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Semivolatile Organic Compounds	EP075	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Standard Anions -by IC (Extended Method)	ED009-X	1	13	7.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	6	16.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Cyanide By Discrete Analyser	EK026G	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	18	5.6	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	1	13	7.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	1	18	5.6	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Speciation (TPH CWG RIVM fractions)	EP070-CWG	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Organic Compounds	EP074	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
<b>Method Blanks (MB)</b>							
Alcohols by HS-GC-MS	EP117	1	11	9.1	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Ammonia as N by Discrete analyser	EK055G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Anionic Surfactants as MBAS	EP050	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	6	16.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	5.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	16	6.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	1	9	11.1	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Formaldehyde	EP010	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Free CN by Discrete Analyser	EK025G	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	2	25	8.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	16	6.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nonionic Surfactants as CTAS	EP041A	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	6	16.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Semivolatile Organic Compounds	EP075	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Standard Anions -by IC (Extended Method)	ED009-X	1	13	7.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	6	16.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Cyanide By Discrete Analyser	EK026G	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	18	5.6	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	1	13	7.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	1	18	5.6	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Speciation (TPH CWG RIVM fractions)	EP070-CWG	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement





Matrix: **WATER** Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Regular	Actual	Expected	Evaluation	
<b>Analytical Methods</b>							
<b>Method Blanks (MB) - Continued</b>							
Volatile Organic Compounds	EP074	1	2	50.0	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
<b>Matrix Spikes (MS)</b>							
Alcohols by HS-GC-MS	EP117	1	11	9.1	5.0	✔	ALS QCS3 requirement
Ammonia as N by Discrete analyser	EK055G	1	20	5.0	5.0	✔	ALS QCS3 requirement
Anionic Surfactants as MBAS	EP050	1	20	5.0	5.0	✔	ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	6	16.7	5.0	✔	ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	20	5.0	5.0	✔	ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	5.3	5.0	✔	ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	1	9	11.1	5.0	✔	ALS QCS3 requirement
Formaldehyde	EP010	1	2	50.0	5.0	✔	ALS QCS3 requirement
Free CN by Discrete Analyser	EK025G	1	2	50.0	5.0	✔	ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	16	6.3	5.0	✔	ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	20	5.0	5.0	✔	ALS QCS3 requirement
Nonionic Surfactants as CTAS	EP041A	1	2	50.0	5.0	✔	ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	6	16.7	5.0	✔	ALS QCS3 requirement
Semivolatile Organic Compounds	EP075	1	2	50.0	5.0	✔	ALS QCS3 requirement
Standard Anions -by IC (Extended Method)	ED009-X	1	13	7.7	5.0	✔	ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	6	16.7	5.0	✔	ALS QCS3 requirement
Total Cyanide By Discrete Analyser	EK026G	1	12	8.3	5.0	✔	ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	18	5.6	5.0	✔	ALS QCS3 requirement
Total Organic Carbon	EP005	1	13	7.7	5.0	✔	ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	1	18	5.6	5.0	✔	ALS QCS3 requirement
TPH Speciation (TPH CWG RIVM fractions)	EP070-CWG	1	2	50.0	5.0	✔	ALS QCS3 requirement
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	1	2	50.0	5.0	✔	ALS QCS3 requirement
Volatile Organic Compounds	EP074	1	2	50.0	5.0	✔	ALS QCS3 requirement



## Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH	EA005	WATER	APHA 21st ed. 4500 H+ B. pH of water samples is determined by ISE either manually or by automated pH meter. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Dissolved Solids (High Level)	EA015H	WATER	In-House, APHA 21st ed., 2540C A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Hardness as CaCO3	EA065	WATER	APHA 21st ed., 2340 B. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Standard Anions -by IC (Extended Method)	* ED009-X	WATER	APHA 21st ed., 4110. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Alkalinity by PC Titrator	ED037-P	WATER	APHA 21st ed., 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Major Anions - Dissolved	ED040F	WATER	APHA 21st ed., 3120. The 0.45um filtered samples are determined by ICP/AES for Sulfur and/or Silcon content and reported as Sulfate and/or Silica after conversion by gravimetric factor.
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	APHA 21st ed., 4500-SO4 Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Chloride by Discrete Analyser	ED045G	WATER	APHA 21st ed., 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	Major Cations is determined based on APHA 21st ed., 3120; USEPA SW 846 - 6010 The ICPAES technique ionises the 0.45um filtered sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)  Sodium Absorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)  Hardness parameters are calculated based on APHA 21st ed., 2340 B. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): Samples are 0.45 um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite B	EG020B-F	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): Samples are 0.45 um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.



Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Mercury by FIMS	EG035F	WATER	AS 3550, APHA 21st ed. 3112 Hg - B (Flow-injection (SnCl <sub>2</sub> )(Cold Vapour generation) AAS) Samples are 0.45 um filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl <sub>2</sub> which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Silica (Total Dissolved) by ICPAES	EG052F	WATER	APHA 21st ed., 4500-SiO <sub>2</sub> . Silica (Total) determined by calculation from Silicon by ICPAES.
Residual Chlorine by DPD Colourimetry	EK010-1 (Field)	WATER	Adapted from APHA 21st edition, 4500-Cl G, using Palintest Chlorometer 1000
Free CN by Discrete Analyser	EK025G	WATER	APHA 21st ed., 4500-CN-C&N Free Cyanide is determined on samples after distillation using a pyridine- barbituric acid colouring reagent followed with an Discrete Analyser finish. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Cyanide By Discrete Analyser	EK026G	WATER	APHA 21st ed., 4500-CN-C & N Total Cyanide is determined from aqueous solutions after distillation with sulphuric acid. The resultant distillate is then captured in a caustic absorber solution followed by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Fluoride by PC Titrator	EK040P	WATER	APHA 21st ed., 4500 F--C CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Ammonia as N by Discrete analyser	EK055G	WATER	APHA 21st ed., 4500-NH <sub>3</sub> G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrite as N by Discrete Analyser	EK057G	WATER	APHA 21st ed., 4500-NO <sub>2</sub> - B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrate as N by Discrete Analyser	EK058G	WATER	APHA 21st ed., 4500-NO <sub>3</sub> - F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrite and Nitrate as N (NO <sub>x</sub> ) by Discrete Analyser	EK059G	WATER	APHA 21st ed., 4500-NO <sub>3</sub> - F. Combined oxidised Nitrogen (NO <sub>2</sub> +NO <sub>3</sub> ) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	APHA 21st ed., 4500-Norg D. 25mL water samples are digested using a traditional Kjeldahl digestion followed by determination by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	APHA 21st ed., 4500-Norg / 4500-NO <sub>3</sub> -. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	APHA 21st ed., 4500-P B&F This procedure involves sulphuric acid digestion of a 100mL sample to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	APHA 21st ed., 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with orthophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Ionic Balance by PCT DA and Turbi SO <sub>4</sub> DA	EN055 - PG	WATER	APHA 21st Ed. 1030F. The Ionic Balance is calculated based on the major Anions and Cations. The major anions include Alkalinity, Chloride and Sulfate which determined by PCT and DA. The Cations are determined by Turbi SO <sub>4</sub> by DA. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Organic Carbon	EP005	WATER	APHA 21st ed., 5310 B, The automated TOC analyzer determines Total and Inorganic Carbon by IR cell. TOC is calculated as the difference. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)



Analytical Methods	Method	Matrix	Method Descriptions
Formaldehyde	EP010	WATER	In-house (ASTM D 6303-98) Determined by colourimetry using NASH reagent. The Hantzsch reaction method is based on the reaction of acetylacetone with formaldehyde in the presence of excess ammonium acetate to form a coloured compound.
Nonionic Surfactants as CTAS	EP041	WATER	APHA 21st ed., 5540 B & D This method estimates the non-ionic surfactant content of waters. Sublation transfers all surfactants into a solvent matrix. Cationic and Anionic surfactants are removed by an ion exchange resin column. The remaining surfactant is coloured up with Cobalt Thiocyanate solution and quantified by UV-vis against LAS standards. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nonionic Surfactants as CTAS	EP041A	WATER	APHA 21st ed., 5540 B & D This method estimates the non-ionic surfactant content of waters. Sublation transfers all surfactants into a solvent matrix. Cationic and Anionic surfactants are removed by an ion exchange resin column. The remaining surfactant is coloured up with Cobalt Thiocyanate solution and quantified by UV-vis against LAS standards. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Anionic Surfactants as MBAS	EP050	WATER	APHA 21st ed., 5540 B & C This method comprises three successive extractions from acid aqueous medium containing excess methylene blue, into chloroform, followed by an aqueous backwash and measurement of the colour by spectrophotometry at 652nm. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
TPH Speciation (TPH CWG RIVM fractions)	EP070-CWG	WATER	In-house: Determination of TPH following fractionation by GC-FID. Fractions correspond to those outlined in TPHCWG, 1998, Analysis of Petroleum Hydrocarbons in Environmental Media, TPH Criteria Working Group, Toxicity Technical Action Group, vol I and RIVM report 601501021/2004, Environmental Risk Limits for Mineral Oil (Total Petroleum Hydrocarbons). Aliphatic >C21 - C35 is defined by RIVM only.
Volatile Organic Compounds	EP074	WATER	USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Semivolatile Organic Compounds	EP075	WATER	USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	WATER	In-house. Conventional TPH and MAH data are determined by Purge and Trap GCMS analysis. TIC data (as fractions) and target aromatics (or groups of aromatics) are used to compute aliphatic and aromatic hydrocarbon fractions by addition or difference. Fractions conform to those outlined in TPHCWG, 1998, Analysis of Petroleum Hydrocarbons in Environmental Media, TPH Criteria Working Group, Toxicity Technical Action Group, vol I and RIVM report 601501021/2004, Environmental Risk Limits for Mineral Oil (Total Petroleum Hydrocarbons)
Alcohols by HS-GC-MS	* EP117	WATER	In House. A 10 mL aliquot of sample is mixed with 4 g of sodium chloride, equilibrated at 80 degrees C for 10 minutes and the headspace analysed by GCMS in the selected ion monitoring mode.
Preparation Methods	Method	Matrix	Method Descriptions
Free Cyanide	EK025-PR	WATER	APHA 21st ed., 4500 CN- C&N. The sample is distilled at natural pH. The CN is trapped in a caustic solution, and quantified by colourimetry on FIA. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Cyanide	EK026-PR	WATER	APHA 21st ed., 4500 CN- C&N. The sample is distilled with H2SO4 releasing all bound cyanides as HCN. The CN is trapped in a caustic solution, and quantified by colourimetry on FIA. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
TKN/TP Digestion	EK061/EK067	WATER	APHA 21st ed., 4500 Norg - D; APHA 21st ed., 4500 P - H. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Separatory Funnel Extraction of Liquids	ORG14	WATER	USEPA SW 846 - 3510B 500 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2). ALS default excludes sediment which may be resident in the container.

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Work Order : EM1209245  
Client : SANTOS LTD  
Project : HFRA Fluids Sampling - Extended Analysis



<i>Preparation Methods</i>	<i>Method</i>	<i>Matrix</i>	<i>Method Descriptions</i>
Separatory Funnel Extraction of Liquids	ORG14-HX	WATER	Variation of USEPA SW 846 - 3510B: 500 mL to 0.5L of sample is transferred to a separatory funnel and serially extracted three times using 30mL DCM for each extract. The resultant extracts are combined, dehydrated, and exchanged into 5 mL of hexane for analysis. ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for sparging.



## Summary of Outliers

### Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

#### Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
<b>Laboratory Control Spike (LCS) Recoveries</b>							
EP074D: Fumigants	2903282-001	----	<b>cis-1.3-Dichloropropylene</b>	10061-01-5	68.4 %	70-118%	<b>Recovery less than lower control limit</b>
EP074D: Fumigants	2903282-001	----	<b>trans-1.3-Dichloropropylene</b>	10061-02-6	60.9 %	66-120%	<b>Recovery less than lower control limit</b>
EP074E: Halogenated Aliphatic Compounds	2903282-001	----	<b>1.1-Dichloroethene</b>	75-35-4	127 %	71-125%	<b>Recovery greater than upper control limit</b>
EP074E: Halogenated Aliphatic Compounds	2903282-001	----	<b>1.1-Dichloroethane</b>	75-34-3	122 %	77-121%	<b>Recovery greater than upper control limit</b>
EP075D: Nitrosamines	2903208-001	----	<b>Methapyrilene</b>	91-80-5	22.0 %	28.1-70%	<b>Recovery less than lower control limit</b>
EP075E: Nitroaromatics and Ketones	2903208-001	----	<b>2-Picoline</b>	109-06-8	12.4 %	28.4-57%	<b>Recovery less than lower control limit</b>
EP075G: Chlorinated Hydrocarbons	2903208-001	----	<b>1.4-Dichlorobenzene</b>	106-46-7	114 %	23-109%	<b>Recovery greater than upper control limit</b>
<b>Matrix Spike (MS) Recoveries</b>							
ED009: Anions	EM1209245-001	"Tindilpie Pad Clean" frac make	<b>Bromide</b>	24959-67-9	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
ED045G: Chloride Discrete analyser	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>Chloride</b>	16887-00-6	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
EG020F: Dissolved Metals by ICP-MS	EM1209234-001	Anonymous	<b>Cadmium</b>	7440-43-9	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
EG020F: Dissolved Metals by ICP-MS	EM1209234-001	Anonymous	<b>Cobalt</b>	7440-48-4	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
EG020F: Dissolved Metals by ICP-MS	EM1209234-001	Anonymous	<b>Copper</b>	7440-50-8	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
EG020F: Dissolved Metals by ICP-MS	EM1209234-001	Anonymous	<b>Nickel</b>	7440-02-0	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
EG020F: Dissolved Metals by ICP-MS	EM1209234-001	Anonymous	<b>Vanadium</b>	7440-62-2	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
EG020F: Dissolved Metals by ICP-MS	EM1209234-001	Anonymous	<b>Zinc</b>	7440-66-6	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
EP041A: Nonionic Surfactants	EM1209245-001	"Tindilpie Pad Clean" frac make	<b>Nonionic Surfactants as CTAS</b>	----	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>



Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
<b>Matrix Spike (MS) Recoveries - Continued</b>							
EP075A: Phenolic Compounds	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>Phenol</b>	108-95-2	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
EP075A: Phenolic Compounds	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>2-Chlorophenol</b>	95-57-8	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP075A: Phenolic Compounds	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>2-Nitrophenol</b>	88-75-5	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP075A: Phenolic Compounds	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>4-Chloro-3-Methylphenol</b>	59-50-7	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP075A: Phenolic Compounds	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>Pentachlorophenol</b>	87-86-5	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP075B: Polynuclear Aromatic Hydrocarbons	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>Acenaphthene</b>	83-32-9	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP075B: Polynuclear Aromatic Hydrocarbons	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>Pyrene</b>	129-00-0	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP075D: Nitrosamines	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>N-Nitrosodi-n-propylamine</b>	621-64-7	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP075E: Nitroaromatics and Ketones	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>2,4-Dinitrotoluene</b>	121-14-2	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP075G: Chlorinated Hydrocarbons	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>1,4-Dichlorobenzene</b>	106-46-7	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP075G: Chlorinated Hydrocarbons	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>1,2,4-Trichlorobenzene</b>	120-82-1	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>Aliphatic &gt;C10-C12</b>	TPHCWG-ALE1	19.5 %	70-130%	<b>Recovery less than lower data quality objective</b>
EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>Aliphatic &gt;C12-C16</b>	TPHCWG-ALE2	25.1 %	70-130%	<b>Recovery less than lower data quality objective</b>
EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>Aliphatic &gt;C16-C21</b>	----	31.2 %	70-130%	<b>Recovery less than lower data quality objective</b>
EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>Aliphatic &gt;C21-C35</b>	----	25.8 %	70-130%	<b>Recovery less than lower data quality objective</b>
EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions	EM1209245-001	"Tindilpie Pad Clean" frac make	<b>Aliphatic &gt;C8-C10</b>	TPHCWG-ALV3	131 %	70-130%	<b>Recovery greater than upper data quality objective</b>
EP079/070: TPH CWG Aromatic Hydrocarbon Fractions	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>Aromatic &gt;C10-C12</b>	TPHCWG-ARE1	33.0 %	70-130%	<b>Recovery less than lower data quality objective</b>
EP079/070: TPH CWG Aromatic Hydrocarbon Fractions	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>Aromatic &gt;C12-C16</b>	TPHCWG-ARE2	32.9 %	70-130%	<b>Recovery less than lower data quality objective</b>
EP079/070: TPH CWG Aromatic Hydrocarbon Fractions	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>Aromatic &gt;C16-C21</b>	TPHCWG-ARE3	33.2 %	70-130%	<b>Recovery less than lower data quality objective</b>
EP079/070: TPH CWG Aromatic Hydrocarbon Fractions	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>Aromatic &gt;C21-C35</b>	TPHCWG-ARE4	25.5 %	70-130%	<b>Recovery less than lower data quality objective</b>

- For all matrices, no Method Blank value outliers occur.
- For all matrices, no Duplicate outliers occur.



### Regular Sample Surrogates

Sub-Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
<b>Samples Submitted</b>							
EP075S: Acid Extractable Surrogates	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>2-Fluorophenol</b>	367-12-4	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>Phenol-d6</b>	13127-88-3	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>2-Chlorophenol-D4</b>	93951-73-6	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>2,4,6-Tribromophenol</b>	118-79-6	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>Nitrobenzene-D5</b>	4165-60-0	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>1,2-Dichlorobenzene-D4</b>	2199-69-1	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>2-Fluorobiphenyl</b>	321-60-8	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>Anthracene-d10</b>	1719-06-8	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1209245-002	"Tindilpie Pad Pit Circ" Pit water	<b>4-Terphenyl-d14</b>	1718-51-0	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences

### Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

Matrix: **WATER**

Method	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
<b>EA005: pH</b>						
<b>Clear Plastic Bottle - Natural</b> "Tindilpie Pad Clean" - frac make up water from pond, "Tindilpie Pad Pit Circ" - Pit water prior to flowback	----	----	----	15-AUG-2012	13-AUG-2012	2
<b>EK011: Chlorine - Free</b>						
<b>Clear Plastic Bottle - Natural</b> "Tindilpie Pad Clean" - frac make up water from pond, "Tindilpie Pad Pit Circ" - Pit water prior to flowback	----	----	----	14-AUG-2012	13-AUG-2012	1

### Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- **No Quality Control Sample Frequency Outliers exist.**





# CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐ Sydney: 271 Woodbank Rd, Smithfield NSW 2178  
Ph: 02 834 9525 E: samples.sydney@alsenviro.com

☐ Brisbane: 32 Strand St, Stafford QLD 4053  
Ph: 07 3243 7322 E: samples.brisbane@alsenviro.com

☐ Melbourne: 2-4 Vernal Rd, Springvale VIC 3171  
Ph: 03 8540 9600 E: samples.melbourne@alsenviro.com

☐ Perth: 10 Hod Way, Malaga WA 6000  
Ph: 08 9206 7955 E: samples.perth@alsenviro.com

☐ Newcastle: 5 Roseglen Rd, Warabook NSW 2304  
Ph: 02 4676 9433 E: samples.newcastle@alsenviro.com


☐ Townsville: 14-15 Desma Ct, Esplanade QLD 4818  
Ph: 07 4726 0500 E: samples.townsville@alsenviro.com

☐ Adelaide: 2-1 Burma Rd, Pooraka SA 5005  
Ph: 08 8349 0590 E: samples.adelaide@alsenviro.com

☐ Launceston: 27 Wellington St, Launceston TAS 7250  
Ph: 03 0331 2158 E: samples.launceston@alsenviro.com

<b>CLIENT:</b> SANTOS	<b>TURNAROUND REQUIREMENTS:</b> <input checked="" type="checkbox"/> Standard TAT (List due date):	<b>FOR LABORATORY USE ONLY (Circle)</b> Custody Seal Intact? <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A Frac/ice / freezing / etc. present upon receipt? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A Random Sample Temperature on Receipt: <input type="checkbox"/> No <input type="checkbox"/> Yes Other comment: <b>130-135</b>
<b>OFFICE:</b> Eastern Australia D&C, 80 Flinders Street, Adelaide SA	(Standard TAT may be longer for some tests e.g., Ultra Trace Organics) <input type="checkbox"/> Non Standard or urgent TAT (List due date):	
<b>PROJECT:</b> HFRA Fluids Sampling - Extended Analysis	<b>ALS QUOTE NO.:</b> EN/039/11	<b>COC SEQUENCE NUMBER (Circle)</b>
<b>ORDER NUMBER:</b> 878002/538	<b>CONTACT PH:</b> 8116	<b>COC:</b> <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7
<b>PROJECT MANAGER:</b> Barry Ritchie	<b>SAMPLER MOBILE:</b> 0421312739	<b>OF:</b> <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7
<b>SAMPLER:</b> Tom Delaney / Andrew Johnston	<b>RELINQUISHED BY:</b> Tom Delaney	<b>RECEIVED BY:</b> <b>Resmond</b>
<b>COC emailed to ALS? ( YES / NO )</b>	<b>EDD FORMAT (or default):</b>	<b>DATE/TIME:</b> 13/8/12 8:30
<b>Email Reports to (will default to PM if no other addresses are listed):</b> andrew.johnston@santos.com; frac.rig.rep.completions@santos.com; barry.ritchie@santos.com; thomas.delaney@santos.com		<b>DATE/TIME:</b>
<b>Email Invoice to (will default to PM if no other addresses are listed):</b> barry.ritchie@santos.com		<b>DATE/TIME:</b>

**COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:** Dissolved Metals Required are W-3 + Fe, Se, B, Sr, Al, Mo, Sn, U, I *Samples received 14/8/12 08:50*

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).							Additional Information		
	LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	EA005, EA015H, EK011	NT-1B, NT-2A, NT-6A	EG052, ENO65-DA, ED009X	EA065, EK025, EK026, EP005	W-3 and EG020F (See Additional Info)	EP117, TRH-CWG		EP074A-H, EP075	EP010, EP050, EP041
1	"Tindipie Pad Clean" - frac make up water from pond	13/8/12 0800	W	1L plastic / green; 60ml plastic green; 125ml plastic purple; 60ml plastic blue; 40ml vial purple; 60ml plastic red; 2 x 40ml vial purple; 3x 100ml glass orange; 2 x 40ml amber glass maroon; 3 x 100ml glass orange; 2 x 500ml amber brown;	18	X	X	X	X	X	X	X	X	X	Sample taken from Frac Fluid at Tindipie Pad Wellister clean fluid pond prior to treatment. Dissolved Metals Required are W-3 + Fe, Se, B, Sr, Al, Mo, Sn, U, Li
2	"Tindipie Pad Pit Circ" - Pit water prior to flowback	13/8/12 0730	W	1L plastic / green; 60ml plastic green; 125ml plastic purple; 60ml plastic blue; 40ml vial purple; 60ml plastic red; 2 x 40ml vial purple; 3x 100ml glass orange; 2 x 40ml amber glass maroon; 3 x 100ml glass orange; 2 x 500ml amber brown;	18	X	X	X	X	X	X	X	X	X	Sample taken from Frac Fluid at Tindipie Pad Welliste pit after coil tubing clean outs have occurred prior to flowback. Dissolved Metals Required are W-3 + Fe, Se, B, Sr, Al, Mo, Sn, U, Li
															<p style="text-align: center;">Environmental Division Melbourne Work Order <b>EM1209245</b></p>  <p>Telephone : +61-3-8549 9600</p>

Samples sent to lab for  
Micro Nitrate BOD pH  
Colour Turbidity RP  
Other Nitrate  
Date 14-8-12 4:30pm

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



## CHAIN OF CUSTODY

ALS Laboratory: please tick à

CLIENT:	SANTOS	TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)	<input checked="" type="checkbox"/> Standard TAT (List due date):
OFFICE:	Eastern Australia D&C, 60 Flinders Street, Adelaide SA		<input type="checkbox"/> Non Standard or urgent TAT (Li

<b>PROJECT:</b>	HFRA Fluids Sampling - Extended Analysis	<b>ALS QUOTE NO.:</b>	EN/039/11
<b>ORDER NUMBER:</b>	879002/538		
<b>PROJECT MANAGER:</b>	Barry Ritchie	<b>CONTACT PH:</b>	8116
<b>SAMPLER:</b>	Tom Delaney / Andrew Johnston	<b>SAMPLER MOBILE:</b>	0421312739
<b>COC emailed to ALS? ( YES / NO)</b>		<b>EDD FORMAT (or default):</b>	
<b>Email Reports to</b> (will default to PM if no other addresses are listed): andrew.johnston@santos.com; frac.rig.rep.completions@santos.com; barry.ritchie@santos.com; thomas.delaney@santos.com			<b>RELINQUISHED BY:</b> Tom Delaney
<b>Email Invoice to</b> (will default to PM if no other addresses are listed): barry.ritchie@santos.com			<b>DATE/TIME:</b> 13/8/12 8:30

**COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:** Dissolved Metals Required are W-3 + Fe, Se, B, Sr, Al, Mo, Sn, U, Li

ALS USE ONLY	SAMPLE DETAILS			CONTAINER INFORMATION		Al
	MATRIX: Solid(S) Water(W)					
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE <i>(refer to codes below)</i>	TOTAL BOTTLES	EA005, EA015H, EK011

	<p>"Tindilpie Pad Clean" - frac make up water from pond</p>	<p>13/8/12 0800</p>	<p>w</p>	<p>1L plastic / green; 60ml plastic green; 125ml plastic purple; 60ml plastic blue; 40ml vial purple; 60ml plastic red; 2 x 40ml vial purple; 3x 100ml glass orange; 2 x 40ml amber glass maroon; 3 x 100ml glass orange; 2 x 500ml amber brown;</p>	<p>18</p>	<p>X</p>
	<p>"Tindilpie Pad Pit Circ" - Pit water prior to flowback</p>	<p>13/8/12 0730</p>	<p>w</p>	<p>1L plastic / green; 60ml plastic green; 125ml plastic purple; 60ml plastic blue; 40ml vial purple; 60ml plastic red; 2 x 40ml vial purple; 3x 100ml glass orange; 2 x 40ml amber glass maroon; 3 x 100ml glass orange; 2 x 500ml amber brown;</p>	<p>18</p>	<p>X</p>

						<b>TOTAL</b>	<b>36</b>

**Water Container Codes:** P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; A V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl pre Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

**Ranil Weerakkody**

---

**From:** Delaney, Thomas [Thomas.Delaney@santos.com]  
**Sent:** Monday, 13 August 2012 8:57 AM  
**To:** Samples Melbourne; Kieren Burns  
**Cc:** Johnston, Andrew  
**Subject:** Fwd: Environmental Visitation - Frac Spread, Tindilpie  
**Attachments:** Santos\_-\_Tindilpie\_PAD\_-\_Frac\_Fluid\_Sample\_-\_HFRA\_Analysis\_Aug\_2012(1).xlsx; ATT00001.htm

Als,  
There will be 2 sets of 18 samples in a blue esky arriving at you Melbourne Lab sometime soon - these were taken this morning and should be flying over there this afternoon. See attached for the COC which is included in the package.

Any queries call my mobile.

Thanks

Tom Delaney  
0421312739

Begin forwarded message:

From: Thomas Delaney <thomas.j.delaney@gmail.com<mailto:thomas.j.delaney@gmail.com>>  
Date: 12 August 2012 4:30:35 PM ACST  
To: "Delaney, Thomas" <thomas.delaney@santos.com<mailto:thomas.delaney@santos.com>>  
Subject: Re: FW: Environmental Visitation - Frac Spread, Tindilpie  
samples.melbourne@alsenviro.com<mailto:samples.melbourne@alsenviro.com>;  
Kieren.burns@alsglobal.com<mailto:Kieren.burns@alsglobal.com>;

On Sat, Aug 11, 2012 at 5:19 PM, Delaney, Thomas  
<Thomas.Delaney@santos.com<mailto:Thomas.Delaney@santos.com>> wrote:

From: Delaney, Thomas  
Sent: Saturday, 11 August 2012 17:19  
To: Completions, Frac Rig Rep  
Subject: Fw: Environmental Visitation - Frac Spread, Tindilpie  
Importance: High

Hey Jeff - any chance you can print these out for me? Just the email and attached chain of custody forms when you get a chance. Thivanka wants me to sort this out with Mr PIC to get it into Moomba by Monday morning - so want to have a read and get our head around it.

Cheers mate  
TD

-----  
Kind regards,

Tom Delaney | Subsurface Lead  
Cooper Basin SIMOPS - EA Drilling & Completions | Santos Limited Ph +61 8 8116  
5358<tel:%2B61%208%208116%C2%A05358> | Fax +61 8 8116 7755<tel:%2B61%208%208116%207755> |  
Mob: +61 421 312 739<tel:%2B61%C2%A0421%20312%20739> |  
thomas.delaney@santos.com<mailto:thomas.delaney@santos.com>

Level 8, Santos Centre, 60 Flinders Street, Adelaide SA 5000 | GPO Box 2455, Adelaide SA 5001 Santos

From: Dedigama, Thivanka  
Sent: Wednesday, 8 August 2012 12:11  
To: Japp, Kenneth; Delaney, Thomas  
Cc: Best, William  
Subject: FW: Environmental Visitation - Frac Spread, Tindilpie  
Importance: High

Hi Ken and Tom,

Here's one that's going to be interesting. Please review the email below. Only wanted to give you a heads-up on what coming. Don't collect samples yet.

This has previously been communicated to Mark and Paul but I'd like you to take the Lead on this for Tindilpie.

For now could you please:

1. Review this and see if you have and EHS or operational concerns about this sampling
2. Locate the cool box, ice packs and 3 x 18 bottles that already supposed to be out there

If you can't find these we have another set coming

3. Locate the 'swing sampler' referred to below. No idea what this looks like. Mark may know.
4. Review the attached CoC form. Some changes will need to be made to update names etc.

I am in the process of getting approval for these samples to fly. Also need to work out with our logistics guys how best that can be rushed to Melbourne for testing. Should have answers in a couple of days.

The sampling that Bill Best did yesterday should get us out of trouble for this pad. This is more a longer term thing.

Thivanka Dedigama  
Deputy Field Superintendent - Drilling and Petroleum Engineering  
Tel: 08 8678 4191<tel:08%208678%204191>  
Mob: 0431 375 187<tel:0431%20375%20187>

From: Johnston, Andrew  
Sent: Wednesday, 8 August 2012 09:06  
To: Dedigama, Thivanka; Ritchie, Barry  
Cc: Johnston, Andrew; Swann, Louise; Best, William; Smith, Chris  
Subject: FW: Environmental Visitation - Frac Spread, Tindilpie  
Importance: High

Thivanka,

A proposed schedule for the HFRA sampling is below, I have received no feedback as yet so I suggest we run with it, unless some FR or Frac fluid samples overlap? If this is the case please advise in which case maybe 4 samples in total.

A water sample representing influent stream in considered essential. We picked up some unexpected contaminants in the SWQ samples (Coonaberry 3) that may have been present in the bore water being used. This data can be used to give us an indication of quality prior to addition of frac chemicals, or reservoir constituents from flowback. The procedure for collection of this could be applying the same methodology as per below, but taking from the Turkey's Nest or similar storage of influent water.

Sample Collection procedure / COC is as follows:

Pre sampling

- Place cooler blocks in freezer the day before sample collection – these are located in esky from ALS

- Use of ALS supplied bottles (as per attached COC) is essential. Once obtained, label each bottle (18 make a full "sample) with Sample ID, sampler name, date time etc, and ensure this is consistent with updated COC (example attached – note this needs amending to suit this and other events)

- Aim to collect sample early in the day, and despatch via Airfreight that day for minimum lab turnaround time

On the day

- Make sure disposable gloves are worn, and other PPE also
- Take care when standing near pit, and choose a steady location

- The "swing" sampler is located at the frac spread, and there are specific sample containers that fit this apparatus. Ensure a clean sampling container (500ml) is fitted for each sampling event (an "event" requiring 18 sub samples – you don't need 18 separate sampling containers!)

- Using sampler, extract sample from approximately 10cm below surface of the fluid. Repeat and purge 3x

- From then, fill all 18 sample containers to the top with fluids collected in a similar manner to above. Aim to lay off air bubbles so as to minimise voids when lids are placed on. Places these containers into bubble wrap and straight into esky with cooler blocks present.

- Record any field observations, such as HC sheen present, presence of condensate, and approximate volume in pit at the time of sample collection directly onto the COC in the final column. Stage of frac operations would be valuable information also.

- Update COC electronically, as this needs to be both emailed to ALS and also printed off and placed inside the esky prior to despatch. Ensure info on sample containers is entirely consistent with info on COC, otherwise ALS will note this and contact us for clarification

- Seal up esky with completed COC and all containers using labels supplied by ALS
- Either clean thoroughly or discard used 500ml sample container as this must not be used for subsequent collection events (to prevent cross contamination)
- Dispose of gloves appropriately also





## Environmental Division

### CERTIFICATE OF ANALYSIS

Work Order	: <b>EM1209924</b>	Page	: 1 of 14
Amendment	: <b>1</b>		
Client	: <b>SANTOS LTD</b>	Laboratory	: Environmental Division Melbourne
Contact	: MR BARRY RITCHIE	Contact	: Jodie Hancock
Address	: GROUND FLOOR SANTOS CENTRE 60 FLINDERS STREET ADELAIDE SA, AUSTRALIA 5001	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: barry.ritchie@santos.com	E-mail	: Jodie.Hancock@alsenviro.com
Telephone	: +61 08 8116 5000	Telephone	: +61 7 3243 7128
Facsimile	: +61 08 8116 5050	Facsimile	: +61 7 3243 7218
Project	: HFRA Fluids Sampling - Extended Analysis	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: 879002/538		
C-O-C number	: ----	Date Samples Received	: 28-AUG-2012
Sampler	: BC/AJ	Issue Date	: 12-SEP-2012
Site	: ----		
Quote number	: EN/039/11	No. of samples received	: 1
		No. of samples analysed	: 1

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits



## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

- (11/09/2012) This report has been amended following changes to anonymous quality control samples attached to this analytical data reported. All analysis results are as per the previous report.
- Alcohols, Bromide, Iodide, MBAS & CTAS analysis conducted by ALS Sydney, NATA accreditation no. 825, site no 10911.
- EG035F positive mercury result has been confirmed for EM1209924#1 by re-preparation and re-analysis.
- EK025G: Free cyanide was analysed by Segmented Flow analyser Method (EK025SF).
- EK026G: Total cyanide was analysed by Segmented Flow analyser Method (EK026SF).
- EK059G : EM1209937-001 matrix spike failed for Nitrite and Nitrate as N due to possible sample matrix interference. This has been confirmed by re-digestion and re-analysis.
- EK059G:Nitrite and Nitrate as N was analysed by NOX Vanadium Chloride Method (EK059GV).
- EP050: The MBAS reported is calculated as LAS, mol wt 342
- EP074/079-CWG: Particular sample (EM-1209924-001) required dilution due to the presence of high level contaminants. LOR values have been adjusted accordingly.
- EP075: EM1209924-001 Particular sample required dilution prior to analysis due to matrix interferences. LOR values have been adjusted accordingly.
- EP075: LOR raised for Di-n-butylphthalate due to laboratory background.
- EP075: Matrix spike not determined due to matrix interferences.
- EP075: 'Sum of PAH' is the sum of the USEPA 16 priority PAHs
- EP117: Matrix spike recovery bias low due to sample matrix interferences.
- EP117: Particular samples required dilution due to the presence of high level contaminants. LOR values have been adjusted accordingly.
- Ionic Balance out of acceptable limits due to analytes not quantified in this report.
- Ionic balances were calculated using: major anions - chloride, alkalinity and sulfate; and major cations - calcium, magnesium, potassium and sodium.
- It is recognised that Nitrite + Nitrate as N is less than Nitrite as N for EM1209924 #1. However, the difference is within experimental variation of the methods.



NATA Accredited Laboratory 825

Accredited for compliance with  
ISO/IEC 17025.

### *Signatories*

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics
Eric Chau	Metals Team Leader	Melbourne Inorganics
Hoa Nguyen	Inorganic Chemist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Sarah Millington	Senior Inorganic Chemist	Sydney Inorganics
Varsha Ho Wing	Non-Metals Team Leader	Melbourne Inorganics
Xingbin Lin	Senior Organic Chemist	Melbourne Organics



## Analytical Results

Sub-Matrix: **WATER**

Client sample ID

				Tindilpie Pad Pit Flowback frac pit water post flowback	---	---	---	---
				27-AUG-2012 06:15	---	---	---	---
Compound	CAS Number	LOR	Unit	EM1209924-001	---	---	---	---
<b>EA005: pH</b>								
pH Value	---	0.01	pH Unit	7.46	---	---	---	---
<b>EA006: Sodium Adsorption Ratio (SAR)</b>								
Sodium Adsorption Ratio	---	0.01	-	105	---	---	---	---
<b>EA015: Total Dissolved Solids</b>								
Total Dissolved Solids @180°C	GIS-210-010	10	mg/L	10100	---	---	---	---
<b>EA065: Total Hardness as CaCO3</b>								
Total Hardness as CaCO3	---	1	mg/L	135	---	---	---	---
<b>ED009: Anions</b>								
Bromide	24959-67-9	0.010	mg/L	16.7	---	---	---	---
Iodide	20461-54-5	0.010	mg/L	1.29	---	---	---	---
<b>ED037P: Alkalinity by PC Titrator</b>								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	---	---	---	---
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	---	---	---	---
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	2150	---	---	---	---
Total Alkalinity as CaCO3	---	1	mg/L	2150	---	---	---	---
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</b>								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	22	---	---	---	---
<b>ED045G: Chloride Discrete analyser</b>								
Chloride	16887-00-6	1	mg/L	3710	---	---	---	---
<b>ED093F: Dissolved Major Cations</b>								
Calcium	7440-70-2	1	mg/L	41	---	---	---	---
Magnesium	7439-95-4	1	mg/L	8	---	---	---	---
Sodium	7440-23-5	1	mg/L	2810	---	---	---	---
Potassium	7440-09-7	1	mg/L	83	---	---	---	---
<b>EG020F: Dissolved Metals by ICP-MS</b>								
Aluminium	7429-90-5	0.01	mg/L	0.09	---	---	---	---
Arsenic	7440-38-2	0.001	mg/L	0.182	---	---	---	---
Barium	7440-39-3	0.001	mg/L	31.6	---	---	---	---
Beryllium	7440-41-7	0.001	mg/L	<0.001	---	---	---	---
Cadmium	7440-43-9	0.0001	mg/L	0.0001	---	---	---	---
Cobalt	7440-48-4	0.001	mg/L	0.006	---	---	---	---
Chromium	7440-47-3	0.001	mg/L	<0.001	---	---	---	---
Copper	7440-50-8	0.001	mg/L	0.061	---	---	---	---



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

				Tindilpie Pad Pit Flowback frac pit water post flowback	---	---	---	---
				27-AUG-2012 06:15	---	---	---	---
Compound	CAS Number	LOR	Unit	EM1209924-001	---	---	---	---
<b>EG020F: Dissolved Metals by ICP-MS - Continued</b>								
Manganese	7439-96-5	0.001	mg/L	2.68	---	---	---	---
Nickel	7440-02-0	0.001	mg/L	0.028	---	---	---	---
Lead	7439-92-1	0.001	mg/L	0.088	---	---	---	---
Vanadium	7440-62-2	0.01	mg/L	0.02	---	---	---	---
Zinc	7440-66-6	0.005	mg/L	0.052	---	---	---	---
Lithium	7439-93-2	0.001	mg/L	2.58	---	---	---	---
Molybdenum	7439-98-7	0.001	mg/L	0.020	---	---	---	---
Selenium	7782-49-2	0.01	mg/L	<0.01	---	---	---	---
Strontium	7440-24-6	0.001	mg/L	1.70	---	---	---	---
Tin	7440-31-5	0.001	mg/L	<0.001	---	---	---	---
Uranium	7440-61-1	0.001	mg/L	<0.001	---	---	---	---
Boron	7440-42-8	0.05	mg/L	57.9	---	---	---	---
Iron	7439-89-6	0.05	mg/L	15.6	---	---	---	---
<b>EG035F: Dissolved Mercury by FIMS</b>								
Mercury	7439-97-6	0.0001	mg/L	0.0005	---	---	---	---
<b>EG052F: Dissolved Silica by ICPAES</b>								
Silica	7631-86-9	0.1	mg/L	12.6	---	---	---	---
<b>EK011: Chlorine - Free</b>								
Free Chlorine	---	0.02	mg/L	0.30	---	---	---	---
<b>EK025G: Free cyanide by Discrete Analyser</b>								
Free Cyanide	---	0.004	mg/L	<0.004	---	---	---	---
<b>EK026G: Total Cyanide By Discrete Analyser</b>								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	---	---	---	---
<b>EK040P: Fluoride by PC Titrator</b>								
Fluoride	16984-48-8	0.1	mg/L	1.8	---	---	---	---
<b>EK055G: Ammonia as N by Discrete Analyser</b>								
Ammonia as N	7664-41-7	0.01	mg/L	55.4	---	---	---	---
<b>EK057G: Nitrite as N by Discrete Analyser</b>								
Nitrite as N	---	0.01	mg/L	0.05	---	---	---	---
<b>EK058G: Nitrate as N by Discrete Analyser</b>								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	---	---	---	---
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>								



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

				Tindilpie Pad Pit Flowback frac pit water post flowback	---	---	---	---
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Compound	CAS Number	LOR	Unit	EM1209924-001	---	---	---	---
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued</b>								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	---	---	---	---
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	166	---	---	---	---
<b>EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser</b>								
Total Nitrogen as N	----	0.1	mg/L	166	---	---	---	---
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>								
Total Phosphorus as P	----	0.01	mg/L	2.22	---	---	---	---
<b>EK071G: Reactive Phosphorus as P by discrete analyser</b>								
Reactive Phosphorus as P	----	0.01	mg/L	0.09	---	---	---	---
<b>EN055: Ionic Balance</b>								
Total Anions	----	0.01	meq/L	148	---	---	---	---
Total Cations	----	0.01	meq/L	127	---	---	---	---
Ionic Balance	----	0.01	%	7.67	---	---	---	---
<b>EP005: Total Organic Carbon (TOC)</b>								
Total Organic Carbon	----	1	mg/L	1320	---	---	---	---
<b>EP010: Formaldehyde</b>								
Formaldehyde	50-00-0	0.1	mg/L	2.9	---	---	---	---
<b>EP041A: Nonionic Surfactants</b>								
Nonionic Surfactants as CTAS	----	5	mg/L	<5	---	---	---	---
<b>EP050: Anionic Surfactants as MBAS</b>								
Anionic Surfactants as MBAS	----	0.1	mg/L	0.1	---	---	---	---
<b>EP074A: Monocyclic Aromatic Hydrocarbons</b>								
Benzene	71-43-2	1	µg/L	848	---	---	---	---
Toluene	108-88-3	2	µg/L	5320	---	---	---	---
Ethylbenzene	100-41-4	2	µg/L	533	---	---	---	---
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	7210	---	---	---	---
Styrene	100-42-5	5	µg/L	<100	---	---	---	---
ortho-Xylene	95-47-6	2	µg/L	1350	---	---	---	---
Isopropylbenzene	98-82-8	5	µg/L	118	---	---	---	---
n-Propylbenzene	103-65-1	5	µg/L	628	---	---	---	---
1.3.5-Trimethylbenzene	108-67-8	5	µg/L	1760	---	---	---	---
sec-Butylbenzene	135-98-8	5	µg/L	<100	---	---	---	---



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Tindilpie Pad Pit  
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 flowback

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Compound	CAS Number	LOR	Unit	EM1209924-001	---	---	---	---
<b>EP074A: Monocyclic Aromatic Hydrocarbons - Continued</b>								
1,2,4-Trimethylbenzene	95-63-6	5	µg/L	2550	---	---	---	---
tert-Butylbenzene	98-06-6	5	µg/L	<100	---	---	---	---
p-Isopropyltoluene	99-87-6	5	µg/L	2680	---	---	---	---
n-Butylbenzene	104-51-8	5	µg/L	199	---	---	---	---
<b>EP074B: Oxygenated Compounds</b>								
Vinyl Acetate	108-05-4	50	µg/L	<1000	---	---	---	---
2-Butanone (MEK)	78-93-3	50	µg/L	<1000	---	---	---	---
4-Methyl-2-pentanone (MIBK)	108-10-1	50	µg/L	<1000	---	---	---	---
2-Hexanone (MBK)	591-78-6	50	µg/L	<1000	---	---	---	---
<b>EP074C: Sulfonated Compounds</b>								
Carbon disulfide	75-15-0	5	µg/L	<100	---	---	---	---
<b>EP074D: Fumigants</b>								
2,2-Dichloropropane	594-20-7	5	µg/L	<100	---	---	---	---
1,2-Dichloropropane	78-87-5	5	µg/L	<100	---	---	---	---
cis-1,3-Dichloropropylene	10061-01-5	5	µg/L	<100	---	---	---	---
trans-1,3-Dichloropropylene	10061-02-6	5	µg/L	<100	---	---	---	---
1,2-Dibromoethane (EDB)	106-93-4	5	µg/L	<100	---	---	---	---
<b>EP074E: Halogenated Aliphatic Compounds</b>								
Dichlorodifluoromethane	75-71-8	50	µg/L	<1000	---	---	---	---
Chloromethane	74-87-3	50	µg/L	<1000	---	---	---	---
Vinyl chloride	75-01-4	50	µg/L	<1000	---	---	---	---
Bromomethane	74-83-9	50	µg/L	<1000	---	---	---	---
Chloroethane	75-00-3	50	µg/L	<1000	---	---	---	---
Trichlorofluoromethane	75-69-4	50	µg/L	<1000	---	---	---	---
1,1-Dichloroethene	75-35-4	5	µg/L	<100	---	---	---	---
Iodomethane	74-88-4	5	µg/L	<100	---	---	---	---
trans-1,2-Dichloroethene	156-60-5	5	µg/L	<100	---	---	---	---
1,1-Dichloroethane	75-34-3	5	µg/L	<100	---	---	---	---
cis-1,2-Dichloroethene	156-59-2	5	µg/L	<100	---	---	---	---
1,1,1-Trichloroethane	71-55-6	5	µg/L	<100	---	---	---	---
1,1-Dichloropropylene	563-58-6	5	µg/L	<100	---	---	---	---
Carbon Tetrachloride	56-23-5	5	µg/L	<100	---	---	---	---
1,2-Dichloroethane	107-06-2	5	µg/L	<100	---	---	---	---



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Compound	CAS Number	LOR	Unit	EM1209924-001	---	---	---	---
<b>EP074E: Halogenated Aliphatic Compounds - Continued</b>								
Trichloroethene	79-01-6	5	µg/L	<100	---	---	---	---
Dibromomethane	74-95-3	5	µg/L	<100	---	---	---	---
1.1.2-Trichloroethane	79-00-5	5	µg/L	<100	---	---	---	---
1.3-Dichloropropane	142-28-9	5	µg/L	<100	---	---	---	---
Tetrachloroethene	127-18-4	5	µg/L	<100	---	---	---	---
1.1.1.2-Tetrachloroethane	630-20-6	5	µg/L	<100	---	---	---	---
trans-1.4-Dichloro-2-butene	110-57-6	5	µg/L	<100	---	---	---	---
cis-1.4-Dichloro-2-butene	1476-11-5	5	µg/L	<100	---	---	---	---
1.1.2.2-Tetrachloroethane	79-34-5	5	µg/L	<100	---	---	---	---
1.2.3-Trichloropropane	96-18-4	5	µg/L	<100	---	---	---	---
Pentachloroethane	76-01-7	5	µg/L	<100	---	---	---	---
1.2-Dibromo-3-chloropropane	96-12-8	5	µg/L	<100	---	---	---	---
<b>EP074F: Halogenated Aromatic Compounds</b>								
Chlorobenzene	108-90-7	5	µg/L	<100	---	---	---	---
Bromobenzene	108-86-1	5	µg/L	<100	---	---	---	---
2-Chlorotoluene	95-49-8	5	µg/L	<100	---	---	---	---
4-Chlorotoluene	106-43-4	5	µg/L	<100	---	---	---	---
1.2.3-Trichlorobenzene	87-61-6	5	µg/L	<100	---	---	---	---
<b>EP074G: Trihalomethanes</b>								
Chloroform	67-66-3	5	µg/L	<100	---	---	---	---
Bromodichloromethane	75-27-4	5	µg/L	<100	---	---	---	---
Dibromochloromethane	124-48-1	5	µg/L	<100	---	---	---	---
Bromoform	75-25-2	5	µg/L	<100	---	---	---	---
<b>EP075A: Phenolic Compounds</b>								
Phenol	108-95-2	2	µg/L	418	---	---	---	---
2-Chlorophenol	95-57-8	2	µg/L	<10	---	---	---	---
2-Methylphenol	95-48-7	2	µg/L	503	---	---	---	---
3- & 4-Methylphenol	1319-77-3	4	µg/L	354	---	---	---	---
2-Nitrophenol	88-75-5	2	µg/L	<10	---	---	---	---
2.4-Dimethylphenol	105-67-9	2	µg/L	337	---	---	---	---
2.4-Dichlorophenol	120-83-2	2	µg/L	<10	---	---	---	---
2.6-Dichlorophenol	87-65-0	2	µg/L	<10	---	---	---	---
4-Chloro-3-Methylphenol	59-50-7	2	µg/L	<10	---	---	---	---





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Compound	CAS Number	LOR	Unit	EM1209924-001	---	---	---	---
<b>EP075A: Phenolic Compounds - Continued</b>								
2,4,6-Trichlorophenol	88-06-2	2	µg/L	<10	---	---	---	---
2,4,5-Trichlorophenol	95-95-4	2	µg/L	<10	---	---	---	---
Pentachlorophenol	87-86-5	4	µg/L	<20	---	---	---	---
<b>EP075B: Polynuclear Aromatic Hydrocarbons</b>								
Naphthalene	91-20-3	2	µg/L	156	---	---	---	---
2-Methylnaphthalene	91-57-6	2	µg/L	330	---	---	---	---
2-Chloronaphthalene	91-58-7	2	µg/L	<10	---	---	---	---
Acenaphthylene	208-96-8	2	µg/L	<10	---	---	---	---
Acenaphthene	83-32-9	2	µg/L	<10	---	---	---	---
Fluorene	86-73-7	2	µg/L	14	---	---	---	---
Phenanthrene	85-01-8	2	µg/L	32	---	---	---	---
Anthracene	120-12-7	2	µg/L	<10	---	---	---	---
Fluoranthene	206-44-0	2	µg/L	<10	---	---	---	---
Pyrene	129-00-0	2	µg/L	<10	---	---	---	---
N-2-Fluorenyl Acetamide	53-96-3	2	µg/L	<10	---	---	---	---
Benz(a)anthracene	56-55-3	2	µg/L	<10	---	---	---	---
Chrysene	218-01-9	2	µg/L	<10	---	---	---	---
Benzo(b) & Benzo(k)fluoranthene	205-99-2 207-08-9	4	µg/L	<20	---	---	---	---
7,12-Dimethylbenz(a)anthracene	57-97-6	2	µg/L	<10	---	---	---	---
Benzo(a)pyrene	50-32-8	2	µg/L	<10	---	---	---	---
3-Methylcholanthrene	56-49-5	2	µg/L	<10	---	---	---	---
Indeno(1,2,3.cd)pyrene	193-39-5	2	µg/L	<10	---	---	---	---
Dibenz(a,h)anthracene	53-70-3	2	µg/L	<10	---	---	---	---
Benzo(g,h,i)perylene	191-24-2	2	µg/L	<10	---	---	---	---
^ Sum of PAHs	----	2	µg/L	202	---	---	---	---
^ Benzo(a)pyrene TEQ (WHO)	----	2	µg/L	<10	---	---	---	---
<b>EP075C: Phthalate Esters</b>								
Dimethyl phthalate	131-11-3	2	µg/L	<10	---	---	---	---
Diethyl phthalate	84-66-2	2	µg/L	<10	---	---	---	---
Di-n-butyl phthalate	84-74-2	2	µg/L	<10	---	---	---	---
Butyl benzyl phthalate	85-68-7	2	µg/L	<10	---	---	---	---
bis(2-ethylhexyl) phthalate	117-81-7	10	µg/L	<50	---	---	---	---
Di-n-octylphthalate	117-84-0	2	µg/L	<10	---	---	---	---



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Compound	CAS Number	LOR	Unit	EM1209924-001	---	---	---	---
<b>EP075C: Phthalate Esters - Continued</b>								
<b>EP075D: Nitrosamines</b>								
N-Nitrosomethylethylamine	10595-95-6	2	µg/L	<10	---	---	---	---
N-Nitrosodiethylamine	55-18-5	2	µg/L	<10	---	---	---	---
N-Nitrosopyrrolidine	930-55-2	4	µg/L	<20	---	---	---	---
N-Nitrosomorpholine	59-89-2	2	µg/L	<10	---	---	---	---
N-Nitrosodi-n-propylamine	621-64-7	2	µg/L	<10	---	---	---	---
N-Nitrosopiperidine	100-75-4	2	µg/L	<10	---	---	---	---
N-Nitrosodibutylamine	924-16-3	2	µg/L	<10	---	---	---	---
N-Nitrosodiphenyl & Diphenylamine	86-30-6 122-39-4	4	µg/L	<20	---	---	---	---
Methapyrilene	91-80-5	2	µg/L	<10	---	---	---	---
<b>EP075E: Nitroaromatics and Ketones</b>								
2-Picoline	109-06-8	2	µg/L	<10	---	---	---	---
Acetophenone	98-86-2	2	µg/L	<10	---	---	---	---
Nitrobenzene	98-95-3	2	µg/L	<10	---	---	---	---
Isophorone	78-59-1	2	µg/L	<10	---	---	---	---
2,6-Dinitrotoluene	606-20-2	4	µg/L	<20	---	---	---	---
2,4-Dinitrotoluene	121-14-2	4	µg/L	<20	---	---	---	---
1-Naphthylamine	134-32-7	2	µg/L	<10	---	---	---	---
4-Nitroquinoline-N-oxide	56-57-5	2	µg/L	<10	---	---	---	---
5-Nitro-o-toluidine	99-55-8	2	µg/L	<10	---	---	---	---
Azobenzene	103-33-3	2	µg/L	<10	---	---	---	---
1,3,5-Trinitrobenzene	99-35-4	2	µg/L	<10	---	---	---	---
Phenacetin	62-44-2	2	µg/L	<10	---	---	---	---
4-Aminobiphenyl	92-67-1	2	µg/L	<10	---	---	---	---
Pentachloronitrobenzene	82-68-8	2	µg/L	<10	---	---	---	---
Pronamide	23950-58-5	2	µg/L	<10	---	---	---	---
Dimethylaminoazobenzene	60-11-7	2	µg/L	<10	---	---	---	---
Chlorobenzilate	510-15-6	2	µg/L	<10	---	---	---	---
<b>EP075F: Haloethers</b>								
Bis(2-chloroethyl) ether	111-44-4	2	µg/L	<10	---	---	---	---
Bis(2-chloroethoxy) methane	111-91-1	2	µg/L	<10	---	---	---	---
4-Chlorophenyl phenyl ether	7005-72-3	2	µg/L	<10	---	---	---	---



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Compound	CAS Number	LOR	Unit	EM1209924-001	---	---	---	---
<b>EP075F: Haloethers - Continued</b>								
4-Bromophenyl phenyl ether	101-55-3	2	µg/L	<10	---	---	---	---
<b>EP075G: Chlorinated Hydrocarbons</b>								
1.3-Dichlorobenzene	541-73-1	2	µg/L	<10	---	---	---	---
1.4-Dichlorobenzene	106-46-7	2	µg/L	<10	---	---	---	---
1.2-Dichlorobenzene	95-50-1	2	µg/L	<10	---	---	---	---
Hexachloroethane	67-72-1	2	µg/L	<10	---	---	---	---
1.2.4-Trichlorobenzene	120-82-1	2	µg/L	<10	---	---	---	---
Hexachloropropylene	1888-71-7	2	µg/L	<10	---	---	---	---
Hexachlorobutadiene	87-68-3	2	µg/L	<10	---	---	---	---
Hexachlorocyclopentadiene	77-47-4	10	µg/L	<50	---	---	---	---
Pentachlorobenzene	608-93-5	2	µg/L	<10	---	---	---	---
Hexachlorobenzene (HCB)	118-74-1	4	µg/L	<20	---	---	---	---
<b>EP075H: Anilines and Benzidines</b>								
Aniline	62-53-3	2	µg/L	<10	---	---	---	---
4-Chloroaniline	106-47-8	2	µg/L	<10	---	---	---	---
2-Nitroaniline	88-74-4	4	µg/L	<20	---	---	---	---
3-Nitroaniline	99-09-2	4	µg/L	<20	---	---	---	---
Dibenzofuran	132-64-9	2	µg/L	<10	---	---	---	---
4-Nitroaniline	100-01-6	2	µg/L	<10	---	---	---	---
Carbazole	86-74-8	2	µg/L	<10	---	---	---	---
3,3'-Dichlorobenzidine	91-94-1	2	µg/L	<10	---	---	---	---
<b>EP075I: Organochlorine Pesticides</b>								
alpha-BHC	319-84-6	2	µg/L	<10	---	---	---	---
beta-BHC	319-85-7	2	µg/L	<10	---	---	---	---
gamma-BHC	58-89-9	2	µg/L	<10	---	---	---	---
delta-BHC	319-86-8	2	µg/L	<10	---	---	---	---
Heptachlor	76-44-8	2	µg/L	<10	---	---	---	---
Aldrin	309-00-2	2	µg/L	<10	---	---	---	---
Heptachlor epoxide	1024-57-3	2	µg/L	<10	---	---	---	---
alpha-Endosulfan	959-98-8	2	µg/L	<10	---	---	---	---
4,4'-DDE	72-55-9	2	µg/L	<10	---	---	---	---
Dieldrin	60-57-1	2	µg/L	<10	---	---	---	---
Endrin	72-20-8	2	µg/L	<10	---	---	---	---



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Client sample ID

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				EM1209924-001	----	----	----	----
Compound	CAS Number	LOR	Unit					
<b>EP075I: Organochlorine Pesticides - Continued</b>								
beta-Endosulfan	33213-65-9	2	µg/L	<10	----	----	----	----
4,4'-DDD	72-54-8	2	µg/L	<10	----	----	----	----
Endosulfan sulfate	1031-07-8	2	µg/L	<10	----	----	----	----
4,4'-DDT	50-29-3	4	µg/L	<20	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	4	µg/L	<20	----	----	----	----
^ Sum of DDD + DDE + DDT	----	4	µg/L	<20	----	----	----	----
<b>EP075J: Organophosphorus Pesticides</b>								
Dichlorvos	62-73-7	2	µg/L	<10	----	----	----	----
Dimethoate	60-51-5	2	µg/L	<10	----	----	----	----
Diazinon	333-41-5	2	µg/L	<10	----	----	----	----
Chlorpyrifos-methyl	5598-13-0	2	µg/L	<10	----	----	----	----
Malathion	121-75-5	2	µg/L	<10	----	----	----	----
Fenthion	55-38-9	2	µg/L	<10	----	----	----	----
Chlorpyrifos	2921-88-2	2	µg/L	<10	----	----	----	----
Pirimphos-ethyl	23505-41-1	2	µg/L	<10	----	----	----	----
Chlorfenvinphos	470-90-6	2	µg/L	<10	----	----	----	----
Prothiofos	34643-46-4	2	µg/L	<10	----	----	----	----
Ethion	563-12-2	2	µg/L	<10	----	----	----	----
<b>EP117: Alcohols</b>								
Ethanol	64-17-5	50	µg/L	1360	----	----	----	----
Isopropanol	67-63-0	50	µg/L	2840	----	----	----	----
n-Propanol	71-23-8	50	µg/L	22800	----	----	----	----
Isobutanol	78-83-1	50	µg/L	<250	----	----	----	----
n-Butanol	71-36-3	50	µg/L	<250	----	----	----	----
<b>RIVM Aliphatic Hydrocarbon Fractions</b>								
Aliphatic >C5-C6	----	20	µg/L	3440	----	----	----	----
Aliphatic >C6-C8	TPHCWG-ALV2	20	µg/L	24100	----	----	----	----
Aliphatic >C8-C10	TPHCWG-ALV3	20	µg/L	47400	----	----	----	----
Aliphatic >C10-C12	TPHCWG-ALE1	50	µg/L	5180	----	----	----	----
Aliphatic >C12-C16	TPHCWG-ALE2	50	µg/L	12500	----	----	----	----
Aliphatic >C16-C21	----	50	µg/L	11600	----	----	----	----
Aliphatic >C21-C35	----	50	µg/L	4750	----	----	----	----
<b>RIVM Aromatic Hydrocarbon Fractions</b>								



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Tindilpie Pad Pit  
 Flowback  
 frac pit water post  
 flowback

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Client sampling date / time

27-AUG-2012 06:15

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Compound	CAS Number	LOR	Unit	EM1209924-001	---	---	---	---
<b>RIVM Aromatic Hydrocarbon Fractions - Continued</b>								
Aromatic >C5-C7	----	5	µg/L	837	---	---	---	---
Aromatic >C7-C8	TPHCWG-ARV2	5	µg/L	4420	---	---	---	---
Aromatic >C8-C10	TPHCWG-ARV3	5	µg/L	10100	---	---	---	---
Aromatic >C10-C12	TPHCWG-ARE1	50	µg/L	4100	---	---	---	---
Aromatic >C12-C16	TPHCWG-ARE2	50	µg/L	3660	---	---	---	---
Aromatic >C16-C21	TPHCWG-ARE3	50	µg/L	2780	---	---	---	---
Aromatic >C21-C35	TPHCWG-ARE4	50	µg/L	640	---	---	---	---
<b>EP074S: VOC Surrogates</b>								
1,2-Dichloroethane-D4	17060-07-0	0.1	%	92.0	---	---	---	---
Toluene-D8	2037-26-5	0.1	%	108	---	---	---	---
4-Bromofluorobenzene	460-00-4	0.1	%	104	---	---	---	---
<b>EP075S: Acid Extractable Surrogates</b>								
2-Fluorophenol	367-12-4	0.1	%	Not Determined	---	---	---	---
Phenol-d6	13127-88-3	0.1	%	Not Determined	---	---	---	---
2-Chlorophenol-D4	93951-73-6	0.1	%	Not Determined	---	---	---	---
2,4,6-Tribromophenol	118-79-6	0.1	%	Not Determined	---	---	---	---
<b>EP075T: Base/Neutral Extractable Surrogates</b>								
Nitrobenzene-D5	4165-60-0	0.1	%	Not Determined	---	---	---	---
1,2-Dichlorobenzene-D4	2199-69-1	0.1	%	Not Determined	---	---	---	---
2-Fluorobiphenyl	321-60-8	0.1	%	Not Determined	---	---	---	---
Anthracene-d10	1719-06-8	0.1	%	Not Determined	---	---	---	---
4-Terphenyl-d14	1718-51-0	0.1	%	Not Determined	---	---	---	---
<b>EP079/EP070S:TPH Surrogates - semivolatile speciation</b>								
2-Fluorobiphenyl	321-60-8	0.1	%	104	---	---	---	---
2-Bromonaphthalene	580-13-2	0.1	%	111	---	---	---	---



## Surrogate Control Limits

Sub-Matrix: WATER		Recovery Limits (%)	
Compound	CAS Number	Low	High
<b>EP074S: VOC Surrogates</b>			
1,2-Dichloroethane-D4	17060-07-0	72	132
Toluene-D8	2037-26-5	74	128
4-Bromofluorobenzene	460-00-4	70	132
<b>EP075S: Acid Extractable Surrogates</b>			
2-Fluorophenol	367-12-4	10	83
Phenol-d6	13127-88-3	10	49
2-Chlorophenol-D4	93951-73-6	20.3	101
2,4,6-Tribromophenol	118-79-6	19.5	134
<b>EP075T: Base/Neutral Extractable Surrogates</b>			
Nitrobenzene-D5	4165-60-0	18.2	114
1,2-Dichlorobenzene-D4	2199-69-1	18.8	100
2-Fluorobiphenyl	321-60-8	25.3	122
Anthracene-d10	1719-06-8	35	137
4-Terphenyl-d14	1718-51-0	32	136
<b>EP079/EP070S:TPH Surrogates - semivolatile speciation</b>			
2-Fluorobiphenyl	321-60-8	77	127
2-Bromonaphthalene	580-13-2	67	123



## Environmental Division

### QUALITY CONTROL REPORT

<b>Work Order</b>	<b>: EM1209924</b>	<b>Page</b>	<b>: 1 of 24</b>
<b>Amendment</b>	<b>: 1</b>		
<b>Client</b>	<b>: SANTOS LTD</b>	<b>Laboratory</b>	<b>: Environmental Division Melbourne</b>
<b>Contact</b>	<b>: MR BARRY RITCHIE</b>	<b>Contact</b>	<b>: Jodie Hancock</b>
<b>Address</b>	<b>: GROUND FLOOR SANTOS CENTRE 60 FLINDERS STREET ADELAIDE SA, AUSTRALIA 5001</b>	<b>Address</b>	<b>: 4 Westall Rd Springvale VIC Australia 3171</b>
<b>E-mail</b>	<b>: barry.ritchie@santos.com</b>	<b>E-mail</b>	<b>: Jodie.Hancock@alsenviro.com</b>
<b>Telephone</b>	<b>: +61 08 8116 5000</b>	<b>Telephone</b>	<b>: +61 7 3243 7128</b>
<b>Facsimile</b>	<b>: +61 08 8116 5050</b>	<b>Facsimile</b>	<b>: +61 7 3243 7218</b>
<b>Project</b>	<b>: HFRA Fluids Sampling - Extended Analysis</b>	<b>QC Level</b>	<b>: NEPM 1999 Schedule B(3) and ALS QCS3 requirement</b>
<b>Site</b>	<b>: ----</b>		
<b>C-O-C number</b>	<b>: ----</b>	<b>Date Samples Received</b>	<b>: 28-AUG-2012</b>
<b>Sampler</b>	<b>: BC/AJ</b>	<b>Issue Date</b>	<b>: 12-SEP-2012</b>
<b>Order number</b>	<b>: 879002/538</b>		
<b>Quote number</b>	<b>: EN/039/11</b>	<b>No. of samples received</b>	<b>: 1</b>
		<b>No. of samples analysed</b>	<b>: 1</b>

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits



NATA Accredited Laboratory 825

Accredited for compliance with  
ISO/IEC 17025.

### *Signatories*

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics
Eric Chau	Metals Team Leader	Melbourne Inorganics
Hoa Nguyen	Inorganic Chemist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Sarah Millington	Senior Inorganic Chemist	Sydney Inorganics
Varsha Ho Wing	Non-Metals Team Leader	Melbourne Inorganics
Xingbin Lin	Senior Organic Chemist	Melbourne Organics





## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key :  
Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot  
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.  
LOR = Limit of reporting  
RPD = Relative Percentage Difference  
# = Indicates failed QC



## Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:- No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:- 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EA005: pH (QC Lot: 2476913)</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EA005: pH Value	----	0.01	pH Unit	7.46	7.48	0.3	0% - 20%
EM1209984-003	Anonymous	EA005: pH Value	----	0.01	pH Unit	6.55	6.57	0.3	0% - 20%
<b>EA015: Total Dissolved Solids (QC Lot: 2474076)</b>									
EM1209916-012	Anonymous	EA015H: Total Dissolved Solids @180°C	GIS-210-010	10	mg/L	2350	2380	1.3	0% - 20%
EM1209947-004	Anonymous	EA015H: Total Dissolved Solids @180°C	GIS-210-010	10	mg/L	4790	4850	1.2	0% - 20%
<b>ED009: Anions (QC Lot: 2476447)</b>									
EM1209913-001	Anonymous	ED009-X: Bromide	24959-67-9	0.010	mg/L	16.0	15.6	2.0	0% - 20%
		ED009-X: Iodide	20461-54-5	0.010	mg/L	<0.050	<0.050	0.0	No Limit
<b>ED037P: Alkalinity by PC Titrator (QC Lot: 2475151)</b>									
EM1209916-011	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	<1	<1	0.0	No Limit
EM1209937-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	103	104	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	103	104	0.0	0% - 20%
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 2473892)</b>									
EM1209916-010	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	1	<1	0.0	No Limit
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	22	20	9.6	0% - 20%
<b>ED045G: Chloride Discrete analyser (QC Lot: 2473894)</b>									
EM1209916-010	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	48	48	0.0	0% - 20%
<b>ED093F: Dissolved Major Cations (QC Lot: 2473893)</b>									
EM1209916-010	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	24	27	11.6	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	18	19	0.0	0% - 50%
		ED093F: Sodium	7440-23-5	1	mg/L	29	29	0.0	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	2	2	0.0	No Limit
<b>EG020F: Dissolved Metals by ICP-MS (QC Lot: 2476712)</b>									
EM1209762-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.004	0.003	29.9	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EG020F: Dissolved Metals by ICP-MS (QC Lot: 2476712) - continued</b>									
EM1209762-001	Anonymous	EG020A-F: Barium	7440-39-3	0.001	mg/L	0.109	0.106	2.3	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	0.035	0.036	3.5	0% - 20%
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.022	0.022	0.0	0% - 20%
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.006	0.006	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.745	0.733	1.6	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.002	0.002	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.183	0.191	4.3	0% - 20%
		EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.029	0.027	7.9	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.05	0.03	55.6	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	0.04	0.04	0.0	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	4.66	4.97	6.5	0% - 20%
EM1209762-021	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.002	0.002	0.0	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.098	0.098	0.0	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.032	0.032	0.0	0% - 20%
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.005	0.005	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Lithium	7439-93-2	0.001	mg/L	0.029	0.030	4.8	0% - 20%
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	1.82	1.87	2.8	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.007	0.007	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.198	0.202	2.4	0% - 20%
		EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.018	0.019	0.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.01	0.01	0.0	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	5.69	5.46	4.2	0% - 20%
EG020A-F: Iron	7439-89-6	0.05	mg/L	1.57	1.57	0.0	0% - 20%		
<b>EG020F: Dissolved Metals by ICP-MS (QC Lot: 2476713)</b>									
EM1209762-021	Anonymous	EG020B-F: Strontium	7440-24-6	0.001	mg/L	2.96	2.99	1.0	0% - 20%
		EG020B-F: Uranium	7440-61-1	0.001	mg/L	0.008	0.008	0.0	No Limit
<b>EG035F: Dissolved Mercury by FIMS (QC Lot: 2476711)</b>									
EM1209762-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EM1209762-021	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit

Page : 6 of 24  
 Work Order : EM1209924 Amendment 1  
 Client : SANTOS LTD  
 Project : HFRA Fluids Sampling - Extended Analysis



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EK025G: Free cyanide by Discrete Analyser (QC Lot: 2474592)</b>									
EM1209920-001	Anonymous	EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	<0.004	0.0	No Limit
<b>EK026G: Total Cyanide By Discrete Analyser (QC Lot: 2474599)</b>									
EM1209913-001	Anonymous	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	0.140	0.120	15.8	0% - 20%
<b>EK040P: Fluoride by PC Titrator (QC Lot: 2475152)</b>									
EM1209916-011	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	0.2	0.0	No Limit
EM1209945-003	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.1	0.1	0.0	No Limit
<b>EK055G: Ammonia as N by Discrete Analyser (QC Lot: 2475171)</b>									
EM1209914-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.04	0.02	68.9	No Limit
EM1209916-006	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.03	0.03	0.0	No Limit
<b>EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2473891)</b>									
EM1209916-001	Anonymous	EK057G: Nitrite as N	----	0.01	mg/L	0.01	<0.01	0.0	No Limit
EM1209916-010	Anonymous	EK057G: Nitrite as N	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2475172)</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EM1209973-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	5.41	5.21	3.8	0% - 20%
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2475438)</b>									
EM1209916-011	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	2.9	2.4	19.8	0% - 20%
EM1210012-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	3.2	3.6	8.6	0% - 20%
<b>EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2475439)</b>									
EM1209916-011	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	2.16	1.82	17.1	0% - 20%
EM1210012-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	5.11	6.06	17.0	0% - 20%
<b>EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 2473890)</b>									
EM1209913-001	Anonymous	EK071G: Reactive Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EM1209916-010	Anonymous	EK071G: Reactive Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
<b>EP005: Total Organic Carbon (TOC) (QC Lot: 2488012)</b>									
EM1209762-020	Anonymous	EP005: Total Organic Carbon	----	1	mg/L	122	121	0.0	0% - 20%
EM1210086-001	Anonymous	EP005: Total Organic Carbon	----	1	mg/L	19	19	0.0	0% - 50%
<b>EP010: Formaldehyde (QC Lot: 2473623)</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP010: Formaldehyde	50-00-0	0.1	mg/L	2.9	2.9	0.0	0% - 20%
<b>EP041A: Nonionic Surfactants (QC Lot: 2476292)</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP041A: Nonionic Surfactants as CTAS	----	5	mg/L	<5	<5	0.0	No Limit
<b>EP050: Anionic Surfactants as MBAS (QC Lot: 2475995)</b>									



Sub-Matrix: **WATER**

Laboratory Duplicate (DUP) Report

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)	
<b>EP050: Anionic Surfactants as MBAS (QC Lot: 2475995) - continued</b>										
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP050: Anionic Surfactants as MBAS		0.1	mg/L	0.1	0.1	0.0	No Limit	
<b>EP074A: Monocyclic Aromatic Hydrocarbons (QC Lot: 2485081)</b>										
EM1210094-014	Anonymous	EP074: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit	
		EP074: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit	
		EP074: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit	
		EP074: meta- & para-Xylene	108-38-3	2	µg/L	<2	<2	0.0	No Limit	
			106-42-3							
		EP074: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit	
		EP074: Styrene	100-42-5	5	µg/L	<5	<5	0.0	No Limit	
		EP074: Isopropylbenzene	98-82-8	5	µg/L	<5	<5	0.0	No Limit	
		EP074: n-Propylbenzene	103-65-1	5	µg/L	<5	<5	0.0	No Limit	
		EP074: 1.3.5-Trimethylbenzene	108-67-8	5	µg/L	<5	<5	0.0	No Limit	
		EP074: sec-Butylbenzene	135-98-8	5	µg/L	<5	<5	0.0	No Limit	
		EP074: 1.2.4-Trimethylbenzene	95-63-6	5	µg/L	<5	<5	0.0	No Limit	
		EP074: tert-Butylbenzene	98-06-6	5	µg/L	<5	<5	0.0	No Limit	
		EP074: p-Isopropyltoluene	99-87-6	5	µg/L	<5	<5	0.0	No Limit	
EP074: n-Butylbenzene	104-51-8	5	µg/L	<5	<5	0.0	No Limit			
<b>EP074B: Oxygenated Compounds (QC Lot: 2485081)</b>										
EM1210094-014	Anonymous	EP074: Vinyl Acetate	108-05-4	50	µg/L	<50	<50	0.0	No Limit	
		EP074: 2-Butanone (MEK)	78-93-3	50	µg/L	<50	<50	0.0	No Limit	
		EP074: 4-Methyl-2-pentanone (MIBK)	108-10-1	50	µg/L	<50	<50	0.0	No Limit	
		EP074: 2-Hexanone (MBK)	591-78-6	50	µg/L	<50	<50	0.0	No Limit	
<b>EP074C: Sulfonated Compounds (QC Lot: 2485081)</b>										
EM1210094-014	Anonymous	EP074: Carbon disulfide	75-15-0	5	µg/L	<5	<5	0.0	No Limit	
<b>EP074D: Fumigants (QC Lot: 2485081)</b>										
EM1210094-014	Anonymous	EP074: 2.2-Dichloropropane	594-20-7	5	µg/L	<5	<5	0.0	No Limit	
		EP074: 1.2-Dichloropropane	78-87-5	5	µg/L	<5	<5	0.0	No Limit	
		EP074: cis-1.3-Dichloropropylene	10061-01-5	5	µg/L	<5	<5	0.0	No Limit	
		EP074: trans-1.3-Dichloropropylene	10061-02-6	5	µg/L	<5	<5	0.0	No Limit	
		EP074: 1.2-Dibromoethane (EDB)	106-93-4	5	µg/L	<5	<5	0.0	No Limit	
<b>EP074E: Halogenated Aliphatic Compounds (QC Lot: 2485081)</b>										
EM1210094-014	Anonymous	EP074: 1.1-Dichloroethene	75-35-4	5	µg/L	<5	<5	0.0	No Limit	
		EP074: Iodomethane	74-88-4	5	µg/L	<5	<5	0.0	No Limit	
		EP074: trans-1.2-Dichloroethene	156-60-5	5	µg/L	<5	<5	0.0	No Limit	
		EP074: 1.1-Dichloroethane	75-34-3	5	µg/L	<5	<5	0.0	No Limit	
		EP074: cis-1.2-Dichloroethene	156-59-2	5	µg/L	<5	<5	0.0	No Limit	
		EP074: 1.1.1-Trichloroethane	71-55-6	5	µg/L	<5	<5	0.0	No Limit	



Sub-Matrix: **WATER**

Laboratory Duplicate (DUP) Report

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP074E: Halogenated Aliphatic Compounds (QC Lot: 2485081) - continued</b>									
EM1210094-014	Anonymous	EP074: 1,1-Dichloropropylene	563-58-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: Carbon Tetrachloride	56-23-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,2-Dichloroethane	107-06-2	5	µg/L	<5	<5	0.0	No Limit
		EP074: Trichloroethene	79-01-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: Dibromomethane	74-95-3	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,1,1,2-Tetrachloroethane	79-00-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,3-Dichloropropane	142-28-9	5	µg/L	<5	<5	0.0	No Limit
		EP074: Tetrachloroethene	127-18-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,1,1,2-Tetrachloroethane	630-20-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: trans-1,4-Dichloro-2-butene	110-57-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: cis-1,4-Dichloro-2-butene	1476-11-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,1,1,2,2-Tetrachloroethane	79-34-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,2,3-Trichloropropane	96-18-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: Pentachloroethane	76-01-7	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,2-Dibromo-3-chloropropane	96-12-8	5	µg/L	<5	<5	0.0	No Limit
		EP074: Dichlorodifluoromethane	75-71-8	50	µg/L	<50	<50	0.0	No Limit
		EP074: Chloromethane	74-87-3	50	µg/L	<50	<50	0.0	No Limit
		EP074: Vinyl chloride	75-01-4	50	µg/L	<50	<50	0.0	No Limit
		EP074: Bromomethane	74-83-9	50	µg/L	<50	<50	0.0	No Limit
		EP074: Chloroethane	75-00-3	50	µg/L	<50	<50	0.0	No Limit
EP074: Trichlorofluoromethane	75-69-4	50	µg/L	<50	<50	0.0	No Limit		
<b>EP074F: Halogenated Aromatic Compounds (QC Lot: 2485081)</b>									
EM1210094-014	Anonymous	EP074: Chlorobenzene	108-90-7	5	µg/L	<5	<5	0.0	No Limit
		EP074: Bromobenzene	108-86-1	5	µg/L	<5	<5	0.0	No Limit
		EP074: 2-Chlorotoluene	95-49-8	5	µg/L	<5	<5	0.0	No Limit
		EP074: 4-Chlorotoluene	106-43-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,2,3-Trichlorobenzene	87-61-6	5	µg/L	<5	<5	0.0	No Limit
<b>EP074G: Trihalomethanes (QC Lot: 2485081)</b>									
EM1210094-014	Anonymous	EP074: Chloroform	67-66-3	5	µg/L	<5	<5	0.0	No Limit
		EP074: Bromodichloromethane	75-27-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: Dibromochloromethane	124-48-1	5	µg/L	<5	<5	0.0	No Limit
		EP074: Bromoform	75-25-2	5	µg/L	<5	<5	0.0	No Limit
<b>EP075A: Phenolic Compounds (QC Lot: 2474975)</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP075: Phenol	108-95-2	2	µg/L	418	380	9.3	0% - 20%
		EP075: 2-Chlorophenol	95-57-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: 2-Methylphenol	95-48-7	2	µg/L	503	519	3.2	0% - 20%
		EP075: 2-Nitrophenol	88-75-5	2	µg/L	<10	<10	0.0	No Limit



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP075A: Phenolic Compounds (QC Lot: 2474975) - continued</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP075: 2,4-Dimethylphenol	105-67-9	2	µg/L	337	311	8.0	0% - 20%
		EP075: 2,4-Dichlorophenol	120-83-2	2	µg/L	<10	<10	0.0	No Limit
		EP075: 2,6-Dichlorophenol	87-65-0	2	µg/L	<10	<10	0.0	No Limit
		EP075: 4-Chloro-3-Methylphenol	59-50-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: 2,4,6-Trichlorophenol	88-06-2	2	µg/L	<10	<10	0.0	No Limit
		EP075: 2,4,5-Trichlorophenol	95-95-4	2	µg/L	<10	<10	0.0	No Limit
		EP075: 3- & 4-Methylphenol	1319-77-3	4	µg/L	354	371	4.8	0% - 20%
		EP075: Pentachlorophenol	87-86-5	4	µg/L	<20	<20	0.0	No Limit
<b>EP075B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2474975)</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP075: Naphthalene	91-20-3	2	µg/L	156	136	13.5	0% - 20%
		EP075: 2-Methylnaphthalene	91-57-6	2	µg/L	330	258	# 24.3	0% - 20%
		EP075: 2-Chloronaphthalene	91-58-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: Acenaphthylene	208-96-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: Acenaphthene	83-32-9	2	µg/L	<10	<10	0.0	No Limit
		EP075: Fluorene	86-73-7	2	µg/L	14	14	0.0	No Limit
		EP075: Phenanthrene	85-01-8	2	µg/L	32	27	16.4	0% - 50%
		EP075: Anthracene	120-12-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: Fluoranthene	206-44-0	2	µg/L	<10	<10	0.0	No Limit
		EP075: Pyrene	129-00-0	2	µg/L	<10	<10	0.0	No Limit
		EP075: N-2-Fluorenyl Acetamide	53-96-3	2	µg/L	<10	<10	0.0	No Limit
		EP075: Benz(a)anthracene	56-55-3	2	µg/L	<10	<10	0.0	No Limit
		EP075: Chrysene	218-01-9	2	µg/L	<10	<10	0.0	No Limit
		EP075: 7,12-Dimethylbenz(a)anthracene	57-97-6	2	µg/L	<10	<10	0.0	No Limit
		EP075: Benzo(a)pyrene	50-32-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: 3-Methylcholanthrene	56-49-5	2	µg/L	<10	<10	0.0	No Limit
		EP075: Indeno(1,2,3.cd)pyrene	193-39-5	2	µg/L	<10	<10	0.0	No Limit
		EP075: Dibenz(a,h)anthracene	53-70-3	2	µg/L	<10	<10	0.0	No Limit
		EP075: Benzo(g,h,i)perylene	191-24-2	2	µg/L	<10	<10	0.0	No Limit
		EP075: Sum of PAHs	----	2	µg/L	202	177	13.2	0% - 20%
EP075: Benzo(b) & Benzo(k)fluoranthene	205-99-2 207-08-9	4	µg/L	<20	<20	0.0	No Limit		
<b>EP075C: Phthalate Esters (QC Lot: 2474975)</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP075: bis(2-ethylhexyl) phthalate	117-81-7	10	µg/L	<50	<50	0.0	No Limit
		EP075: Dimethyl phthalate	131-11-3	2	µg/L	<10	<10	0.0	No Limit



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP075C: Phthalate Esters (QC Lot: 2474975) - continued</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP075: Diethyl phthalate	84-66-2	2	µg/L	<10	<10	0.0	No Limit
		EP075: Di-n-butyl phthalate	84-74-2	2	µg/L	<10	<10	0.0	No Limit
		EP075: Butyl benzyl phthalate	85-68-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: Di-n-octylphthalate	117-84-0	2	µg/L	<10	<10	0.0	No Limit
<b>EP075D: Nitrosamines (QC Lot: 2474975)</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP075: N-Nitrosomethylethylamine	10595-95-6	2	µg/L	<10	<10	0.0	No Limit
		EP075: N-Nitrosodiethylamine	55-18-5	2	µg/L	<10	<10	0.0	No Limit
		EP075: N-Nitrosomorpholine	59-89-2	2	µg/L	<10	<10	0.0	No Limit
		EP075: N-Nitrosodi-n-propylamine	621-64-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: N-Nitrosopiperidine	100-75-4	2	µg/L	<10	<10	0.0	No Limit
		EP075: N-Nitrosodibutylamine	924-16-3	2	µg/L	<10	<10	0.0	No Limit
		EP075: Methapyrilene	91-80-5	2	µg/L	<10	<10	0.0	No Limit
		EP075: N-Nitrosopyrrolidine	930-55-2	4	µg/L	<20	<20	0.0	No Limit
EP075: N-Nitrosodiphenyl & Diphenylamine	86-30-6 122-39-4	4	µg/L	<20	<20	0.0	No Limit		
<b>EP075E: Nitroaromatics and Ketones (QC Lot: 2474975)</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP075: 2-Picoline	109-06-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: Acetophenone	98-86-2	2	µg/L	<10	<10	0.0	No Limit
		EP075: Nitrobenzene	98-95-3	2	µg/L	<10	<10	0.0	No Limit
		EP075: Isophorone	78-59-1	2	µg/L	<10	<10	0.0	No Limit
		EP075: 1-Naphthylamine	134-32-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: 4-Nitroquinoline-N-oxide	56-57-5	2	µg/L	<10	<10	0.0	No Limit
		EP075: 5-Nitro-o-toluidine	99-55-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: Azobenzene	103-33-3	2	µg/L	<10	<10	0.0	No Limit
		EP075: 1,3,5-Trinitrobenzene	99-35-4	2	µg/L	<10	<10	0.0	No Limit
		EP075: Phenacetin	62-44-2	2	µg/L	<10	<10	0.0	No Limit
		EP075: 4-Aminobiphenyl	92-67-1	2	µg/L	<10	<10	0.0	No Limit
		EP075: Pentachloronitrobenzene	82-68-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: Pronamide	23950-58-5	2	µg/L	<10	<10	0.0	No Limit
		EP075: Dimethylaminoazobenzene	60-11-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: Chlorobenzilate	510-15-6	2	µg/L	<10	<10	0.0	No Limit
EP075: 2,6-Dinitrotoluene	606-20-2	4	µg/L	<20	<20	0.0	No Limit		
EP075: 2,4-Dinitrotoluene	121-14-2	4	µg/L	<20	<20	0.0	No Limit		
<b>EP075F: Haloethers (QC Lot: 2474975)</b>									





Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP075F: Haloethers (QC Lot: 2474975) - continued</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP075: Bis(2-chloroethyl) ether	111-44-4	2	µg/L	<10	<10	0.0	No Limit
		EP075: Bis(2-chloroethoxy) methane	111-91-1	2	µg/L	<10	<10	0.0	No Limit
		EP075: 4-Chlorophenyl phenyl ether	7005-72-3	2	µg/L	<10	<10	0.0	No Limit
		EP075: 4-Bromophenyl phenyl ether	101-55-3	2	µg/L	<10	<10	0.0	No Limit
<b>EP075G: Chlorinated Hydrocarbons (QC Lot: 2474975)</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP075: Hexachlorocyclopentadiene	77-47-4	10	µg/L	<50	<50	0.0	No Limit
		EP075: 1,4-Dichlorobenzene	106-46-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: 1,3-Dichlorobenzene	541-73-1	2	µg/L	<10	<10	0.0	No Limit
		EP075: 1,2-Dichlorobenzene	95-50-1	2	µg/L	<10	<10	0.0	No Limit
		EP075: Hexachloroethane	67-72-1	2	µg/L	<10	<10	0.0	No Limit
		EP075: 1,2,4-Trichlorobenzene	120-82-1	2	µg/L	<10	<10	0.0	No Limit
		EP075: Hexachloropropylene	1888-71-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: Hexachlorobutadiene	87-68-3	2	µg/L	<10	<10	0.0	No Limit
		EP075: Pentachlorobenzene	608-93-5	2	µg/L	<10	<10	0.0	No Limit
EP075: Hexachlorobenzene (HCB)	118-74-1	4	µg/L	<20	<20	0.0	No Limit		
<b>EP075H: Anilines and Benzidines (QC Lot: 2474975)</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP075: Aniline	62-53-3	2	µg/L	<10	<10	0.0	No Limit
		EP075: 4-Chloroaniline	106-47-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: Dibenzofuran	132-64-9	2	µg/L	<10	<10	0.0	No Limit
		EP075: 4-Nitroaniline	100-01-6	2	µg/L	<10	<10	0.0	No Limit
		EP075: Carbazole	86-74-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: 3,3'-Dichlorobenzidine	91-94-1	2	µg/L	<10	<10	0.0	No Limit
		EP075: 2-Nitroaniline	88-74-4	4	µg/L	<20	<20	0.0	No Limit
		EP075: 3-Nitroaniline	99-09-2	4	µg/L	<20	<20	0.0	No Limit
<b>EP075I: Organochlorine Pesticides (QC Lot: 2474975)</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP075: alpha-BHC	319-84-6	2	µg/L	<10	<10	0.0	No Limit
		EP075: beta-BHC	319-85-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: gamma-BHC	58-89-9	2	µg/L	<10	<10	0.0	No Limit
		EP075: delta-BHC	319-86-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: Heptachlor	76-44-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: Aldrin	309-00-2	2	µg/L	<10	<10	0.0	No Limit
		EP075: Heptachlor epoxide	1024-57-3	2	µg/L	<10	<10	0.0	No Limit



Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP075I: Organochlorine Pesticides (QC Lot: 2474975) - continued</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP075: alpha-Endosulfan	959-98-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: 4.4'-DDE	72-55-9	2	µg/L	<10	<10	0.0	No Limit
		EP075: Dieldrin	60-57-1	2	µg/L	<10	<10	0.0	No Limit
		EP075: Endrin	72-20-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: beta-Endosulfan	33213-65-9	2	µg/L	<10	<10	0.0	No Limit
		EP075: 4.4'-DDD	72-54-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: Endosulfan sulfate	1031-07-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: 4.4'-DDT	50-29-3	4	µg/L	<20	<20	0.0	No Limit
<b>EP075J: Organophosphorus Pesticides (QC Lot: 2474975)</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP075: Dichlorvos	62-73-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: Dimethoate	60-51-5	2	µg/L	<10	<10	0.0	No Limit
		EP075: Diazinon	333-41-5	2	µg/L	<10	<10	0.0	No Limit
		EP075: Chlorpyrifos-methyl	5598-13-0	2	µg/L	<10	<10	0.0	No Limit
		EP075: Malathion	121-75-5	2	µg/L	<10	<10	0.0	No Limit
		EP075: Fenthion	55-38-9	2	µg/L	<10	<10	0.0	No Limit
		EP075: Chlorpyrifos	2921-88-2	2	µg/L	<10	<10	0.0	No Limit
		EP075: Pirimphos-ethyl	23505-41-1	2	µg/L	<10	<10	0.0	No Limit
		EP075: Chlorfenvinphos	470-90-6	2	µg/L	<10	<10	0.0	No Limit
		EP075: Prothiofos	34643-46-4	2	µg/L	<10	<10	0.0	No Limit
EP075: Ethion	563-12-2	2	µg/L	<10	<10	0.0	No Limit		
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QC Lot: 2475028)</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP070-CWG: Aliphatic >C10-C12	TPHCWG-ALE1	50	µg/L	5180	4870	6.2	0% - 20%
		EP070-CWG: Aliphatic >C12-C16	TPHCWG-ALE2	50	µg/L	12500	11700	6.5	0% - 20%
		EP070-CWG: Aliphatic >C16-C21	----	50	µg/L	11600	10800	7.8	0% - 20%
		EP070-CWG: Aliphatic >C21-C35	----	50	µg/L	4750	4320	9.5	0% - 20%
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QC Lot: 2485082)</b>									
EM1210094-014	Anonymous	EP079-CWG: Aliphatic >C5-C6	----	20	µg/L	<20	<20	0.0	No Limit
		EP079-CWG: Aliphatic >C6-C8	TPHCWG-ALV2	20	µg/L	<20	<20	0.0	No Limit
		EP079-CWG: Aliphatic >C8-C10	TPHCWG-ALV3	20	µg/L	<20	<20	0.0	No Limit
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QC Lot: 2475028)</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP070-CWG: Aromatic >C10-C12	TPHCWG-ARE1	50	µg/L	4100	4040	1.4	0% - 20%
		EP070-CWG: Aromatic >C12-C16	TPHCWG-ARE2	50	µg/L	3660	3540	3.5	0% - 20%

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 Work Order : EM1209924 Amendment 1  
 Client : SANTOS LTD  
 Project : HFRA Fluids Sampling - Extended Analysis



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QC Lot: 2475028) - continued</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP070-CWG: Aromatic >C16-C21	TPHCWG-ARE3	50	µg/L	2780	2640	5.3	0% - 20%
		EP070-CWG: Aromatic >C21-C35	TPHCWG-ARE4	50	µg/L	640	595	7.3	0% - 50%
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QC Lot: 2485082)</b>									
EM1210094-014	Anonymous	EP079-CWG: Aromatic >C5-C7	----	5	µg/L	<5	<5	0.0	No Limit
		EP079-CWG: Aromatic >C7-C8	TPHCWG-ARV 2	5	µg/L	<5	<5	0.0	No Limit
		EP079-CWG: Aromatic >C8-C10	TPHCWG-ARV 3	5	µg/L	<5	<5	0.0	No Limit
<b>EP117: Alcohols (QC Lot: 2477831)</b>									
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP117: Ethanol	64-17-5	50	µg/L	1360	1350	1.2	0% - 20%
		EP117: Isopropanol	67-63-0	50	µg/L	2840	2920	2.6	0% - 20%
		EP117: n-Propanol	71-23-8	50	µg/L	22800	21300	6.9	0% - 20%
		EP117: Isobutanol	78-83-1	50	µg/L	<250	<250	0.0	No Limit
		EP117: n-Butanol	71-36-3	50	µg/L	<250	<250	0.0	No Limit



## Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: WATER

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
Method: Compound	CAS Number	LOR	Unit	Result	Spike Concentration	Spike Recovery (%) LCS	Recovery Limits (%) Low High	
<b>EA015: Total Dissolved Solids (QCLot: 2474076)</b>								
EA015H: Total Dissolved Solids @180°C	GIS-210-010	10	mg/L	<10	2000 mg/L	102	98	104
<b>ED009: Anions (QCLot: 2476447)</b>								
ED009-X: Bromide	24959-67-9	0.01	mg/L	<0.010	2 mg/L	96.6	88	112
ED009-X: Iodide	20461-54-5	0.01	mg/L	<0.010	0.5 mg/L	113	75	127
<b>ED037P: Alkalinity by PC Titrator (QCLot: 2475151)</b>								
ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	----	200 mg/L	100	77	127
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2473892)</b>								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	12.5 mg/L	104	81	125
<b>ED045G: Chloride Discrete analyser (QCLot: 2473894)</b>								
ED045G: Chloride	16887-00-6	1	mg/L	<1	1000 mg/L	99.0	89	117
<b>ED093F: Dissolved Major Cations (QCLot: 2473893)</b>								
ED093F: Calcium	7440-70-2	1	mg/L	<1	5 mg/L	102	83	129
ED093F: Magnesium	7439-95-4	1	mg/L	<1	5 mg/L	101	80	124
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	98.4	77	125
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	95.8	77	123
<b>EG020F: Dissolved Metals by ICP-MS (QCLot: 2476712)</b>								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	102	80	120
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	102	87	109
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	100	70	124
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	102	88	110
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	97.7	88	110
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	95.0	86	112
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	106	87	111
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	97.8	86	108
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	104	90	110
EG020A-F: Lithium	7439-93-2	0.001	mg/L	<0.001	0.1 mg/L	110	60	130
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	97.0	87	111
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	97.6	84	108
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	106	86	112
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	97.5	83	111
EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	0.1 mg/L	103	83	111
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	93.9	85	113
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	102	86	120
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.1 mg/L	124	61	133



Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
				Result	Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
						LCS	Low	High
<b>EG020F: Dissolved Metals by ICP-MS (QCLot: 2476712) - continued</b>								
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	98.3	79	119
<b>EG020F: Dissolved Metals by ICP-MS (QCLot: 2476713)</b>								
EG020B-F: Strontium	7440-24-6	0.001	mg/L	<0.001	0.1 mg/L	99.4	88	108
EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	----	----	----	----
<b>EG035F: Dissolved Mercury by FIMS (QCLot: 2476711)</b>								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.0100 mg/L	107	71	125
<b>EK025G: Free cyanide by Discrete Analyser (QCLot: 2474592)</b>								
EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	0.2 mg/L	100	73	111
<b>EK026G: Total Cyanide By Discrete Analyser (QCLot: 2474599)</b>								
EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	0.2 mg/L	95.8	85	125
<b>EK040P: Fluoride by PC Titrator (QCLot: 2475152)</b>								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	101	78	120
<b>EK055G: Ammonia as N by Discrete Analyser (QCLot: 2475171)</b>								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	90.4	76	122
<b>EK057G: Nitrite as N by Discrete Analyser (QCLot: 2473891)</b>								
EK057G: Nitrite as N	----	0.01	mg/L	<0.01	0.5 mg/L	93.1	84	112
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2475172)</b>								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	101	73	127
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2475438)</b>								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	85.5	63	117
<b>EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2475439)</b>								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	93.5	73	117
<b>EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2473890)</b>								
EK071G: Reactive Phosphorus as P	----	0.01	mg/L	<0.01	0.5 mg/L	99.6	84	108
<b>EP005: Total Organic Carbon (TOC) (QCLot: 2488012)</b>								
EP005: Total Organic Carbon	----	1	mg/L	<1	100 mg/L	98.6	81	111
<b>EP010: Formaldehyde (QCLot: 2473623)</b>								
EP010: Formaldehyde	50-00-0	0.1	mg/L	<0.1	5.0 mg/L	102	91	117
<b>EP041A: Nonionic Surfactants (QCLot: 2476292)</b>								
EP041A: Nonionic Surfactants as CTAS	----	5	mg/L	<5	10 mg/L	97.0	81.1	110
<b>EP050: Anionic Surfactants as MBAS (QCLot: 2475995)</b>								
EP050: Anionic Surfactants as MBAS		0.1	mg/L	<0.1	1 mg/L	90.0	83.2	115
<b>EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 2485081)</b>								
EP074: Benzene	71-43-2	1	µg/L	<1	20 µg/L	97.5	79	121
EP074: Toluene	108-88-3	2	µg/L	<2	20 µg/L	109	80	124
EP074: Ethylbenzene	100-41-4	2	µg/L	<2	20 µg/L	98.3	79	121



Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike	Spike Recovery (%)		Recovery Limits (%)	
					Concentration	LCS	Low	High	
<b>EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 2485081) - continued</b>									
EP074: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	40 µg/L	96.8	80	122	
EP074: Styrene	100-42-5	5	µg/L	<5	20 µg/L	96.1	74	122	
EP074: ortho-Xylene	95-47-6	2	µg/L	<2	20 µg/L	99.2	81	123	
EP074: Isopropylbenzene	98-82-8	5	µg/L	<5	20 µg/L	91.5	80	120	
EP074: n-Propylbenzene	103-65-1	5	µg/L	<5	20 µg/L	94.3	70	120	
EP074: 1,3,5-Trimethylbenzene	108-67-8	5	µg/L	<5	20 µg/L	92.8	71	119	
EP074: sec-Butylbenzene	135-98-8	5	µg/L	<5	20 µg/L	96.2	72	120	
EP074: 1,2,4-Trimethylbenzene	95-63-6	5	µg/L	<5	20 µg/L	91.4	73	119	
EP074: tert-Butylbenzene	98-06-6	5	µg/L	<5	20 µg/L	90.1	73	119	
EP074: p-Isopropyltoluene	99-87-6	5	µg/L	<5	20 µg/L	92.3	71	121	
EP074: n-Butylbenzene	104-51-8	5	µg/L	<5	20 µg/L	92.3	65	121	
<b>EP074B: Oxygenated Compounds (QCLot: 2485081)</b>									
EP074: Vinyl Acetate	108-05-4	50	µg/L	<50	200 µg/L	85.1	57	131	
EP074: 2-Butanone (MEK)	78-93-3	50	µg/L	<50	200 µg/L	88.5	69	135	
EP074: 4-Methyl-2-pentanone (MIBK)	108-10-1	50	µg/L	<50	200 µg/L	95.3	68	136	
EP074: 2-Hexanone (MBK)	591-78-6	50	µg/L	<50	200 µg/L	98.1	68	138	
<b>EP074C: Sulfonated Compounds (QCLot: 2485081)</b>									
EP074: Carbon disulfide	75-15-0	5	µg/L	<5	20 µg/L	75.0	67	127	
<b>EP074D: Fumigants (QCLot: 2485081)</b>									
EP074: 2,2-Dichloropropane	594-20-7	5	µg/L	<5	20 µg/L	91.6	59	128	
EP074: 1,2-Dichloropropane	78-87-5	5	µg/L	<5	20 µg/L	93.3	77	121	
EP074: cis-1,3-Dichloropropylene	10061-01-5	5	µg/L	<5	20 µg/L	82.0	70	118	
EP074: trans-1,3-Dichloropropylene	10061-02-6	5	µg/L	<5	20 µg/L	67.7	66	120	
EP074: 1,2-Dibromoethane (EDB)	106-93-4	5	µg/L	<5	20 µg/L	94.4	78	124	
<b>EP074E: Halogenated Aliphatic Compounds (QCLot: 2485081)</b>									
EP074: Dichlorodifluoromethane	75-71-8	50	µg/L	<50	200 µg/L	112	58	148	
EP074: Chloromethane	74-87-3	50	µg/L	<50	200 µg/L	107	62	142	
EP074: Vinyl chloride	75-01-4	50	µg/L	<50	200 µg/L	104	61	141	
EP074: Bromomethane	74-83-9	50	µg/L	<50	200 µg/L	81.3	57	131	
EP074: Chloroethane	75-00-3	50	µg/L	<50	200 µg/L	107	64	138	
EP074: Trichlorofluoromethane	75-69-4	50	µg/L	<50	200 µg/L	99.0	67	131	
EP074: 1,1-Dichloroethene	75-35-4	5	µg/L	<5	20 µg/L	88.1	71	125	
EP074: Iodomethane	74-88-4	5	µg/L	<5	20 µg/L	66.0	61	135	
EP074: trans-1,2-Dichloroethene	156-60-5	5	µg/L	<5	20 µg/L	90.9	75	121	
EP074: 1,1-Dichloroethane	75-34-3	5	µg/L	<5	20 µg/L	94.4	77	121	
EP074: cis-1,2-Dichloroethene	156-59-2	5	µg/L	<5	20 µg/L	95.1	78	122	
EP074: 1,1,1-Trichloroethane	71-55-6	5	µg/L	<5	20 µg/L	86.0	70	120	
EP074: 1,1-Dichloropropylene	563-58-6	5	µg/L	<5	20 µg/L	94.5	74	122	



Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike	Spike Recovery (%)		Recovery Limits (%)	
					Concentration	LCS	Low	High	
<b>EP074E: Halogenated Aliphatic Compounds (QCLot: 2485081) - continued</b>									
EP074: Carbon Tetrachloride	56-23-5	5	µg/L	<5	20 µg/L	81.2	57	123	
EP074: 1,2-Dichloroethane	107-06-2	5	µg/L	<5	20 µg/L	94.2	75	125	
EP074: Trichloroethene	79-01-6	5	µg/L	<5	20 µg/L	93.2	77	121	
EP074: Dibromomethane	74-95-3	5	µg/L	<5	20 µg/L	86.6	76	122	
EP074: 1,1,2-Trichloroethane	79-00-5	5	µg/L	<5	20 µg/L	118	78	126	
EP074: 1,3-Dichloropropane	142-28-9	5	µg/L	<5	20 µg/L	108	79	125	
EP074: Tetrachloroethene	127-18-4	5	µg/L	<5	20 µg/L	112	76	122	
EP074: 1,1,1,2-Tetrachloroethane	630-20-6	5	µg/L	<5	20 µg/L	89.6	65	119	
EP074: trans-1,4-Dichloro-2-butene	110-57-6	5	µg/L	<5	20 µg/L	75.4	46	126	
EP074: cis-1,4-Dichloro-2-butene	1476-11-5	5	µg/L	<5	20 µg/L	66.4	54	132	
EP074: 1,1,2,2-Tetrachloroethane	79-34-5	5	µg/L	<5	20 µg/L	93.3	75	131	
EP074: 1,2,3-Trichloropropane	96-18-4	5	µg/L	<5	20 µg/L	95.2	75	133	
EP074: Pentachloroethane	76-01-7	5	µg/L	<5	20 µg/L	64.7	46	118	
EP074: 1,2-Dibromo-3-chloropropane	96-12-8	5	µg/L	<5	20 µg/L	71.6	54	124	
<b>EP074F: Halogenated Aromatic Compounds (QCLot: 2485081)</b>									
EP074: Chlorobenzene	108-90-7	5	µg/L	<5	20 µg/L	105	81	121	
EP074: Bromobenzene	108-86-1	5	µg/L	<5	20 µg/L	98.1	75	119	
EP074: 2-Chlorotoluene	95-49-8	5	µg/L	<5	20 µg/L	96.2	73	121	
EP074: 4-Chlorotoluene	106-43-4	5	µg/L	<5	20 µg/L	97.1	72	120	
EP074: 1,2,3-Trichlorobenzene	87-61-6	5	µg/L	<5	20 µg/L	96.7	69	123	
<b>EP074G: Trihalomethanes (QCLot: 2485081)</b>									
EP074: Chloroform	67-66-3	5	µg/L	<5	20 µg/L	94.4	77	121	
EP074: Bromodichloromethane	75-27-4	5	µg/L	<5	20 µg/L	76.9	69	117	
EP074: Dibromochloromethane	124-48-1	5	µg/L	<5	20 µg/L	78.7	59	119	
EP074: Bromoform	75-25-2	5	µg/L	<5	20 µg/L	70.9	49	121	
<b>EP075A: Phenolic Compounds (QCLot: 2474975)</b>									
EP075: Phenol	108-95-2	2	µg/L	<2	10 µg/L	34.8	10	65	
EP075: 2-Chlorophenol	95-57-8	2	µg/L	<2	10 µg/L	76.7	29.8	108	
EP075: 2-Methylphenol	95-48-7	2	µg/L	<2	10 µg/L	72.4	21.9	110	
EP075: 3- & 4-Methylphenol	1319-77-3	2	µg/L	----	20 µg/L	73.4	10	108	
		4	µg/L	<4	----	----	----	----	
EP075: 2-Nitrophenol	88-75-5	2	µg/L	<2	10 µg/L	101	31.2	123	
EP075: 2,4-Dimethylphenol	105-67-9	2	µg/L	<2	10 µg/L	60.2	36	124	
EP075: 2,4-Dichlorophenol	120-83-2	2	µg/L	<2	10 µg/L	95.2	31.2	125	
EP075: 2,6-Dichlorophenol	87-65-0	2	µg/L	<2	10 µg/L	94.5	33	123	
EP075: 4-Chloro-3-Methylphenol	59-50-7	2	µg/L	<2	10 µg/L	93.4	39	125	
EP075: 2,4,6-Trichlorophenol	88-06-2	2	µg/L	<2	10 µg/L	92.3	23.9	134	
EP075: 2,4,5-Trichlorophenol	95-95-4	2	µg/L	<2	10 µg/L	90.7	31.6	136	



Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike Concentration	Spike Recovery (%)		Recovery Limits (%)	
						LCS	Low	High	
<b>EP075A: Phenolic Compounds (QCLot: 2474975) - continued</b>									
EP075: Pentachlorophenol	87-86-5	2	µg/L	----	10 µg/L	104	47	153	
		4	µg/L	<4	----	----	----	----	
<b>EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 2474975)</b>									
EP075: Naphthalene	91-20-3	2	µg/L	<2	10 µg/L	117	33	117	
EP075: 2-Methylnaphthalene	91-57-6	2	µg/L	<2	10 µg/L	93.2	33	123	
EP075: 2-Chloronaphthalene	91-58-7	2	µg/L	<2	10 µg/L	88.4	22.6	133	
EP075: Acenaphthylene	208-96-8	2	µg/L	<2	10 µg/L	93.4	35	131	
EP075: Acenaphthene	83-32-9	2	µg/L	<2	10 µg/L	99.6	37	127	
EP075: Fluorene	86-73-7	2	µg/L	<2	10 µg/L	102	39	133	
EP075: Phenanthrene	85-01-8	2	µg/L	<2	10 µg/L	106	42	134	
EP075: Anthracene	120-12-7	2	µg/L	<2	10 µg/L	102	41	135	
EP075: Fluoranthene	206-44-0	2	µg/L	<2	10 µg/L	106	40	146	
EP075: Pyrene	129-00-0	2	µg/L	<2	10 µg/L	107	42	142	
EP075: N-2-Fluorenyl Acetamide	53-96-3	2	µg/L	<2	10 µg/L	104	40	146	
EP075: Benz(a)anthracene	56-55-3	2	µg/L	<2	10 µg/L	105	41	143	
EP075: Chrysene	218-01-9	2	µg/L	<2	10 µg/L	113	40	146	
EP075: Benzo(b) & Benzo(k)fluoranthene	205-99-2	4	µg/L	<4	20 µg/L	114	21	151	
	207-08-9								
EP075: 7,12-Dimethylbenz(a)anthracene	57-97-6	2	µg/L	<2	10 µg/L	123	39	151	
EP075: Benzo(a)pyrene	50-32-8	2	µg/L	<2	10 µg/L	101	39	141	
EP075: 3-Methylcholanthrene	56-49-5	2	µg/L	<2	10 µg/L	99.8	33	139	
EP075: Indeno(1,2,3-cd)pyrene	193-39-5	2	µg/L	<2	10 µg/L	114	31.5	139	
EP075: Dibenz(a,h)anthracene	53-70-3	2	µg/L	<2	10 µg/L	112	30.1	140	
EP075: Benzo(g,h,i)perylene	191-24-2	2	µg/L	<2	10 µg/L	109	29.5	138	
<b>EP075C: Phthalate Esters (QCLot: 2474975)</b>									
EP075: Dimethyl phthalate	131-11-3	2	µg/L	<2	10 µg/L	104	41	141	
EP075: Diethyl phthalate	84-66-2	2	µg/L	<2	10 µg/L	112	45	139	
EP075: Di-n-butyl phthalate	84-74-2	2	µg/L	<4	10 µg/L	114	42	150	
EP075: Butyl benzyl phthalate	85-68-7	2	µg/L	<2	10 µg/L	110	36	152	
EP075: bis(2-ethylhexyl) phthalate	117-81-7	10	µg/L	<10	----	----	----	----	
		20	µg/L	----	10 µg/L	111	42	158	
EP075: Di-n-octylphthalate	117-84-0	2	µg/L	<2	10 µg/L	107	43	141	
<b>EP075D: Nitrosamines (QCLot: 2474975)</b>									
EP075: N-Nitrosomethylethylamine	10595-95-6	2	µg/L	<2	10 µg/L	56.8	10	109	
EP075: N-Nitrosodiethylamine	55-18-5	2	µg/L	<2	10 µg/L	84.5	23.5	124	
EP075: N-Nitrosopyrrolidine	930-55-2	4	µg/L	<4	10 µg/L	68.5	18.8	97	
EP075: N-Nitrosomorpholine	59-89-2	2	µg/L	<2	10 µg/L	64.6	18.3	94	
EP075: N-Nitrosodi-n-propylamine	621-64-7	2	µg/L	<2	10 µg/L	95.0	30.6	129	
EP075: N-Nitrosopiperidine	100-75-4	2	µg/L	<2	10 µg/L	87.4	32	126	





Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report				
					Spike Concentration	Spike Recovery (%)		Recovery Limits (%)	
						LCS	Low	High	
<b>EP075D: Nitrosamines (QCLot: 2474975) - continued</b>									
EP075: N-Nitrosodibutylamine	924-16-3	2	µg/L	<2	10 µg/L	83.8	29.1	135	
EP075: N-Nitrosodiphenyl & Diphenylamine	86-30-6 122-39-4	4	µg/L	<4	10 µg/L	108	39	139	
EP075: Methapyrilene	91-80-5	2	µg/L	<2	10 µg/L	# 116	28.1	70	
<b>EP075E: Nitroaromatics and Ketones (QCLot: 2474975)</b>									
EP075: 2-Picoline	109-06-8	2	µg/L	<2	10 µg/L	38.1	28.4	57	
EP075: Acetophenone	98-86-2	2	µg/L	<2	10 µg/L	98.5	34	126	
EP075: Nitrobenzene	98-95-3	2	µg/L	<2	10 µg/L	93.4	36	120	
EP075: Isophorone	78-59-1	2	µg/L	<2	10 µg/L	94.2	38	124	
EP075: 2,6-Dinitrotoluene	606-20-2	4	µg/L	<4	10 µg/L	105	38	142	
EP075: 2,4-Dinitrotoluene	121-14-2	4	µg/L	<4	10 µg/L	112	44	138	
EP075: 1-Naphthylamine	134-32-7	2	µg/L	<2	10 µg/L	83.3	29.8	152	
EP075: 4-Nitroquinoline-N-oxide	56-57-5	2	µg/L	<2	10 µg/L	153	25.9	168	
EP075: 5-Nitro-o-tolidine	99-55-8	2	µg/L	<2	10 µg/L	93.9	26.2	138	
EP075: Azobenzene	103-33-3	2	µg/L	<2	10 µg/L	109	43	135	
EP075: 1,3,5-Trinitrobenzene	99-35-4	2	µg/L	<2	10 µg/L	110	10	158	
EP075: Phenacetin	62-44-2	2	µg/L	<2	10 µg/L	100	37	131	
EP075: 4-Aminobiphenyl	92-67-1	2	µg/L	<2	10 µg/L	69.1	10	150	
EP075: Pentachloronitrobenzene	82-68-8	2	µg/L	<2	10 µg/L	119	38	146	
EP075: Pronamide	23950-58-5	2	µg/L	<2	10 µg/L	95.9	45	139	
EP075: Dimethylaminoazobenzene	60-11-7	2	µg/L	<2	10 µg/L	117	37	147	
EP075: Chlorobenzilate	510-15-6	2	µg/L	<2	10 µg/L	112	42	148	
<b>EP075F: Haloethers (QCLot: 2474975)</b>									
EP075: Bis(2-chloroethyl) ether	111-44-4	2	µg/L	<2	10 µg/L	40.0	10	142	
EP075: Bis(2-chloroethoxy) methane	111-91-1	2	µg/L	<2	10 µg/L	103	34	126	
EP075: 4-Chlorophenyl phenyl ether	7005-72-3	2	µg/L	<2	10 µg/L	110	39	133	
EP075: 4-Bromophenyl phenyl ether	101-55-3	2	µg/L	<2	10 µg/L	114	39	137	
<b>EP075G: Chlorinated Hydrocarbons (QCLot: 2474975)</b>									
EP075: 1,4-Dichlorobenzene	106-46-7	2	µg/L	<2	10 µg/L	104	23	109	
EP075: 1,3-Dichlorobenzene	541-73-1	2	µg/L	<2	10 µg/L	79.8	19.8	112	
EP075: 1,2-Dichlorobenzene	95-50-1	2	µg/L	<2	10 µg/L	87.8	25.2	109	
EP075: Hexachloroethane	67-72-1	2	µg/L	<2	10 µg/L	99.5	17.4	115	
EP075: 1,2,4-Trichlorobenzene	120-82-1	2	µg/L	<2	10 µg/L	88.6	25.7	112	
EP075: Hexachloropropylene	1888-71-7	2	µg/L	<2	10 µg/L	95.6	19.1	115	
EP075: Hexachlorobutadiene	87-68-3	2	µg/L	<2	10 µg/L	94.3	21.1	117	
EP075: Hexachlorocyclopentadiene	77-47-4	10	µg/L	<10	10 µg/L	94.1	10	120	
EP075: Pentachlorobenzene	608-93-5	2	µg/L	<2	10 µg/L	110	36	130	
EP075: Hexachlorobenzene (HCB)	118-74-1	4	µg/L	<4	20 µg/L	116	11.1	135	
<b>EP075H: Anilines and Benzidines (QCLot: 2474975)</b>									



Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike	Spike Recovery (%)		Recovery Limits (%)	
					Concentration	LCS	Low	High	
<b>EP075H: Anilines and Benzidines (QCLot: 2474975) - continued</b>									
EP075: Aniline	62-53-3	2	µg/L	<2	10 µg/L	44.5	19.8	96	
EP075: 4-Chloroaniline	106-47-8	2	µg/L	<2	10 µg/L	46.0	16.4	130	
EP075: 2-Nitroaniline	88-74-4	4	µg/L	<4	10 µg/L	99.3	38	138	
EP075: 3-Nitroaniline	99-09-2	4	µg/L	<4	10 µg/L	84.7	10	135	
EP075: Dibenzofuran	132-64-9	2	µg/L	<2	10 µg/L	104	39	129	
EP075: 4-Nitroaniline	100-01-6	2	µg/L	<2	10 µg/L	98.6	22.8	133	
EP075: Carbazole	86-74-8	2	µg/L	<2	10 µg/L	95.0	44	138	
EP075: 3,3'-Dichlorobenzidine	91-94-1	2	µg/L	<2	10 µg/L	51.5	14.6	107	
<b>EP075I: Organochlorine Pesticides (QCLot: 2474975)</b>									
EP075: alpha-BHC	319-84-6	2	µg/L	<2	10 µg/L	116	41	143	
EP075: beta-BHC	319-85-7	2	µg/L	<2	10 µg/L	114	39	145	
EP075: gamma-BHC	58-89-9	2	µg/L	<2	10 µg/L	115	39	143	
EP075: delta-BHC	319-86-8	2	µg/L	<2	10 µg/L	111	42	142	
EP075: Heptachlor	76-44-8	2	µg/L	<2	10 µg/L	110	39	139	
EP075: Aldrin	309-00-2	2	µg/L	<2	10 µg/L	113	40	142	
EP075: Heptachlor epoxide	1024-57-3	2	µg/L	<2	10 µg/L	113	37	147	
EP075: alpha-Endosulfan	959-98-8	2	µg/L	<2	10 µg/L	110	42	146	
EP075: 4,4'-DDE	72-55-9	2	µg/L	<2	10 µg/L	100	41	141	
EP075: Dieldrin	60-57-1	2	µg/L	<2	10 µg/L	112	42	144	
EP075: Endrin	72-20-8	2	µg/L	<2	10 µg/L	118	41	145	
EP075: beta-Endosulfan	33213-65-9	2	µg/L	<2	10 µg/L	108	42	146	
EP075: 4,4'-DDD	72-54-8	2	µg/L	<2	10 µg/L	112	40	148	
EP075: Endosulfan sulfate	1031-07-8	2	µg/L	<2	10 µg/L	121	38	152	
EP075: 4,4'-DDT	50-29-3	4	µg/L	<4	10 µg/L	115	33	145	
<b>EP075J: Organophosphorus Pesticides (QCLot: 2474975)</b>									
EP075: Dichlorvos	62-73-7	2	µg/L	<2	10 µg/L	92.5	38	132	
EP075: Dimethoate	60-51-5	2	µg/L	<2	10 µg/L	98.6	36	138	
EP075: Diazinon	333-41-5	2	µg/L	<2	10 µg/L	109	43	141	
EP075: Chlorpyrifos-methyl	5598-13-0	2	µg/L	<2	10 µg/L	112	43	141	
EP075: Malathion	121-75-5	2	µg/L	<2	10 µg/L	120	44	148	
EP075: Fenthion	55-38-9	2	µg/L	<2	10 µg/L	114	42	144	
EP075: Chlorpyrifos	2921-88-2	2	µg/L	<2	10 µg/L	104	42	142	
EP075: Pirimphos-ethyl	23505-41-1	2	µg/L	<2	10 µg/L	111	44	142	
EP075: Chlorfenvinphos	470-90-6	2	µg/L	<2	10 µg/L	120	44	146	
EP075: Prothiofos	34643-46-4	2	µg/L	<2	10 µg/L	106	40	142	
EP075: Ethion	563-12-2	2	µg/L	<2	10 µg/L	116	42	146	
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QCLot: 2475028)</b>									
EP070-CWG: Aliphatic >C10-C12	TPHCWG-AL E1	50	µg/L	<50	2505 µg/L	85.7	70	130	



Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
						LCS	Low	High
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QCLot: 2475028) - continued</b>								
EP070-CWG: Aliphatic >C12-C16	TPHCWG-AL E2	50	µg/L	<50	10590 µg/L	90.1	70	130
EP070-CWG: Aliphatic >C16-C21	----	50	µg/L	<50	9345 µg/L	106	70	130
EP070-CWG: Aliphatic >C21-C35	----	50	µg/L	<50	2253 µg/L	97.7	70	130
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QCLot: 2485082)</b>								
EP079-CWG: Aliphatic >C5-C6	----	20	µg/L	<20	50 µg/L	98.6	70	130
EP079-CWG: Aliphatic >C6-C8	TPHCWG-AL V2	20	µg/L	<20	100 µg/L	85.7	70	130
EP079-CWG: Aliphatic >C8-C10	TPHCWG-AL V3	20	µg/L	<20	120 µg/L	86.2	70	130
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QCLot: 2475028)</b>								
EP070-CWG: Aromatic >C10-C12	TPHCWG-AR E1	50	µg/L	<50	750 µg/L	92.8	70	130
EP070-CWG: Aromatic >C12-C16	TPHCWG-AR E2	50	µg/L	<50	3174 µg/L	107	70	130
EP070-CWG: Aromatic >C16-C21	TPHCWG-AR E3	50	µg/L	<50	2607 µg/L	97.7	70	130
EP070-CWG: Aromatic >C21-C35	TPHCWG-AR E4	50	µg/L	<50	606 µg/L	90.4	70	130
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QCLot: 2485082)</b>								
EP079-CWG: Aromatic >C5-C7	----	1	µg/L	<1	20 µg/L	104	70	130
EP079-CWG: Aromatic >C7-C8	TPHCWG-AR V2	2	µg/L	<2	20 µg/L	102	70	130
EP079-CWG: Aromatic >C8-C10	TPHCWG-AR V3	2	µg/L	<2	180 µg/L	75.2	70	130
<b>EP117: Alcohols (QCLot: 2477831)</b>								
EP117: Ethanol	64-17-5	50	µg/L	<50	100 µg/L	92.6	73	121
EP117: Isopropanol	67-63-0	50	µg/L	<50	100 µg/L	92.9	73	113
EP117: n-Propanol	71-23-8	50	µg/L	<50	100 µg/L	88.4	68	116
EP117: Isobutanol	78-83-1	50	µg/L	<50	100 µg/L	93.2	67	117
EP117: n-Butanol	71-36-3	50	µg/L	<50	100 µg/L	91.4	65	119



## Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
					MS	Low	High
<b>ED009: Anions (QCLot: 2476447)</b>							
EM1209913-001	Anonymous	ED009-X: Bromide	24959-67-9	0.2 mg/L	# Not Determined	70	130
		ED009-X: Iodide	20461-54-5	8 mg/L	102	70	130
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2473892)</b>							
EM1209916-010	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	10 mg/L	93.1	70	130
<b>ED045G: Chloride Discrete analyser (QCLot: 2473894)</b>							
EM1209916-010	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	112	70	130
<b>EG020F: Dissolved Metals by ICP-MS (QCLot: 2476712)</b>							
EM1209762-001	Anonymous	EG020A-F: Arsenic	7440-38-2	0.2 mg/L	127	89	139
		EG020A-F: Beryllium	7440-41-7	0.2 mg/L	104	64	138
		EG020A-F: Barium	7440-39-3	0.2 mg/L	89.0	80	122
		EG020A-F: Cadmium	7440-43-9	0.05 mg/L	116	75	131
		EG020A-F: Chromium	7440-47-3	0.2 mg/L	121	70	130
		EG020A-F: Cobalt	7440-48-4	0.2 mg/L	119	77	129
		EG020A-F: Copper	7440-50-8	0.2 mg/L	123	71	127
		EG020A-F: Lead	7439-92-1	0.2 mg/L	117	71	123
		EG020A-F: Manganese	7439-96-5	0.2 mg/L	126	66	132
		EG020A-F: Nickel	7440-02-0	0.2 mg/L	112	73	129
		EG020A-F: Vanadium	7440-62-2	0.2 mg/L	96.4	70	130
EG020A-F: Zinc	7440-66-6	0.2 mg/L	98.5	68	136		
<b>EG035F: Dissolved Mercury by FIMS (QCLot: 2476711)</b>							
EM1209762-002	Anonymous	EG035F: Mercury	7439-97-6	0.0100 mg/L	85.8	70	130
<b>EK025G: Free cyanide by Discrete Analyser (QCLot: 2474592)</b>							
EM1209920-003	Anonymous	EK025G: Free Cyanide	----	0.2 mg/L	102	70	130
<b>EK026G: Total Cyanide By Discrete Analyser (QCLot: 2474599)</b>							
EM1209913-002	Anonymous	EK026G: Total Cyanide	57-12-5	0.2 mg/L	101	70	130
<b>EK040P: Fluoride by PC Titrator (QCLot: 2475152)</b>							
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EK040P: Fluoride	16984-48-8	5.0 mg/L	99.8	70	130
<b>EK055G: Ammonia as N by Discrete Analyser (QCLot: 2475171)</b>							
EM1209914-002	Anonymous	EK055G: Ammonia as N	7664-41-7	0.5 mg/L	87.0	70	130
<b>EK057G: Nitrite as N by Discrete Analyser (QCLot: 2473891)</b>							
EM1209916-002	Anonymous	EK057G: Nitrite as N	----	0.5 mg/L	93.8	70	130
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2475172)</b>							

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 Client : SANTOS LTD  
 Project : HFRA Fluids Sampling - Extended Analysis



Sub-Matrix: WATER

				Matrix Spike (MS) Report			
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Spike	Spike Recovery (%)	Recovery Limits (%)	
				Concentration	MS	Low	High
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2475172) - continued</b>							
EM1209937-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	1.0 mg/L	# 66.7	70	130
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2475438)</b>							
EM1209916-012	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	129	70	130
<b>EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2475439)</b>							
EM1209916-012	Anonymous	EK067G: Total Phosphorus as P	----	1 mg/L	# Not Determined	70	130
<b>EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2473890)</b>							
EM1209913-002	Anonymous	EK071G: Reactive Phosphorus as P	----	0.5 mg/L	97.9	70	130
<b>EP005: Total Organic Carbon (TOC) (QCLot: 2488012)</b>							
EM1209762-024	Anonymous	EP005: Total Organic Carbon	----	100 mg/L	103	70	130
<b>EP041A: Nonionic Surfactants (QCLot: 2476292)</b>							
ES1220994-003	Anonymous	EP041A: Nonionic Surfactants as CTAS	----	5 mg/L	78.0	70	130
<b>EP050: Anionic Surfactants as MBAS (QCLot: 2475995)</b>							
ES1220980-001	Anonymous	EP050: Anionic Surfactants as MBAS	----	1.0 mg/L	80.0	70	130
<b>EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 2485081)</b>							
EM1210094-015	Anonymous	EP074: Benzene	71-43-2	20 µg/L	91.9	64	121
		EP074: Toluene	108-88-3	20 µg/L	111	63	125
<b>EP074E: Halogenated Aliphatic Compounds (QCLot: 2485081)</b>							
EM1210094-015	Anonymous	EP074: 1,1-Dichloroethene	75-35-4	20 µg/L	76.4	52	104
		EP074: Trichloroethene	79-01-6	20 µg/L	83.8	59	120
<b>EP074F: Halogenated Aromatic Compounds (QCLot: 2485081)</b>							
EM1210094-015	Anonymous	EP074: Chlorobenzene	108-90-7	20 µg/L	109	63	132
<b>EP075A: Phenolic Compounds (QCLot: 2474975)</b>							
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP075: Phenol	108-95-2	10 µg/L	# Not Determined	10	51
		EP075: 2-Chlorophenol	95-57-8	10 µg/L	# Not Determined	26.1	104
		EP075: 2-Nitrophenol	88-75-5	10 µg/L	# Not Determined	34	118
		EP075: 4-Chloro-3-Methylphenol	59-50-7	10 µg/L	# Not Determined	24.9	135
		EP075: Pentachlorophenol	87-86-5	10 µg/L	# Not Determined	29.9	194
<b>EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 2474975)</b>							
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP075: Acenaphthene	83-32-9	10 µg/L	# Not Determined	27	133
		EP075: Pyrene	129-00-0	10 µg/L	# Not Determined	28.1	146
<b>EP075D: Nitrosamines (QCLot: 2474975)</b>							
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP075: N-Nitrosodi-n-propylamine	621-64-7	10 µg/L	# Not Determined	22.8	125
<b>EP075E: Nitroaromatics and Ketones (QCLot: 2474975)</b>							
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP075: 2,4-Dinitrotoluene	121-14-2	10 µg/L	# Not Determined	27.9	138



Sub-Matrix: WATER

				Matrix Spike (MS) Report			
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Spike	Spike Recovery (%)	Recovery Limits (%)	
				Concentration	MS	Low	High
<b>EP075G: Chlorinated Hydrocarbons (QCLot: 2474975)</b>							
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP075: 1,4-Dichlorobenzene	106-46-7	10 µg/L	# Not Determined	22.1	112
		EP075: 1,2,4-Trichlorobenzene	120-82-1	10 µg/L	# Not Determined	15.3	117
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QCLot: 2485082)</b>							
EM1210094-015	Anonymous	EP079-CWG: Aliphatic >C5-C6	----	70 µg/L	113	70	130
		EP079-CWG: Aliphatic >C6-C8	TPHCWG-AL V2	120 µg/L	91.1	70	130
		EP079-CWG: Aliphatic >C8-C10	TPHCWG-AL V3	120 µg/L	# 66.5	70	130
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QCLot: 2485082)</b>							
EM1210094-015	Anonymous	EP079-CWG: Aromatic >C5-C7	----	20 µg/L	91.6	70	130
		EP079-CWG: Aromatic >C7-C8	TPHCWG-AR V2	20 µg/L	99.2	70	130
<b>EP117: Alcohols (QCLot: 2477831)</b>							
EM1209924-001	Tindilpie Pad Pit Flowback frac pit water post flowback	EP117: Ethanol	64-17-5	100 µg/L	# Not Determined	70	130
		EP117: Isopropanol	67-63-0	100 µg/L	# Not Determined	70	130
		EP117: n-Propanol	71-23-8	100 µg/L	# Not Determined	70	130
		EP117: Isobutanol	78-83-1	1000 µg/L	99.7	70	130
		EP117: n-Butanol	71-36-3	100 µg/L	# Not Determined	70	130



## Environmental Division

### INTERPRETIVE QUALITY CONTROL REPORT

<b>Work Order</b>	: <b>EM1209924</b>	<b>Page</b>	: 1 of 15
<b>Amendment</b>	: <b>1</b>		
<b>Client</b>	: SANTOS LTD	<b>Laboratory</b>	: Environmental Division Melbourne
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<b>Project</b>	: HFRA Fluids Sampling - Extended Analysis	<b>QC Level</b>	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
<b>Site</b>	: ----		
<b>C-O-C number</b>	: ----	<b>Date Samples Received</b>	: 28-AUG-2012
<b>Sampler</b>	: BC/AJ	<b>Issue Date</b>	: 12-SEP-2012
<b>Order number</b>	: 879002/538		
<b>Quote number</b>	: EN/039/11	<b>No. of samples received</b>	: 1
		<b>No. of samples analysed</b>	: 1

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

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## Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **WATER**

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
<b>EA005: pH</b>							
Clear Plastic Bottle - Natural Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	----	----	----	31-AUG-2012	27-AUG-2012	*
<b>EA006: Sodium Adsorption Ratio (SAR)</b>							
Clear Plastic Bottle - Natural Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	---	03-SEP-2012	----	03-SEP-2012	03-SEP-2012	✓
<b>EA015: Total Dissolved Solids</b>							
Clear Plastic Bottle - Natural Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	----	----	----	30-AUG-2012	03-SEP-2012	✓
<b>ED009: Anions</b>							
Clear Plastic Bottle - Natural Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	----	----	----	03-SEP-2012	24-SEP-2012	✓
<b>ED037P: Alkalinity by PC Titrator</b>							
Clear Plastic Bottle - Natural Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	---	10-SEP-2012	----	30-AUG-2012	10-SEP-2012	✓
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</b>							
Clear Plastic Bottle - Natural Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	---	24-SEP-2012	----	31-AUG-2012	24-SEP-2012	✓
<b>ED045G: Chloride Discrete analyser</b>							
Clear Plastic Bottle - Natural Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	---	24-SEP-2012	----	31-AUG-2012	24-SEP-2012	✓
<b>ED093F: Dissolved Major Cations</b>							
Clear Plastic Bottle - Natural Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	---	03-SEP-2012	----	03-SEP-2012	03-SEP-2012	✓
<b>EG020F: Dissolved Metals by ICP-MS</b>							
Clear Plastic Bottle - Natural Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	---	23-FEB-2013	----	03-SEP-2012	23-FEB-2013	✓
<b>EG035F: Dissolved Mercury by FIMS</b>							
Clear Plastic Bottle - Natural Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	---	10-SEP-2012	----	04-SEP-2012	10-SEP-2012	✓
<b>EK011: Chlorine - Free</b>							
Clear Plastic Bottle - Natural Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	----	----	----	29-AUG-2012	27-AUG-2012	*





Matrix: WATER

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
<b>EK025G: Free cyanide by Discrete Analyser</b>							
White Plastic Bottle-NaOH Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	30-AUG-2012	10-SEP-2012	✓	30-AUG-2012	10-SEP-2012	✓
<b>EK026G: Total Cyanide By Discrete Analyser</b>							
White Plastic Bottle-NaOH Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	30-AUG-2012	10-SEP-2012	✓	30-AUG-2012	10-SEP-2012	✓
<b>EK040P: Fluoride by PC Titrator</b>							
Clear Plastic Bottle - Natural Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	---	24-SEP-2012	----	30-AUG-2012	24-SEP-2012	✓
<b>EK055G: Ammonia as N by Discrete Analyser</b>							
Clear Plastic Bottle - Sulfuric Acid Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	---	24-SEP-2012	----	03-SEP-2012	24-SEP-2012	✓
<b>EK057G: Nitrite as N by Discrete Analyser</b>							
Clear Plastic Bottle - Natural Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	---	29-AUG-2012	----	30-AUG-2012	29-AUG-2012	*✗
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>							
Clear Plastic Bottle - Sulfuric Acid Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	---	24-SEP-2012	----	31-AUG-2012	24-SEP-2012	✓
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>							
Clear Plastic Bottle - Sulfuric Acid Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	31-AUG-2012	24-SEP-2012	✓	03-SEP-2012	24-SEP-2012	✓
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>							
Clear Plastic Bottle - Sulfuric Acid Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	31-AUG-2012	24-SEP-2012	✓	03-SEP-2012	24-SEP-2012	✓
<b>EK071G: Reactive Phosphorus as P by discrete analyser</b>							
Clear Plastic Bottle - Natural Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	---	29-AUG-2012	----	30-AUG-2012	29-AUG-2012	*✗
<b>EP005: Total Organic Carbon (TOC)</b>							
Amber VOC Vial - Sulfuric Acid Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	----	----	----	07-SEP-2012	24-SEP-2012	✓
<b>EP010: Formaldehyde</b>							
Clear Plastic Bottle - Natural Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	----	----	----	29-AUG-2012	29-AUG-2012	✓
<b>EP041A: Nonionic Surfactants</b>							
Pres. with Formaldehyde on receipt Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	----	----	----	03-SEP-2012	24-SEP-2012	✓
<b>EP050: Anionic Surfactants as MBAS</b>							
Pres. with Formaldehyde on receipt Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	----	----	----	30-AUG-2012	31-AUG-2012	✓
<b>EP074A: Monocyclic Aromatic Hydrocarbons</b>							
Amber VOC Vial - Sulfuric Acid Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	06-SEP-2012	10-SEP-2012	✓	07-SEP-2012	10-SEP-2012	✓



Matrix: **WATER**

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
<b>EP074B: Oxygenated Compounds</b>							
<b>Amber VOC Vial - Sulfuric Acid</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	06-SEP-2012	10-SEP-2012	✓	07-SEP-2012	10-SEP-2012	✓
<b>EP074C: Sulfonated Compounds</b>							
<b>Amber VOC Vial - Sulfuric Acid</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	06-SEP-2012	10-SEP-2012	✓	07-SEP-2012	10-SEP-2012	✓
<b>EP074D: Fumigants</b>							
<b>Amber VOC Vial - Sulfuric Acid</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	06-SEP-2012	10-SEP-2012	✓	07-SEP-2012	10-SEP-2012	✓
<b>EP074E: Halogenated Aliphatic Compounds</b>							
<b>Amber VOC Vial - Sulfuric Acid</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	06-SEP-2012	10-SEP-2012	✓	07-SEP-2012	10-SEP-2012	✓
<b>EP074F: Halogenated Aromatic Compounds</b>							
<b>Amber VOC Vial - Sulfuric Acid</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	06-SEP-2012	10-SEP-2012	✓	07-SEP-2012	10-SEP-2012	✓
<b>EP074G: Trihalomethanes</b>							
<b>Amber VOC Vial - Sulfuric Acid</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	06-SEP-2012	10-SEP-2012	✓	07-SEP-2012	10-SEP-2012	✓
<b>EP075A: Phenolic Compounds</b>							
<b>Amber Glass Bottle - Unpreserved</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	30-AUG-2012	03-SEP-2012	✓	04-SEP-2012	09-OCT-2012	✓
<b>EP075B: Polynuclear Aromatic Hydrocarbons</b>							
<b>Amber Glass Bottle - Unpreserved</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	30-AUG-2012	03-SEP-2012	✓	04-SEP-2012	09-OCT-2012	✓
<b>EP075C: Phthalate Esters</b>							
<b>Amber Glass Bottle - Unpreserved</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	30-AUG-2012	03-SEP-2012	✓	04-SEP-2012	09-OCT-2012	✓
<b>EP075D: Nitrosamines</b>							
<b>Amber Glass Bottle - Unpreserved</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	30-AUG-2012	03-SEP-2012	✓	04-SEP-2012	09-OCT-2012	✓
<b>EP075E: Nitroaromatics and Ketones</b>							
<b>Amber Glass Bottle - Unpreserved</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	30-AUG-2012	03-SEP-2012	✓	04-SEP-2012	09-OCT-2012	✓
<b>EP075F: Haloethers</b>							
<b>Amber Glass Bottle - Unpreserved</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	30-AUG-2012	03-SEP-2012	✓	04-SEP-2012	09-OCT-2012	✓
<b>EP075G: Chlorinated Hydrocarbons</b>							
<b>Amber Glass Bottle - Unpreserved</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	30-AUG-2012	03-SEP-2012	✓	04-SEP-2012	09-OCT-2012	✓
<b>EP075H: Anilines and Benzidines</b>							
<b>Amber Glass Bottle - Unpreserved</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	30-AUG-2012	03-SEP-2012	✓	04-SEP-2012	09-OCT-2012	✓



Matrix: **WATER**

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method <i>Container / Client Sample ID(s)</i>	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
<b>EP075I: Organochlorine Pesticides</b>							
<b>Amber Glass Bottle - Unpreserved</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	30-AUG-2012	03-SEP-2012	✓	04-SEP-2012	09-OCT-2012	✓
<b>EP075J: Organophosphorus Pesticides</b>							
<b>Amber Glass Bottle - Unpreserved</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	30-AUG-2012	03-SEP-2012	✓	04-SEP-2012	09-OCT-2012	✓
<b>EP117: Alcohols</b>							
<b>Amber VOC Vial - Sulfuric Acid</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	----	----	----	31-AUG-2012	10-SEP-2012	✓
<b>RIVM Aliphatic Hydrocarbon Fractions</b>							
<b>Amber Glass Bottle - Unpreserved</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	30-AUG-2012	03-SEP-2012	✓	05-SEP-2012	09-OCT-2012	✓
<b>Amber VOC Vial - Sulfuric Acid</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	06-SEP-2012	10-SEP-2012	✓	07-SEP-2012	10-SEP-2012	✓
<b>RIVM Aromatic Hydrocarbon Fractions</b>							
<b>Amber Glass Bottle - Unpreserved</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	30-AUG-2012	03-SEP-2012	✓	05-SEP-2012	09-OCT-2012	✓
<b>Amber VOC Vial - Sulfuric Acid</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	27-AUG-2012	06-SEP-2012	10-SEP-2012	✓	07-SEP-2012	10-SEP-2012	✓



## Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER** Evaluation: \* = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Regular	Actual	Expected	Evaluation	
<b>Laboratory Duplicates (DUP)</b>							
Alcohols by HS-GC-MS	EP117	1	1	100.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Alkalinity by PC Titrator	ED037-P	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Ammonia as N by Discrete analyser	EK055G	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Anionic Surfactants as MBAS	EP050	1	4	25.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	4	25.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite B	EG020B-F	2	19	10.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Formaldehyde	EP010	1	1	100.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Free CN by Segmented Flow Analyser	EK025SF	1	6	16.7	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	1	4	25.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	17	11.8	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nonionic Surfactants as CTAS	EP041A	1	2	50.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
pH	EA005	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	12	16.7	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Semivolatile Organic Compounds	EP075	1	1	100.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Standard Anions -by IC (Extended Method)	ED009-X	1	7	14.3	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Cyanide by Segmented Flow Analyser	EK026SF	1	8	12.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	2	12	16.7	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Speciation (TPH CWG RIVM fractions)	EP070-CWG	1	1	100.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	1	3	33.3	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Organic Compounds	EP074	1	5	20.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
<b>Laboratory Control Samples (LCS)</b>							
Alcohols by HS-GC-MS	EP117	1	1	100.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Alkalinity by PC Titrator	ED037-P	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Ammonia as N by Discrete analyser	EK055G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Anionic Surfactants as MBAS	EP050	1	4	25.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	4	50.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	19	5.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Formaldehyde	EP010	1	1	100.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement



Matrix: **WATER** Evaluation: \* = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Regular	Actual	Expected	Evaluation	
<b>Analytical Methods</b>							
<b>Laboratory Control Samples (LCS) - Continued</b>							
Free CN by Segmented Flow Analyser	EK025SF	1	6	16.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	1	4	25.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	17	5.9	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nonionic Surfactants as CTAS	EP041A	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Semivolatile Organic Compounds	EP075	1	1	100.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Standard Anions -by IC (Extended Method)	ED009-X	1	7	14.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Cyanide by Segmented Flow Analyser	EK026SF	1	8	12.5	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Speciation (TPH CWG RIVM fractions)	EP070-CWG	1	1	100.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	1	3	33.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Organic Compounds	EP074	1	5	20.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
<b>Method Blanks (MB)</b>							
Alcohols by HS-GC-MS	EP117	1	1	100.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Ammonia as N by Discrete analyser	EK055G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Anionic Surfactants as MBAS	EP050	1	4	25.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	4	25.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	19	5.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Formaldehyde	EP010	1	1	100.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Free CN by Segmented Flow Analyser	EK025SF	1	6	16.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	1	4	25.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	17	5.9	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nonionic Surfactants as CTAS	EP041A	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Semivolatile Organic Compounds	EP075	1	1	100.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Standard Anions -by IC (Extended Method)	ED009-X	1	7	14.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Cyanide by Segmented Flow Analyser	EK026SF	1	8	12.5	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Speciation (TPH CWG RIVM fractions)	EP070-CWG	1	1	100.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	1	3	33.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement



Matrix: **WATER**

Evaluation: \* = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Regular	Actual	Expected	Evaluation	
<b>Analytical Methods</b>							
<b>Method Blanks (MB) - Continued</b>							
Volatile Organic Compounds	EP074	1	5	20.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
<b>Matrix Spikes (MS)</b>							
Alcohols by HS-GC-MS	EP117	1	1	100.0	5.0	✓	ALS QCS3 requirement
Ammonia as N by Discrete analyser	EK055G	1	20	5.0	5.0	✓	ALS QCS3 requirement
Anionic Surfactants as MBAS	EP050	1	4	25.0	5.0	✓	ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	4	25.0	5.0	✓	ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	20	5.0	5.0	✓	ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.0	5.0	✓	ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	1	20	5.0	5.0	✓	ALS QCS3 requirement
Free CN by Segmented Flow Analyser	EK025SF	1	6	16.7	5.0	✓	ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	17	5.9	5.0	✓	ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	20	5.0	5.0	✓	ALS QCS3 requirement
Nonionic Surfactants as CTAS	EP041A	1	2	50.0	5.0	✓	ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	12	8.3	5.0	✓	ALS QCS3 requirement
Semivolatile Organic Compounds	EP075	1	1	100.0	5.0	✓	ALS QCS3 requirement
Standard Anions -by IC (Extended Method)	ED009-X	1	7	14.3	5.0	✓	ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	5.0	5.0	✓	ALS QCS3 requirement
Total Cyanide by Segmented Flow Analyser	EK026SF	1	8	12.5	5.0	✓	ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.0	5.0	✓	ALS QCS3 requirement
Total Organic Carbon	EP005	1	20	5.0	5.0	✓	ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	1	12	8.3	5.0	✓	ALS QCS3 requirement
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	1	3	33.3	5.0	✓	ALS QCS3 requirement
Volatile Organic Compounds	EP074	1	5	20.0	5.0	✓	ALS QCS3 requirement



## Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH	EA005	WATER	APHA 21st ed. 4500 H+ B. pH of water samples is determined by ISE either manually or by automated pH meter. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Dissolved Solids (High Level)	EA015H	WATER	In-House, APHA 21st ed., 2540C A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Hardness as CaCO3	EA065	WATER	APHA 21st ed., 2340 B. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Standard Anions -by IC (Extended Method)	* ED009-X	WATER	APHA 21st ed., 4110. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Alkalinity by PC Titrator	ED037-P	WATER	APHA 21st ed., 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Major Anions - Dissolved	ED040F	WATER	APHA 21st ed., 3120. The 0.45um filtered samples are determined by ICP/AES for Sulfur and/or Silcon content and reported as Sulfate and/or Silica after conversion by gravimetric factor.
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	APHA 21st ed., 4500-SO4 Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Chloride by Discrete Analyser	ED045G	WATER	APHA 21st ed., 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	Major Cations is determined based on APHA 21st ed., 3120; USEPA SW 846 - 6010 The ICPAES technique ionises the 0.45um filtered sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)  Sodium Absorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)  Hardness parameters are calculated based on APHA 21st ed., 2340 B. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): Samples are 0.45 um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite B	EG020B-F	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): Samples are 0.45 um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.



Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Mercury by FIMS	EG035F	WATER	AS 3550, APHA 21st ed. 3112 Hg - B (Flow-injection (SnCl <sub>2</sub> )(Cold Vapour generation) AAS) Samples are 0.45 um filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl <sub>2</sub> which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Silica (Total Dissolved) by ICPAES	EG052F	WATER	APHA 21st ed., 4500-SiO <sub>2</sub> . Silica (Total) determined by calculation from Silicon by ICPAES.
Residual Chlorine by DPD Colourimetry	EK010-1 (Field)	WATER	Adapted from APHA 21st edition, 4500-Cl G, using Palintest Chlorometer 1000
Free CN by Segmented Flow Analyser	EK025SF	WATER	ASTM D7237: Using an automated segmented flow analyser, a sample at high pH (sodium hydroxide preserved) is buffered to pH 6.0. The hydrogen cyanide present passes across a gas dialysis membrane into an acceptor stream consisting of 0.01 M sodium hydroxide. The acceptor stream mixes with a buffer at pH 5.2 and reacts with chloramine-T to form cyanogen chloride. Cyanogen chloride reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour, measured at 600nm. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Cyanide by Segmented Flow Analyser	EK026SF	WATER	APHA 4500-CN-O. Sodium hydroxide preserved samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Fluoride by PC Titrator	EK040P	WATER	APHA 21st ed., 4500 F--C CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Ammonia as N by Discrete analyser	EK055G	WATER	APHA 21st ed., 4500-NH <sub>3</sub> G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrite as N by Discrete Analyser	EK057G	WATER	APHA 21st ed., 4500-NO <sub>2</sub> - B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrate as N by Discrete Analyser	EK058G	WATER	APHA 21st ed., 4500-NO <sub>3</sub> - F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined separately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrite and Nitrate as N (NO <sub>x</sub> ) by Discrete Analyser	EK059G	WATER	APHA 21st ed., 4500-NO <sub>3</sub> - F. Combined oxidised Nitrogen (NO <sub>2</sub> +NO <sub>3</sub> ) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	APHA 21st ed., 4500-Norg D. 25mL water samples are digested using a traditional Kjeldahl digestion followed by determination by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Nitrogen as N (TKN + No <sub>x</sub> ) By Discrete Analyser	EK062G	WATER	APHA 21st ed., 4500-Norg / 4500-NO <sub>3</sub> -. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	APHA 21st ed., 4500-P B&F This procedure involves sulphuric acid digestion of a 100mL sample to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)





Analytical Methods	Method	Matrix	Method Descriptions
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	APHA 21st ed., 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with orthophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	APHA 21st Ed. 1030F. The Ionic Balance is calculated based on the major Anions and Cations. The major anions include Alkalinity, Chloride and Sulfate which determined by PCT and DA. The Cations are determined by Turbi SO4 by DA. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Organic Carbon	EP005	WATER	APHA 21st ed., 5310 B, The automated TOC analyzer determines Total and Inorganic Carbon by IR cell. TOC is calculated as the difference. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Formaldehyde	EP010	WATER	In-house (ASTM D 6303-98) Determined by colourimetry using NASH reagent. The Hantzsch reaction method is based on the reaction of acetylacetone with formaldehyde in the presence of excess ammonium acetate to form a coloured compound.
Nonionic Surfactants as CTAS	EP041A	WATER	APHA 21st ed., 5540 B & D. This method estimates the non-ionic surfactant content of waters. Sublimation transfers all surfactants into a solvent matrix. Cationic and Anionic surfactants are removed by an ion exchange resin column. The remaining surfactant is coloured up with Cobalt Thiocyanate solution and quantified by UV-vis against LAS standards. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Anionic Surfactants as MBAS	EP050	WATER	APHA 21st ed., 5540 B & C This method comprises three successive extractions from acid aqueous medium containing excess methylene blue, into chloroform, followed by an aqueous backwash and measurement of the colour by spectrophotometry at 652nm. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
TPH Speciation (TPH CWG RIVM fractions)	EP070-CWG	WATER	In-house: Determination of TPH following fractionation by GC-FID. Fractions correspond to those outlined in TPHCWG, 1998, Analysis of Petroleum Hydrocarbons in Environmental Media, TPH Criteria Working Group, Toxicity Technical Action Group, vol I and RIVM report 601501021/2004, Environmental Risk Limits for Mineral Oil (Total Petroleum Hydrocarbons). Aliphatic >C21 - C35 is defined by RIVM only.
Volatile Organic Compounds	EP074	WATER	USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Semivolatile Organic Compounds	EP075	WATER	USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	WATER	In-house. Conventional TPH and MAH data are determined by Purge and Trap GCMS analysis. TIC data (as fractions) and target aromatics (or groups of aromatics) are used to compute aliphatic and aromatic hydrocarbon fractions by addition or difference. Fractions conform to those outlined in TPHCWG, 1998, Analysis of Petroleum Hydrocarbons in Environmental Media, TPH Criteria Working Group, Toxicity Technical Action Group, vol I and RIVM report 601501021/2004, Environmental Risk Limits for Mineral Oil (Total Petroleum Hydrocarbons)
Alcohols by HS-GC-MS	* EP117	WATER	In House. A 10 mL aliquot of sample is mixed with 4 g of sodium chloride, equilibrated at 80 degrees C for 10 minutes and the headspace analysed by GCMS in the selected ion monitoring mode.

Preparation Methods	Method	Matrix	Method Descriptions
CN Dummy Prep	CN-DP	WATER	CN Dummy Prep for SFA Determinations
Free Cyanide	EK025-PR	WATER	APHA 21st ed., 4500 CN- C&N. The sample is distilled at natural pH. The CN is trapped in a caustic solution, and quantified by colourimetry on FIA. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Separatory Funnel Extraction of Liquids	ORG14	WATER	USEPA SW 846 - 3510B 500 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2). ALS default excludes sediment which may be resident in the container.

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Work Order : EM1209924 Amendment 1  
Client : SANTOS LTD  
Project : HFRA Fluids Sampling - Extended Analysis



<i>Preparation Methods</i>	<i>Method</i>	<i>Matrix</i>	<i>Method Descriptions</i>
Separatory Funnel Extraction of Liquids	ORG14-HX	WATER	Variation of USEPA SW 846 - 3510B: 500 mL to 0.5L of sample is transferred to a separatory funnel and serially extracted three times using 30mL DCM for each extract. The resultant extracts are combined, dehydrated, and exchanged into 5 mL of hexane for analysis. ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for sparging.



## Summary of Outliers

### Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

#### Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
<b>Duplicate (DUP) RPDs</b>							
EP075B: Polynuclear Aromatic Hydrocarbons	EM1209924-001	Tindilpie Pad Pit Flowback frac	<b>2-Methylnaphthalene</b>	91-57-6	24.3 %	0-20%	<b>RPD exceeds LOR based limits</b>
<b>Laboratory Control Spike (LCS) Recoveries</b>							
EP075D: Nitrosamines	2932714-029	----	<b>Methapyrilene</b>	91-80-5	116 %	28.1-70%	<b>Recovery greater than upper control limit</b>
<b>Matrix Spike (MS) Recoveries</b>							
ED009: Anions	EM1209913-001	Anonymous	<b>Bromide</b>	24959-67-9	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Ar	EM1209937-001	Anonymous	<b>Nitrite + Nitrate as N</b>	----	66.7 %	70-130%	<b>Recovery less than lower data quality objective</b>
EK067G: Total Phosphorus as P by Discrete Analyser	EM1209916-012	Anonymous	<b>Total Phosphorus as P</b>	----	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
EP075A: Phenolic Compounds	EM1209924-001	Tindilpie Pad Pit Flowback frac	<b>Phenol</b>	108-95-2	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
EP075A: Phenolic Compounds	EM1209924-001	Tindilpie Pad Pit Flowback frac	<b>2-Chlorophenol</b>	95-57-8	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP075A: Phenolic Compounds	EM1209924-001	Tindilpie Pad Pit Flowback frac	<b>2-Nitrophenol</b>	88-75-5	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP075A: Phenolic Compounds	EM1209924-001	Tindilpie Pad Pit Flowback frac	<b>4-Chloro-3-Methylphenol</b>	59-50-7	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP075A: Phenolic Compounds	EM1209924-001	Tindilpie Pad Pit Flowback frac	<b>Pentachlorophenol</b>	87-86-5	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP075B: Polynuclear Aromatic Hydrocarbons	EM1209924-001	Tindilpie Pad Pit Flowback frac	<b>Acenaphthene</b>	83-32-9	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP075B: Polynuclear Aromatic Hydrocarbons	EM1209924-001	Tindilpie Pad Pit Flowback frac	<b>Pyrene</b>	129-00-0	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP075D: Nitrosamines	EM1209924-001	Tindilpie Pad Pit Flowback frac	<b>N-Nitrosodi-n-propylamine</b>	621-64-7	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP075E: Nitroaromatics and Ketones	EM1209924-001	Tindilpie Pad Pit Flowback frac	<b>2,4-Dinitrotoluene</b>	121-14-2	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP075G: Chlorinated Hydrocarbons	EM1209924-001	Tindilpie Pad Pit Flowback frac	<b>1,4-Dichlorobenzene</b>	106-46-7	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP075G: Chlorinated Hydrocarbons	EM1209924-001	Tindilpie Pad Pit Flowback frac	<b>1,2,4-Trichlorobenzene</b>	120-82-1	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>



Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
<b>Matrix Spike (MS) Recoveries - Continued</b>							
EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions	EM1210094-015	Anonymous	Aliphatic >C8-C10	TPHCWG-ALV3	66.5 %	70-130%	Recovery less than lower data quality objective
EP117: Alcohols	EM1209924-001	Tindilpie Pad Pit Flowback frac	Ethanol	64-17-5	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
EP117: Alcohols	EM1209924-001	Tindilpie Pad Pit Flowback frac	Isopropanol	67-63-0	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
EP117: Alcohols	EM1209924-001	Tindilpie Pad Pit Flowback frac	n-Propanol	71-23-8	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
EP117: Alcohols	EM1209924-001	Tindilpie Pad Pit Flowback frac	n-Butanol	71-36-3	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.

- For all matrices, no Method Blank value outliers occur.

**Regular Sample Surrogates**

Sub-Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
<b>Samples Submitted</b>							
EP075S: Acid Extractable Surrogates	EM1209924-001	Tindilpie Pad Pit Flowback frac	2-Fluorophenol	367-12-4	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1209924-001	Tindilpie Pad Pit Flowback frac	Phenol-d6	13127-88-3	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1209924-001	Tindilpie Pad Pit Flowback frac	2-Chlorophenol-D4	93951-73-6	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1209924-001	Tindilpie Pad Pit Flowback frac	2,4,6-Tribromophenol	118-79-6	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1209924-001	Tindilpie Pad Pit Flowback frac	Nitrobenzene-D5	4165-60-0	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1209924-001	Tindilpie Pad Pit Flowback frac	1,2-Dichlorobenzene-D4	2199-69-1	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1209924-001	Tindilpie Pad Pit Flowback frac	2-Fluorobiphenyl	321-60-8	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1209924-001	Tindilpie Pad Pit Flowback frac	Anthracene-d10	1719-06-8	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1209924-001	Tindilpie Pad Pit Flowback frac	4-Terphenyl-d14	1718-51-0	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences

**Outliers : Analysis Holding Time Compliance**

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

Matrix: **WATER**

Method	Extraction / Preparation	Analysis
--------	--------------------------	----------



Matrix: **WATER**

Container / Client Sample ID(s)	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
<b>EA005: pH</b>						
<b>Clear Plastic Bottle - Natural</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	----	----	----	31-AUG-2012	27-AUG-2012	4
<b>EK011: Chlorine - Free</b>						
<b>Clear Plastic Bottle - Natural</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	----	----	----	29-AUG-2012	27-AUG-2012	2
<b>EK057G: Nitrite as N by Discrete Analyser</b>						
<b>Clear Plastic Bottle - Natural</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	----	----	----	30-AUG-2012	29-AUG-2012	1
<b>EK071G: Reactive Phosphorus as P by discrete analyser</b>						
<b>Clear Plastic Bottle - Natural</b> Tindilpie Pad Pit Flowback - frac pit water post flowback	----	----	----	30-AUG-2012	29-AUG-2012	1

**Outliers : Frequency of Quality Control Samples**

The following report highlights breaches in the Frequency of Quality Control Samples.

- No Quality Control Sample Frequency Outliers exist.

**Raymond Thai**

**From:** Sarah Hodgson  
**Sent:** Tuesday, 28 August 2012 4:06 PM  
**To:** Samples Melbourne  
**Cc:** Kieren Burns  
**Subject:** Santos samples from Tindilpie - no COC

**Importance:** High

Hi Guys,

I've spoken with Tom Delaney who thinks that the sample received today should be analysed as per EM1209245.

He will send through the COC and instructions as soon as he can, but in the meantime just use the ID on the bottles and log the analysis as per the previous work order.

Please note some short holding time analysis pH, Chlorine, nitrate, nitrite, reactive P, formaldehyde.

Thank you,

Regards,  
How was your customer experience? Please send us your feedback

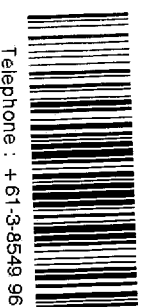
Sarah Hodgson  
PROJECT MANAGER

① BRETT COOK 27/8/12

Environmental Division  
Melbourne  
Work Order  
**EM1209924**

ALS | Environmental  
Address  
4 Westall Road  
Springvale VIC 3171  
PHONE +61 3 8549 9600  
FAX +61 3 8549 9601  
www.alsglobal.com  
cid:615291706@05102011-231E

Samples sent to lab for  
Micro Nitrate BOD pH  
Colour Turbidity RP  
Other Formaldehyde  
Date 29/8/12 BU



Telephone : + 61 -3-8549 9600

-----Original Message-----  
**From:** Kieren Burns  
**Sent:** Tuesday, 28 August 2012 1:30 PM  
**To:** Sarah Hodgson  
**Subject:** FW: Environmental Visitation - Frac Spread, Tindilpie

Regards  
How was your customer experience? Please send us your feedback Kieren Burns ENVIRONMENTAL SERVICES REPRESENTATIVE - SA ALS | Environmental

-----Original Message-----  
**From:** Delaney, Thomas [mailto:Thomas.Delaney@santos.com]  
**Sent:** Monday, 13 August 2012 8:27 AM  
**To:** Samples Melbourne; Kieren Burns  
**Cc:** Johnston, Andrew  
**Subject:** Fwd: Environmental Visitation - Frac Spread, Tindilpie

ALs,  
There will be 2 sets of 18 samples in a blue esky arriving at you Melbourne Lab sometime soon - these were taken this morning and should be flying over there this afternoon. See attached for the COC which is included in the package.

Any queries call my mobile.

Thanks

Tom Delaney  
0421312739

Begin forwarded message:

From: Thomas Delaney <thomas.j.delaney@gmail.com<mailto:thomas.j.delaney@gmail.com>>  
Date: 12 August 2012 4:30:35 PM ACST  
To: "Delaney, Thomas" <thomas.delaney@santos.com<mailto:thomas.delaney@santos.com>>  
Subject: Re: FW: Environmental Visitation - Frac Spread, Tindilpie

samples.melbourne@alsenviro.com<mailto:samples.melbourne@alsenviro.com>;  
Kieren.burns@alsglobal.com<mailto:Kieren.burns@alsglobal.com>;

On Sat, Aug 11, 2012 at 5:19 PM, Delaney, Thomas  
<Thomas.Delaney@santos.com<mailto:Thomas.Delaney@santos.com>> wrote:

From: Delaney, Thomas  
Sent: Saturday, 11 August 2012 17:19  
To: Completions, Frac Rig Rep  
Subject: FW: Environmental Visitation - Frac Spread, Tindilpie  
Importance: High

Hey Jeff - any chance you can print these out for me? Just the email and attached chain of custody forms when you get a chance. Thivanka wants me to sort this out with Mr PIC to get it into Moomba by Monday morning - so want to have a read and get our head around it.

Cheers mate  
TD

-----  
Kind regards,

Tom Delaney | Subsurface Lead  
Cooper Basin SIMOPS - EA Drilling & Completions | Santos Limited  
Ph +61 8 8116 5358<tel:%2B61%208%208116%C2%A05358> | Fax +61 8 8116  
7755<tel:%2B61%208%208116%207755> | Mob: +61 421 312 739<tel:%2B61%C2%A0421%20312%20739> |  
thomas.delaney@santos.com<mailto:thomas.delaney@santos.com>  
Level 8, Santos Centre, 60 Flinders Street, Adelaide SA 5000 | GPO Box 2455, Adelaide SA  
5001  
Santos

From: Dedigama, Thivanka  
Sent: Wednesday, 8 August 2012 12:11  
To: Japp, Kenneth; Delaney, Thomas  
Cc: Best, William  
Subject: FW: Environmental Visitation - Frac Spread, Tindilpie  
Importance: High

Hi Ken and Tom,

Here's one that's going to be interesting. Please review the email below. Only wanted to give you a heads-up on what coming. Don't collect samples yet.

This has previously been communicated to Mark and Paul but I'd like you to take the lead on this for Tindilpie.

For now could you please:

1. Review this and see if you have and EHS or operational concerns about this sampling
2. Locate the cool box, ice packs and 3 x 18 bottles that already supposed to be out there

If you can't find these we have another set coming

3. Locate the 'swing sampler' referred to below. No idea what this looks like. Mark may know.
4. Review the attached CoC form. Some changes will need to be made to update names etc.

I am in the process of getting approval for these samples to fly. Also need to work out with our Logistics guys how best that can be rushed to Melbourne for testing. Should have answers in a couple of days.

The sampling that Bill Best did yesterday should get us out of trouble for this pad. This is more a longer term thing.

Thivanka Dedigama  
Deputy Field Superintendent - Drilling and Petroleum Engineering  
Tel: 08 8678 4191<tel:08%208678%204191>  
Mob: 0431 375 187<tel:0431%20375%20187>

From: Johnston, Andrew  
Sent: Wednesday, 8 August 2012 09:06  
To: Dedigama, Thivanka; Ritchie, Barry  
Cc: Johnston, Andrew; Swann, Louise; Best, William; Smith, Chris  
Subject: Fw: Environmental Visitation - Frac Spread, Tindilpie  
Importance: High

Thivanka,

A proposed schedule for the HFRA sampling is below, I have received no feedback as yet so I suggest we run with it, unless some FR or Frac fluid samples overlap? If this is the case please advise in which case maybe 4 samples in total.

A water sample representing influent stream in considered essential. We picked up some unexpected contaminants in the SWQ samples (Coonaberry 3) that may have been present in the bore water being used. This data can be used to give us an indication of quality prior to addition of frac chemicals, or reservoir constituents from flowback. The procedure for collection of this could be applying the same methodology as per below, but taking from the Turkey's Nest or similar storage of influent water.



Sample Collection procedure / COC is as follows:

Pre sampling

- Place cooler blocks in freezer the day before sample collection – these are located in esky from ALS
- Use of ALS supplied bottles (as per attached COC) is essential. Once obtained, label each bottle (18 make a full “sample) with Sample ID, sampler name, date time etc, and ensure this is consistent with updated COC (example attached – note this needs amending to suit this and other events)

- Aim to collect sample early in the day, and despatch via Airfreight that day for minimum lab turnaround time

On the day

- Make sure disposable gloves are worn, and other PPE also
- Take care when standing near pit, and choose a steady location

- The “swing” sampler is located at the frac spread, and there are specific sample containers that fit this apparatus. Ensure a clean sampling container (500ml) is fitted for each sampling event (an “event” requiring 18 sub samples – you don’t need 18 separate sampling containers!)

- Using sampler, extract sample from approximately 10cm below surface of the fluid. Repeat and purge 3x

- From then, fill all 18 sample containers to the top with fluids collected in a similar manner to above. Aim to lay off air bubbles so as to minimise voids when lids are placed on. Places these containers into bubble wrap and straight into esky with cooler blocks present.

- Record any field observations, such as HC sheen present, presence of condensate, and approximate volume in pit at the time of sample collection directly onto the COC in the final column. Stage of frac operations would be valuable information also.

- Update COC electronically, as this needs to be both emailed to ALS and also printed off and placed inside the esky prior to despatch. Ensure info on sample containers is entirely consistent with info on COC, otherwise ALS will note this and contact us for clarification

- Seal up esky with completed COC and all containers using labels supplied by ALS
- Either clean thoroughly or discard used 500ml sample container as this must not be used for subsequent collection events (to prevent cross contamination)

- Dispose of gloves appropriately also

Despatch

- Complete freight authorisation / declaration and book on flight to go to ALS in Victoria

- Ensure COC is emailed to ALS, and that myself and Barry Ritchie are CC'd into this

- [samples.melbourne@alsenviro.com](mailto:samples.melbourne@alsenviro.com)<<mailto:samples.melbourne@alsenviro.com>>

- Also CC Kieren Burns from ALS when these samples are despatched

- [Kieren.burns@alsglobal.com](mailto:Kieren.burns@alsglobal.com)<<mailto:Kieren.burns@alsglobal.com>>

Please let me know if you have any questions? I really appreciate the support.

Such events would normally be carried out by a field based environmental resource. There is good justification for this and one day we can assume we will get there.

Golder could assist, as too another consultant, though the \$ to achieve this are high as the scheduling of sample collection around fluid generation means a lot of uncertainty and potential for standby time.

Regards,

Andrew Johnston  
Environmental Adviser  
Drilling & Completions, Technical & Engineering BU  
Direct Number: (08) 81165687<tel:%2808%29%2081165687>  
Mobile Number: 0419 835296<tel:0419%20835296>  
Email: [andrew.johnston@santos.com](mailto:andrew.johnston@santos.com)<<mailto:andrew.johnston@santos.com>>

[Santos Logo]

Santos Ltd A.B.N. 80 007 550 923

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Please consider the environment before printing this email





## Environmental Division

### CERTIFICATE OF ANALYSIS

Work Order	: <b>EM1210360</b>	Page	: 1 of 13
Client	: <b>SANTOS LTD</b>	Laboratory	: Environmental Division Melbourne
Contact	: MR BARRY RITCHIE	Contact	: Jodie Hancock
Address	: GROUND FLOOR SANTOS CENTRE 60 FLINDERS STREET ADELAIDE SA, AUSTRALIA 5001	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: barry.ritchie@santos.com	E-mail	: Jodie.Hancock@alsenviro.com
Telephone	: +61 08 8116 5000	Telephone	: +61 7 3243 7128
Facsimile	: +61 08 8116 5050	Facsimile	: +61 7 3243 7218
Project	: HFRA Fluids Sampling - Extended Analysis	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: 879002/538	Date Samples Received	: 06-SEP-2012
C-O-C number	: ----	Issue Date	: 20-SEP-2012
Sampler	: JD, AJ	No. of samples received	: 2
Site	: ----	No. of samples analysed	: 2
Quote number	: EN/039/11		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits



## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

- Bromide, Iodide, Alcohols, MBAS and CTAS conducted by ALS Sydney, NATA accreditation no. 825, site no 10911.
- EG035F: EM1210360 #1 Insufficient sample provided to confirm positive mercury result.
- EG035F: Positive mercury result has been confirmed for EM1210360 #2 by reparation and reanalysis.
- EK059G: Nitrite and Nitrate as N was analysed by NOX Vanadium Chloride Method (EK059GV).
- EP050: The MBAS reported is calculated as LAS, mol wt 342.
- EP074/079-CWG: : Particular sample ( EM-1210360-002), Matix spike has been omitted due to high level of contaminant.
- EP074/079-CWG: Particular samples (EM-1210360-001,002) required dilution due to the presence of high level contaminants. LOR values have been adjusted accordingly.
- EP075: EM1210360-001 & 002 Particular samples required dilution prior to analysis due to matrix interferences. LOR values have been adjusted accordingly.
- EP075: Matrix spike not determined due to matrix interferences.
- EP075: 'Sum of PAH' is the sum of the USEPA 16 priority PAHs
- EP117: Particular samples required dilution due to the presence of high level contaminants. LOR values have been adjusted accordingly.
- Ionic balances were calculated using: major anions - chloride, alkalinity, sulfate; and major cations - calcium, magnesium, potassium, sodium and total nitrogen for EM1210360 #1 and #2.
- Samples were filtered through a 0.45um filter prior to the dissolved metals analysis.



NATA Accredited Laboratory 825

Accredited for compliance with  
ISO/IEC 17025.

## Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics
Eric Chau	Metals Team Leader	Melbourne Inorganics
Herman Lin	Laboratory Coordinator	Melbourne Inorganics
Nancy Wang	Senior Semivolatile Instrument Chemist	Melbourne Organics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Sarah Millington	Senior Inorganic Chemist	Sydney Inorganics
Varsha Ho Wing	Non-Metals Team Leader	Melbourne Inorganics



## Analytical Results

Sub-Matrix: WATER

Client sample ID

				Tildilpie Pad 4-9-2012 Sample1	Tildilpie Pad 4-9-2012 Sample2	----	----	----
				04-SEP-2012 14:00	04-SEP-2012 14:15	----	----	----
				EM1210360-001	EM1210360-002	----	----	----
Compound	CAS Number	LOR	Unit					
<b>EA005: pH</b>								
pH Value	----	0.01	pH Unit	7.50	7.49	----	----	----
<b>EA006: Sodium Adsorption Ratio (SAR)</b>								
Sodium Absorption Ratio	----	0.01	-	112	110	----	----	----
<b>EA015: Total Dissolved Solids</b>								
Total Dissolved Solids @180°C	GIS-210-010	10	mg/L	11900	11700	----	----	----
<b>EA065: Total Hardness as CaCO3</b>								
Total Hardness as CaCO3	----	1	mg/L	174	169	----	----	----
<b>ED009: Anions</b>								
Bromide	24959-67-9	0.010	mg/L	22.4	20.9	----	----	----
Iodide	20461-54-5	0.010	mg/L	1.42	1.61	----	----	----
<b>ED037P: Alkalinity by PC Titrator</b>								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	2270	2310	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	2270	2310	----	----	----
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</b>								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	60	56	----	----	----
<b>ED045G: Chloride Discrete analyser</b>								
Chloride	16887-00-6	1	mg/L	4910	4810	----	----	----
<b>ED093F: Dissolved Major Cations</b>								
Calcium	7440-70-2	1	mg/L	50	48	----	----	----
Magnesium	7439-95-4	1	mg/L	12	12	----	----	----
Sodium	7440-23-5	1	mg/L	3410	3300	----	----	----
Potassium	7440-09-7	1	mg/L	140	135	----	----	----
<b>EG020F: Dissolved Metals by ICP-MS</b>								
Aluminium	7429-90-5	0.01	mg/L	0.07	0.07	----	----	----
Arsenic	7440-38-2	0.001	mg/L	0.216	0.210	----	----	----
Barium	7440-39-3	0.001	mg/L	6.02	5.86	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	0.0001	0.0001	----	----	----
Cobalt	7440-48-4	0.001	mg/L	0.009	0.009	----	----	----
Chromium	7440-47-3	0.001	mg/L	0.040	0.040	----	----	----
Copper	7440-50-8	0.001	mg/L	0.048	0.061	----	----	----
Manganese	7439-96-5	0.001	mg/L	3.62	3.74	----	----	----
Nickel	7440-02-0	0.001	mg/L	0.039	0.038	----	----	----



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

				Tildilpie Pad 4-9-2012 Sample1	Tildilpie Pad 4-9-2012 Sample2	---	---	---
				04-SEP-2012 14:00	04-SEP-2012 14:15	---	---	---
Compound	CAS Number	LOR	Unit	EM1210360-001	EM1210360-002	---	---	---
<b>EG020F: Dissolved Metals by ICP-MS - Continued</b>								
Lead	7439-92-1	0.001	mg/L	0.068	0.068	---	---	---
Vanadium	7440-62-2	0.01	mg/L	0.02	0.02	---	---	---
Zinc	7440-66-6	0.005	mg/L	0.052	0.058	---	---	---
Lithium	7439-93-2	0.001	mg/L	2.42	2.54	---	---	---
Molybdenum	7439-98-7	0.001	mg/L	0.023	0.023	---	---	---
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	---	---	---
Strontium	7440-24-6	0.001	mg/L	1.66	1.67	---	---	---
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	---	---	---
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	---	---	---
Boron	7440-42-8	0.05	mg/L	40.8	44.9	---	---	---
Iron	7439-89-6	0.05	mg/L	28.4	29.4	---	---	---
<b>EG035F: Dissolved Mercury by FIMS</b>								
Mercury	7439-97-6	0.0001	mg/L	0.0002	0.0003	---	---	---
<b>EG052F: Dissolved Silica by ICPAES</b>								
Silica	7631-86-9	0.1	mg/L	141	135	---	---	---
<b>EK010-1: Chlorine (Field Test)</b>								
Free Chlorine	----	0.02	mg/L	<0.02	<0.02	---	---	---
<b>EK025SF: Free CN by Segmented Flow Analyser</b>								
Free Cyanide	----	0.004	mg/L	0.007	<0.004	---	---	---
<b>EK026SF: Total CN by Segmented Flow Analyser</b>								
Total Cyanide	57-12-5	0.004	mg/L	0.008	<0.004	---	---	---
<b>EK040P: Fluoride by PC Titrator</b>								
Fluoride	16984-48-8	0.1	mg/L	2.4	2.0	---	---	---
<b>EK055: Ammonia as N</b>								
Ammonia as N	7664-41-7	0.1	mg/L	90.8	95.8	---	---	---
<b>EK057G: Nitrite as N by Discrete Analyser</b>								
Nitrite as N	----	0.01	mg/L	0.09	0.10	---	---	---
<b>EK058G: Nitrate as N by Discrete Analyser</b>								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	---	---	---
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>								
Nitrite + Nitrate as N	----	0.01	mg/L	0.09	0.10	---	---	---
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	222	271	---	---	---
<b>EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser</b>								



## Analytical Results

Sub-Matrix: WATER

Client sample ID

				Tildilpie Pad 4-9-2012 Sample1	Tildilpie Pad 4-9-2012 Sample2	----	----	----
				04-SEP-2012 14:00	04-SEP-2012 14:15	----	----	----
				EM1210360-001	EM1210360-002	----	----	----
Compound	CAS Number	LOR	Unit					
<b>EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued</b>								
^ Total Nitrogen as N	----	0.1	mg/L	222	271	----	----	----
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>								
Total Phosphorus as P	----	0.01	mg/L	2.16	2.50	----	----	----
<b>EK071G: Reactive Phosphorus as P by discrete analyser</b>								
Reactive Phosphorus as P	----	0.01	mg/L	0.11	0.12	----	----	----
<b>EN055: Ionic Balance</b>								
Total Anions	----	0.01	meq/L	185	183	----	----	----
Total Cations	----	0.01	meq/L	173	172	----	----	----
Ionic Balance	----	0.01	%	3.47	3.24	----	----	----
<b>EP005: Total Organic Carbon (TOC)</b>								
Total Organic Carbon	----	1	mg/L	1930	1800	----	----	----
<b>EP010: Formaldehyde</b>								
Formaldehyde	50-00-0	0.1	mg/L	4.6	4.8	----	----	----
<b>EP041A: Nonionic Surfactants</b>								
Nonionic Surfactants as CTAS	----	5	mg/L	17	21	----	----	----
<b>EP050: Anionic Surfactants as MBAS</b>								
Anionic Surfactants as MBAS	----	0.1	mg/L	0.1	0.1	----	----	----
<b>EP074A: Monocyclic Aromatic Hydrocarbons</b>								
Benzene	71-43-2	1	µg/L	1160	1120	----	----	----
Toluene	108-88-3	2	µg/L	7700	6380	----	----	----
Ethylbenzene	100-41-4	2	µg/L	995	571	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	13000	8130	----	----	----
Styrene	100-42-5	5	µg/L	<100	<100	----	----	----
ortho-Xylene	95-47-6	2	µg/L	2480	1630	----	----	----
Isopropylbenzene	98-82-8	5	µg/L	313	182	----	----	----
n-Propylbenzene	103-65-1	5	µg/L	985	488	----	----	----
1.3.5-Trimethylbenzene	108-67-8	5	µg/L	2480	1340	----	----	----
sec-Butylbenzene	135-98-8	5	µg/L	114	<100	----	----	----
1.2.4-Trimethylbenzene	95-63-6	5	µg/L	4020	2180	----	----	----
tert-Butylbenzene	98-06-6	5	µg/L	<100	<100	----	----	----
p-Isopropyltoluene	99-87-6	5	µg/L	4190	1830	----	----	----
n-Butylbenzene	104-51-8	5	µg/L	586	288	----	----	----
<b>EP074B: Oxygenated Compounds</b>								
Vinyl Acetate	108-05-4	50	µg/L	<1000	<1000	----	----	----
2-Butanone (MEK)	78-93-3	50	µg/L	<1000	<1000	----	----	----





## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

				Tildilpie Pad 4-9-2012 Sample1	Tildilpie Pad 4-9-2012 Sample2	----	----	----
				04-SEP-2012 14:00	04-SEP-2012 14:15	----	----	----
Compound	CAS Number	LOR	Unit	EM1210360-001	EM1210360-002	----	----	----
<b>EP074B: Oxygenated Compounds - Continued</b>								
4-Methyl-2-pentanone (MIBK)	108-10-1	50	µg/L	<1000	<1000	----	----	----
2-Hexanone (MBK)	591-78-6	50	µg/L	<1000	<1000	----	----	----
<b>EP074C: Sulfonated Compounds</b>								
Carbon disulfide	75-15-0	5	µg/L	<100	<100	----	----	----
<b>EP074D: Fumigants</b>								
2,2-Dichloropropane	594-20-7	5	µg/L	<100	<100	----	----	----
1,2-Dichloropropane	78-87-5	5	µg/L	<100	<100	----	----	----
cis-1,3-Dichloropropylene	10061-01-5	5	µg/L	<100	<100	----	----	----
trans-1,3-Dichloropropylene	10061-02-6	5	µg/L	<100	<100	----	----	----
1,2-Dibromoethane (EDB)	106-93-4	5	µg/L	<100	<100	----	----	----
<b>EP074E: Halogenated Aliphatic Compounds</b>								
Dichlorodifluoromethane	75-71-8	50	µg/L	<1000	<1000	----	----	----
Chloromethane	74-87-3	50	µg/L	<1000	<1000	----	----	----
Vinyl chloride	75-01-4	50	µg/L	<1000	<1000	----	----	----
Bromomethane	74-83-9	50	µg/L	<1000	<1000	----	----	----
Chloroethane	75-00-3	50	µg/L	<1000	<1000	----	----	----
Trichlorofluoromethane	75-69-4	50	µg/L	<1000	<1000	----	----	----
1,1-Dichloroethene	75-35-4	5	µg/L	<100	<100	----	----	----
Iodomethane	74-88-4	5	µg/L	<100	<100	----	----	----
trans-1,2-Dichloroethene	156-60-5	5	µg/L	<100	<100	----	----	----
1,1-Dichloroethane	75-34-3	5	µg/L	<100	<100	----	----	----
cis-1,2-Dichloroethene	156-59-2	5	µg/L	<100	<100	----	----	----
1,1,1-Trichloroethane	71-55-6	5	µg/L	<100	<100	----	----	----
1,1-Dichloropropylene	563-58-6	5	µg/L	<100	<100	----	----	----
Carbon Tetrachloride	56-23-5	5	µg/L	<100	<100	----	----	----
1,2-Dichloroethane	107-06-2	5	µg/L	<100	<100	----	----	----
Trichloroethene	79-01-6	5	µg/L	<100	<100	----	----	----
Dibromomethane	74-95-3	5	µg/L	<100	<100	----	----	----
1,1,2-Trichloroethane	79-00-5	5	µg/L	<100	<100	----	----	----
1,3-Dichloropropane	142-28-9	5	µg/L	<100	<100	----	----	----
Tetrachloroethene	127-18-4	5	µg/L	<100	<100	----	----	----
1,1,1,2-Tetrachloroethane	630-20-6	5	µg/L	<100	<100	----	----	----
trans-1,4-Dichloro-2-butene	110-57-6	5	µg/L	<100	<100	----	----	----
cis-1,4-Dichloro-2-butene	1476-11-5	5	µg/L	<100	<100	----	----	----
1,1,2,2-Tetrachloroethane	79-34-5	5	µg/L	<100	<100	----	----	----



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

				Tildilpie Pad 4-9-2012 Sample1	Tildilpie Pad 4-9-2012 Sample2	---	---	---
				04-SEP-2012 14:00	04-SEP-2012 14:15	---	---	---
Compound	CAS Number	LOR	Unit	EM1210360-001	EM1210360-002	---	---	---
<b>EP074E: Halogenated Aliphatic Compounds - Continued</b>								
1.2.3-Trichloropropane	96-18-4	5	µg/L	<100	<100	---	---	---
Pentachloroethane	76-01-7	5	µg/L	<100	<100	---	---	---
1.2-Dibromo-3-chloropropane	96-12-8	5	µg/L	<100	<100	---	---	---
<b>EP074F: Halogenated Aromatic Compounds</b>								
Chlorobenzene	108-90-7	5	µg/L	<100	<100	---	---	---
Bromobenzene	108-86-1	5	µg/L	<100	<100	---	---	---
2-Chlorotoluene	95-49-8	5	µg/L	<100	<100	---	---	---
4-Chlorotoluene	106-43-4	5	µg/L	<100	<100	---	---	---
1.2.3-Trichlorobenzene	87-61-6	5	µg/L	<100	<100	---	---	---
<b>EP074G: Trihalomethanes</b>								
Chloroform	67-66-3	5	µg/L	<100	<100	---	---	---
Bromodichloromethane	75-27-4	5	µg/L	<100	<100	---	---	---
Dibromochloromethane	124-48-1	5	µg/L	<100	<100	---	---	---
Bromoform	75-25-2	5	µg/L	<100	<100	---	---	---
<b>EP075A: Phenolic Compounds</b>								
Phenol	108-95-2	2	µg/L	1250	735	---	---	---
2-Chlorophenol	95-57-8	2	µg/L	<200	<200	---	---	---
2-Methylphenol	95-48-7	2	µg/L	1780	1000	---	---	---
3- & 4-Methylphenol	1319-77-3	4	µg/L	1430	924	---	---	---
2-Nitrophenol	88-75-5	2	µg/L	<200	<200	---	---	---
2.4-Dimethylphenol	105-67-9	2	µg/L	1250	779	---	---	---
2.4-Dichlorophenol	120-83-2	2	µg/L	<200	<200	---	---	---
2.6-Dichlorophenol	87-65-0	2	µg/L	<200	<200	---	---	---
4-Chloro-3-Methylphenol	59-50-7	2	µg/L	<200	<200	---	---	---
2.4.6-Trichlorophenol	88-06-2	2	µg/L	<200	<200	---	---	---
2.4.5-Trichlorophenol	95-95-4	2	µg/L	<200	<200	---	---	---
Pentachlorophenol	87-86-5	4	µg/L	<400	<400	---	---	---
<b>EP075B: Polynuclear Aromatic Hydrocarbons</b>								
Naphthalene	91-20-3	2	µg/L	1200	573	---	---	---
2-Methylnaphthalene	91-57-6	2	µg/L	2090	872	---	---	---
2-Chloronaphthalene	91-58-7	2	µg/L	<200	<200	---	---	---
Acenaphthylene	208-96-8	2	µg/L	<200	<200	---	---	---
Acenaphthene	83-32-9	2	µg/L	<200	<200	---	---	---
Fluorene	86-73-7	2	µg/L	<200	<200	---	---	---
Phenanthrene	85-01-8	2	µg/L	268	<200	---	---	---



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

Compound	CAS Number	LOR	Unit	Tildilpie Pad 4-9-2012	Tildilpie Pad 4-9-2012	---	---	---
				Sample1	Sample2			
				04-SEP-2012 14:00	04-SEP-2012 14:15	---	---	---
				EM1210360-001	EM1210360-002	---	---	---
<b>EP075B: Polynuclear Aromatic Hydrocarbons - Continued</b>								
Anthracene	120-12-7	2	µg/L	<200	<200	---	---	---
Fluoranthene	206-44-0	2	µg/L	<200	<200	---	---	---
Pyrene	129-00-0	2	µg/L	<200	<200	---	---	---
N-2-Fluorenyl Acetamide	53-96-3	2	µg/L	<200	<200	---	---	---
Benzo(a)anthracene	56-55-3	2	µg/L	<200	<200	---	---	---
Chrysene	218-01-9	2	µg/L	<200	<200	---	---	---
Benzo(b) & Benzo(k)fluoranthene	205-99-2 207-08-9	4	µg/L	<400	<400	---	---	---
7,12-Dimethylbenz(a)anthracene	57-97-6	2	µg/L	<200	<200	---	---	---
Benzo(a)pyrene	50-32-8	2	µg/L	<200	<200	---	---	---
3-Methylcholanthrene	56-49-5	2	µg/L	<200	<200	---	---	---
Indeno(1,2,3-cd)pyrene	193-39-5	2	µg/L	<200	<200	---	---	---
Dibenz(a,h)anthracene	53-70-3	2	µg/L	<200	<200	---	---	---
Benzo(g,h,i)perylene	191-24-2	2	µg/L	<200	<200	---	---	---
^ Sum of PAHs	----	2	µg/L	<b>1470</b>	<b>573</b>	---	---	---
^ Benzo(a)pyrene TEQ (WHO)	----	2	µg/L	<200	<200	---	---	---
<b>EP075C: Phthalate Esters</b>								
Dimethyl phthalate	131-11-3	2	µg/L	<200	<200	---	---	---
Diethyl phthalate	84-66-2	2	µg/L	<200	<200	---	---	---
Di-n-butyl phthalate	84-74-2	2	µg/L	<200	<200	---	---	---
Butyl benzyl phthalate	85-68-7	2	µg/L	<200	<200	---	---	---
bis(2-ethylhexyl) phthalate	117-81-7	10	µg/L	<1000	<1000	---	---	---
Di-n-octylphthalate	117-84-0	2	µg/L	<200	<200	---	---	---
<b>EP075D: Nitrosamines</b>								
N-Nitrosomethylethylamine	10595-95-6	2	µg/L	<200	<200	---	---	---
N-Nitrosodiethylamine	55-18-5	2	µg/L	<200	<200	---	---	---
N-Nitrosopyrrolidine	930-55-2	4	µg/L	<400	<400	---	---	---
N-Nitrosomorpholine	59-89-2	2	µg/L	<200	<200	---	---	---
N-Nitrosodi-n-propylamine	621-64-7	2	µg/L	<200	<200	---	---	---
N-Nitrosopiperidine	100-75-4	2	µg/L	<200	<200	---	---	---
N-Nitrosodibutylamine	924-16-3	2	µg/L	<200	<200	---	---	---
N-Nitrosodiphenyl & Diphenylamine	86-30-6 122-39-4	4	µg/L	<400	<400	---	---	---
Methapyrilene	91-80-5	2	µg/L	<200	<200	---	---	---
<b>EP075E: Nitroaromatics and Ketones</b>								



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

Compound	CAS Number	LOR	Unit	Tildilpie Pad 4-9-2012	Tildilpie Pad 4-9-2012	---	---	---
				Sample1	Sample2			
				04-SEP-2012 14:00	04-SEP-2012 14:15	---	---	---
				EM1210360-001	EM1210360-002	---	---	---
<b>EP075E: Nitroaromatics and Ketones - Continued</b>								
2-Picoline	109-06-8	2	µg/L	<200	<200	---	---	---
Acetophenone	98-86-2	2	µg/L	<200	<200	---	---	---
Nitrobenzene	98-95-3	2	µg/L	<200	<200	---	---	---
Isophorone	78-59-1	2	µg/L	<200	<200	---	---	---
2,6-Dinitrotoluene	606-20-2	4	µg/L	<400	<400	---	---	---
2,4-Dinitrotoluene	121-14-2	4	µg/L	<400	<400	---	---	---
1-Naphthylamine	134-32-7	2	µg/L	<200	<200	---	---	---
4-Nitroquinoline-N-oxide	56-57-5	2	µg/L	<200	<200	---	---	---
5-Nitro-o-toluidine	99-55-8	2	µg/L	<200	<200	---	---	---
Azobenzene	103-33-3	2	µg/L	<200	<200	---	---	---
1,3,5-Trinitrobenzene	99-35-4	2	µg/L	<200	<200	---	---	---
Phenacetin	62-44-2	2	µg/L	<200	<200	---	---	---
4-Aminobiphenyl	92-67-1	2	µg/L	<200	<200	---	---	---
Pentachloronitrobenzene	82-68-8	2	µg/L	<200	<200	---	---	---
Pronamide	23950-58-5	2	µg/L	<200	<200	---	---	---
Dimethylaminoazobenzene	60-11-7	2	µg/L	<200	<200	---	---	---
Chlorobenzilate	510-15-6	2	µg/L	<200	<200	---	---	---
<b>EP075F: Haloethers</b>								
Bis(2-chloroethyl) ether	111-44-4	2	µg/L	<200	<200	---	---	---
Bis(2-chloroethoxy) methane	111-91-1	2	µg/L	<200	<200	---	---	---
4-Chlorophenyl phenyl ether	7005-72-3	2	µg/L	<200	<200	---	---	---
4-Bromophenyl phenyl ether	101-55-3	2	µg/L	<200	<200	---	---	---
<b>EP075G: Chlorinated Hydrocarbons</b>								
1,3-Dichlorobenzene	541-73-1	2	µg/L	<200	<200	---	---	---
1,4-Dichlorobenzene	106-46-7	2	µg/L	<200	<200	---	---	---
1,2-Dichlorobenzene	95-50-1	2	µg/L	<200	<200	---	---	---
Hexachloroethane	67-72-1	2	µg/L	<200	<200	---	---	---
1,2,4-Trichlorobenzene	120-82-1	2	µg/L	<200	<200	---	---	---
Hexachloropropylene	1888-71-7	2	µg/L	<200	<200	---	---	---
Hexachlorobutadiene	87-68-3	2	µg/L	<200	<200	---	---	---
Hexachlorocyclopentadiene	77-47-4	10	µg/L	<1000	<1000	---	---	---
Pentachlorobenzene	608-93-5	2	µg/L	<200	<200	---	---	---
Hexachlorobenzene (HCB)	118-74-1	4	µg/L	<400	<400	---	---	---
<b>EP075H: Anilines and Benzidines</b>								
Aniline	62-53-3	2	µg/L	<200	<200	---	---	---



## Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

				Tildilpie Pad 4-9-2012 Sample1	Tildilpie Pad 4-9-2012 Sample2	---	---	---
				04-SEP-2012 14:00	04-SEP-2012 14:15	---	---	---
Compound	CAS Number	LOR	Unit	EM1210360-001	EM1210360-002	---	---	---
<b>EP075H: Anilines and Benzidines - Continued</b>								
4-Chloroaniline	106-47-8	2	µg/L	<200	<200	---	---	---
2-Nitroaniline	88-74-4	4	µg/L	<400	<400	---	---	---
3-Nitroaniline	99-09-2	4	µg/L	<400	<400	---	---	---
Dibenzofuran	132-64-9	2	µg/L	<200	<200	---	---	---
4-Nitroaniline	100-01-6	2	µg/L	<200	<200	---	---	---
Carbazole	86-74-8	2	µg/L	<200	<200	---	---	---
3,3'-Dichlorobenzidine	91-94-1	2	µg/L	<200	<200	---	---	---
<b>EP075I: Organochlorine Pesticides</b>								
alpha-BHC	319-84-6	2	µg/L	<200	<200	---	---	---
beta-BHC	319-85-7	2	µg/L	<200	<200	---	---	---
gamma-BHC	58-89-9	2	µg/L	<200	<200	---	---	---
delta-BHC	319-86-8	2	µg/L	<200	<200	---	---	---
Heptachlor	76-44-8	2	µg/L	<200	<200	---	---	---
Aldrin	309-00-2	2	µg/L	<200	<200	---	---	---
Heptachlor epoxide	1024-57-3	2	µg/L	<200	<200	---	---	---
alpha-Endosulfan	959-98-8	2	µg/L	<200	<200	---	---	---
4,4'-DDE	72-55-9	2	µg/L	<200	<200	---	---	---
Dieldrin	60-57-1	2	µg/L	<200	<200	---	---	---
Endrin	72-20-8	2	µg/L	<200	<200	---	---	---
beta-Endosulfan	33213-65-9	2	µg/L	<200	<200	---	---	---
4,4'-DDD	72-54-8	2	µg/L	<200	<200	---	---	---
Endosulfan sulfate	1031-07-8	2	µg/L	<200	<200	---	---	---
4,4'-DDT	50-29-3	4	µg/L	<400	<400	---	---	---
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	4	µg/L	<400	<400	---	---	---
^ Sum of DDD + DDE + DDT	---	4	µg/L	<400	<400	---	---	---
<b>EP075J: Organophosphorus Pesticides</b>								
Dichlorvos	62-73-7	2	µg/L	<200	<200	---	---	---
Dimethoate	60-51-5	2	µg/L	<200	<200	---	---	---
Diazinon	333-41-5	2	µg/L	<200	<200	---	---	---
Chlorpyrifos-methyl	5598-13-0	2	µg/L	<200	<200	---	---	---
Malathion	121-75-5	2	µg/L	<200	<200	---	---	---
Fenthion	55-38-9	2	µg/L	<200	<200	---	---	---
Chlorpyrifos	2921-88-2	2	µg/L	<200	<200	---	---	---
Pirimphos-ethyl	23505-41-1	2	µg/L	<200	<200	---	---	---
Chlorfenvinphos	470-90-6	2	µg/L	<200	<200	---	---	---



## Analytical Results

Sub-Matrix: WATER

Client sample ID

				Tildilpie Pad 4-9-2012 Sample1	Tildilpie Pad 4-9-2012 Sample2	---	---	---
				04-SEP-2012 14:00	04-SEP-2012 14:15	---	---	---
				EM1210360-001	EM1210360-002	---	---	---
Compound	CAS Number	LOR	Unit					
<b>EP075J: Organophosphorus Pesticides - Continued</b>								
Prothiofos	34643-46-4	2	µg/L	<200	<200	---	---	---
Ethion	563-12-2	2	µg/L	<200	<200	---	---	---
<b>EP117: Alcohols</b>								
Ethanol	64-17-5	50	µg/L	2460	2440	---	---	---
Isopropanol	67-63-0	50	µg/L	3950	4070	---	---	---
n-Propanol	71-23-8	50	µg/L	24900	25600	---	---	---
Isobutanol	78-83-1	50	µg/L	<250	<250	---	---	---
n-Butanol	71-36-3	50	µg/L	<250	<250	---	---	---
<b>RIVM Aliphatic Hydrocarbon Fractions</b>								
Aliphatic >C5-C6	----	20	µg/L	5300	3890	---	---	---
Aliphatic >C6-C8	TPHCWG-ALV2	20	µg/L	71400	22000	---	---	---
Aliphatic >C8-C10	TPHCWG-ALV3	20	µg/L	103000	47100	---	---	---
Aliphatic >C10-C12	TPHCWG-ALE1	50	µg/L	18000	19300	---	---	---
Aliphatic >C12-C16	TPHCWG-ALE2	50	µg/L	53600	54200	---	---	---
Aliphatic >C16-C21	----	50	µg/L	52500	52600	---	---	---
Aliphatic >C21-C35	----	50	µg/L	24900	24200	---	---	---
<b>RIVM Aromatic Hydrocarbon Fractions</b>								
Aromatic >C5-C7	----	5	µg/L	1040	1000	---	---	---
Aromatic >C7-C8	TPHCWG-ARV2	5	µg/L	6490	5420	---	---	---
Aromatic >C8-C10	TPHCWG-ARV3	5	µg/L	17900	10400	---	---	---
Aromatic >C10-C12	TPHCWG-ARE1	50	µg/L	6050	7070	---	---	---
Aromatic >C12-C16	TPHCWG-ARE2	50	µg/L	14900	14800	---	---	---
Aromatic >C16-C21	TPHCWG-ARE3	50	µg/L	12900	12700	---	---	---
Aromatic >C21-C35	TPHCWG-ARE4	50	µg/L	3610	3410	---	---	---
<b>EP074S: VOC Surrogates</b>								
1,2-Dichloroethane-D4	17060-07-0	0.1	%	103	71.2	---	---	---
Toluene-D8	2037-26-5	0.1	%	114	119	---	---	---
4-Bromofluorobenzene	460-00-4	0.1	%	118	97.2	---	---	---
<b>EP075S: Acid Extractable Surrogates</b>								
2-Fluorophenol	367-12-4	0.1	%	Not Determined	Not Determined	---	---	---
Phenol-d6	13127-88-3	0.1	%	Not Determined	Not Determined	---	---	---
2-Chlorophenol-D4	93951-73-6	0.1	%	Not Determined	Not Determined	---	---	---
2,4,6-Tribromophenol	118-79-6	0.1	%	Not Determined	Not Determined	---	---	---
<b>EP075T: Base/Neutral Extractable Surrogates</b>								
Nitrobenzene-D5	4165-60-0	0.1	%	Not Determined	Not Determined	---	---	---



**Analytical Results**

Sub-Matrix: **WATER**

Client sample ID

				Tildilpie Pad 4-9-2012 Sample1	Tildilpie Pad 4-9-2012 Sample2	----	----	----
				04-SEP-2012 14:00	04-SEP-2012 14:15	----	----	----
Compound	CAS Number	LOR	Unit	EM1210360-001	EM1210360-002	----	----	----
<b>EP075T: Base/Neutral Extractable Surrogates - Continued</b>								
1,2-Dichlorobenzene-D4	2199-69-1	0.1	%	Not Determined	Not Determined	----	----	----
2-Fluorobiphenyl	321-60-8	0.1	%	Not Determined	Not Determined	----	----	----
Anthracene-d10	1719-06-8	0.1	%	Not Determined	Not Determined	----	----	----
4-Terphenyl-d14	1718-51-0	0.1	%	Not Determined	Not Determined	----	----	----
<b>EP079/EP070S:TPH Surrogates - semivolatile speciation</b>								
2-Fluorobiphenyl	321-60-8	0.1	%	111	114	----	----	----
2-Bromonaphthalene	580-13-2	0.1	%	104	116	----	----	----

Client sampling date / time



## Surrogate Control Limits

Sub-Matrix: WATER		Recovery Limits (%)	
Compound	CAS Number	Low	High
<b>EP074S: VOC Surrogates</b>			
1,2-Dichloroethane-D4	17060-07-0	72	132
Toluene-D8	2037-26-5	74	128
4-Bromofluorobenzene	460-00-4	70	132
<b>EP075S: Acid Extractable Surrogates</b>			
2-Fluorophenol	367-12-4	10	83
Phenol-d6	13127-88-3	10	49
2-Chlorophenol-D4	93951-73-6	20.3	101
2,4,6-Tribromophenol	118-79-6	19.5	134
<b>EP075T: Base/Neutral Extractable Surrogates</b>			
Nitrobenzene-D5	4165-60-0	18.2	114
1,2-Dichlorobenzene-D4	2199-69-1	18.8	100
2-Fluorobiphenyl	321-60-8	25.3	122
Anthracene-d10	1719-06-8	35	137
4-Terphenyl-d14	1718-51-0	32	136
<b>EP079/EP070S:TPH Surrogates - semivolatile speciation</b>			
2-Fluorobiphenyl	321-60-8	77	127
2-Bromonaphthalene	580-13-2	67	123





Environmental Division

**QUALITY CONTROL REPORT**

<b>Work Order</b>	<b>: EM1210360</b>	<b>Page</b>	: 1 of 23
<b>Client</b>	<b>: SANTOS LTD</b>	<b>Laboratory</b>	: Environmental Division Melbourne
<b>Contact</b>	<b>: MR BARRY RITCHIE</b>	<b>Contact</b>	: Jodie Hancock
<b>Address</b>	<b>: GROUND FLOOR SANTOS CENTRE 60 FLINDERS STREET ADELAIDE SA, AUSTRALIA 5001</b>	<b>Address</b>	: 4 Westall Rd Springvale VIC Australia 3171
<b>E-mail</b>	<b>: barry.ritchie@santos.com</b>	<b>E-mail</b>	: Jodie.Hancock@alsenviro.com
<b>Telephone</b>	<b>: +61 08 8116 5000</b>	<b>Telephone</b>	: +61 7 3243 7128
<b>Facsimile</b>	<b>: +61 08 8116 5050</b>	<b>Facsimile</b>	: +61 7 3243 7218
<b>Project</b>	<b>: HFRA Fluids Sampling - Extended Analysis</b>	<b>QC Level</b>	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
<b>Site</b>	<b>: ----</b>	<b>Date Samples Received</b>	: 06-SEP-2012
<b>C-O-C number</b>	<b>: ----</b>	<b>Issue Date</b>	: 20-SEP-2012
<b>Sampler</b>	<b>: JD, AJ</b>	<b>No. of samples received</b>	: 2
<b>Order number</b>	<b>: 879002/538</b>	<b>No. of samples analysed</b>	: 2
<b>Quote number</b>	<b>: EN/039/11</b>		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits



NATA Accredited Laboratory 825

Accredited for compliance with  
ISO/IEC 17025.

**Signatories**

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics
Eric Chau	Metals Team Leader	Melbourne Inorganics
Herman Lin	Laboratory Coordinator	Melbourne Inorganics
Nancy Wang	Senior Semivolatile Instrument Chemist	Melbourne Organics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Sarah Millington	Senior Inorganic Chemist	Sydney Inorganics
Varsha Ho Wing	Non-Metals Team Leader	Melbourne Inorganics



## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key :  
Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot  
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.  
LOR = Limit of reporting  
RPD = Relative Percentage Difference  
# = Indicates failed QC



## Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:- No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:- 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EA005: pH (QC Lot: 2487664)</b>									
EM1210350-001	Anonymous	EA005: pH Value	----	0.01	pH Unit	8.77	8.72	0.6	0% - 20%
<b>EA015: Total Dissolved Solids (QC Lot: 2487120)</b>									
EM1210242-001	Anonymous	EA015H: Total Dissolved Solids @180°C	GIS-210-010	10	mg/L	2940	2920	0.8	0% - 20%
EM1210334-001	Anonymous	EA015H: Total Dissolved Solids @180°C	GIS-210-010	10	mg/L	3610	3540	2.0	0% - 20%
<b>ED009: Anions (QC Lot: 2489720)</b>									
EM1210339-001	Anonymous	ED009-X: Bromide	24959-67-9	0.010	mg/L	19.5	20.2	3.3	0% - 20%
		ED009-X: Iodide	20461-54-5	0.010	mg/L	0.801	0.934	15.3	0% - 20%
<b>ED037P: Alkalinity by PC Titrator (QC Lot: 2487642)</b>									
EM1210291-005	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	996	996	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	996	996	0.0	0% - 20%
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	2270	2320	2.4	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	2270	2320	2.4	0% - 20%
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 2486620)</b>									
EM1210291-005	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	1140	1150	0.7	0% - 20%
EM1210334-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	150	157	4.1	0% - 20%
<b>ED045G: Chloride Discrete analyser (QC Lot: 2486619)</b>									
EM1210291-005	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	5120	5170	1.0	0% - 20%
EM1210334-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	1600	1620	1.4	0% - 20%
<b>ED093F: Dissolved Major Cations (QC Lot: 2486618)</b>									
EM1210291-005	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	91	94	2.7	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	400	406	1.3	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	2920	2930	0.5	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	69	70	1.5	0% - 20%
EM1210334-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	175	177	1.2	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	173	172	0.6	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	768	764	0.5	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	27	27	0.0	0% - 20%
<b>EG020F: Dissolved Metals by ICP-MS (QC Lot: 2494881)</b>									
EM1210286-010	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EG020F: Dissolved Metals by ICP-MS (QC Lot: 2494881) - continued</b>									
EM1210286-010	Anonymous	EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.001	0.001	0.0	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.054	0.054	0.0	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.002	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Lithium	7439-93-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Tin	7440-31-5	0.001	mg/L	0.008	0.008	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.15	0.15	0.0	0% - 50%
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.0	No Limit
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.0	No Limit		
EM1210484-002	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.018	0.019	6.5	0% - 50%
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.108	0.115	6.3	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.014	0.014	0.0	0% - 50%
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.004	0.005	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Lithium	7439-93-2	0.001	mg/L	0.106	0.104	2.4	0% - 20%
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.042	0.045	7.4	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.001	0.001	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.038	0.040	4.0	0% - 20%
		EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.028	0.027	0.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.13	0.13	0.0	0% - 50%
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EG020A-F: Boron	7440-42-8	0.05	mg/L	0.34	0.34	0.0	No Limit		
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.0	No Limit		
<b>EG020F: Dissolved Metals by ICP-MS (QC Lot: 2494882)</b>									
EM1210484-002	Anonymous	EG020B-F: Strontium	7440-24-6	0.001	mg/L	2.68	2.88	7.0	0% - 20%

Page : 5 of 23  
 Work Order : EM1210360  
 Client : SANTOS LTD  
 Project : HFRA Fluids Sampling - Extended Analysis



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EG020F: Dissolved Metals by ICP-MS (QC Lot: 2494882) - continued</b>									
EM1210484-002	Anonymous	EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
<b>EG035F: Dissolved Mercury by FIMS (QC Lot: 2494880)</b>									
EM1210286-010	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EM1210484-002	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
<b>EK025SF: Free CN by Segmented Flow Analyser (QC Lot: 2487961)</b>									
EM1210095-017	Anonymous	EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	<0.004	0.0	No Limit
<b>EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 2487962)</b>									
EM1210095-017	Anonymous	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.0	No Limit
EM1210342-007	Anonymous	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	0.017	0.017	0.0	No Limit
<b>EK040P: Fluoride by PC Titrator (QC Lot: 2487643)</b>									
EM1210350-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.4	0.5	0.0	No Limit
EP1207391-005	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.5	0.4	0.0	No Limit
<b>EK055: Ammonia as N (QC Lot: 2498816)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EK055: Ammonia as N	7664-41-7	0.1	mg/L	90.8	90.8	0.0	0% - 20%
EM1210656-001	Anonymous	EK055: Ammonia as N	7664-41-7	0.1	mg/L	18.9	18.9	0.0	0% - 20%
<b>EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2486617)</b>									
EM1210291-005	Anonymous	EK057G: Nitrite as N	----	0.01	mg/L	0.16	0.16	0.0	0% - 50%
EM1210334-001	Anonymous	EK057G: Nitrite as N	----	0.01	mg/L	0.06	0.06	0.0	No Limit
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2487853)</b>									
EM1210342-011	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	2.16	2.40	10.6	0% - 20%
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2487602)</b>									
EM1210338-006	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	0.1	0.0	No Limit
EM1210350-007	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	15.2	13.1	14.6	0% - 20%
<b>EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2487603)</b>									
EM1210338-006	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
<b>EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 2486621)</b>									
EM1210334-001	Anonymous	EK071G: Reactive Phosphorus as P	----	0.01	mg/L	0.89	0.99	9.7	0% - 20%
<b>EP005: Total Organic Carbon (TOC) (QC Lot: 2496921)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP005: Total Organic Carbon	----	1	mg/L	1930	1830	5.5	0% - 20%
EM1210572-002	Anonymous	EP005: Total Organic Carbon	----	1	mg/L	8	7	0.0	No Limit
<b>EP010: Formaldehyde (QC Lot: 2487151)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP010: Formaldehyde	50-00-0	0.1	mg/L	4.6	4.7	3.9	0% - 20%
<b>EP041A: Nonionic Surfactants (QC Lot: 2488667)</b>									
ES1221506-001	Anonymous	EP041A: Nonionic Surfactants as CTAS	----	5	mg/L	6	6	0.0	No Limit
<b>EP050: Anionic Surfactants as MBAS (QC Lot: 2488597)</b>									



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP050: Anionic Surfactants as MBAS (QC Lot: 2488597) - continued</b>									
EP1207391-001	Anonymous	EP050: Anionic Surfactants as MBAS		0.1	mg/L	0.1	0.1	0.0	No Limit
ES1221499-001	Anonymous	EP050: Anionic Surfactants as MBAS		0.1	mg/L	0.1	0.1	0.0	No Limit
<b>EP074A: Monocyclic Aromatic Hydrocarbons (QC Lot: 2496299)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP074: Benzene	71-43-2	1	µg/L	1160	1040	11.1	0% - 20%
		EP074: Toluene	108-88-3	2	µg/L	7700	7270	5.8	0% - 20%
		EP074: Ethylbenzene	100-41-4	2	µg/L	995	981	1.4	0% - 20%
		EP074: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	13000	13400	3.2	0% - 20%
		EP074: ortho-Xylene	95-47-6	2	µg/L	2480	2610	4.9	0% - 20%
		EP074: Styrene	100-42-5	5	µg/L	<100	<100	0.0	No Limit
		EP074: Isopropylbenzene	98-82-8	5	µg/L	313	326	4.0	0% - 20%
		EP074: n-Propylbenzene	103-65-1	5	µg/L	985	957	2.8	0% - 20%
		EP074: 1,3,5-Trimethylbenzene	108-67-8	5	µg/L	2480	2660	6.9	0% - 20%
		EP074: sec-Butylbenzene	135-98-8	5	µg/L	114	175	41.6	0% - 20%
		EP074: 1,2,4-Trimethylbenzene	95-63-6	5	µg/L	4020	4290	6.6	0% - 20%
		EP074: tert-Butylbenzene	98-06-6	5	µg/L	<100	<100	0.0	No Limit
		EP074: p-Isopropyltoluene	99-87-6	5	µg/L	4190	3310	# 23.6	0% - 20%
		EP074: n-Butylbenzene	104-51-8	5	µg/L	586	616	5.1	0% - 20%
<b>EP074B: Oxygenated Compounds (QC Lot: 2496299)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP074: Vinyl Acetate	108-05-4	50	µg/L	<1000	<1000	0.0	No Limit
		EP074: 2-Butanone (MEK)	78-93-3	50	µg/L	<1000	<1000	0.0	No Limit
		EP074: 4-Methyl-2-pentanone (MIBK)	108-10-1	50	µg/L	<1000	<1000	0.0	No Limit
		EP074: 2-Hexanone (MBK)	591-78-6	50	µg/L	<1000	<1000	0.0	No Limit
<b>EP074C: Sulfonated Compounds (QC Lot: 2496299)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP074: Carbon disulfide	75-15-0	5	µg/L	<100	<100	0.0	No Limit
<b>EP074D: Fumigants (QC Lot: 2496299)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP074: 2,2-Dichloropropane	594-20-7	5	µg/L	<100	<100	0.0	No Limit
		EP074: 1,2-Dichloropropane	78-87-5	5	µg/L	<100	<100	0.0	No Limit
		EP074: cis-1,3-Dichloropropylene	10061-01-5	5	µg/L	<100	<100	0.0	No Limit
		EP074: trans-1,3-Dichloropropylene	10061-02-6	5	µg/L	<100	<100	0.0	No Limit
		EP074: 1,2-Dibromoethane (EDB)	106-93-4	5	µg/L	<100	<100	0.0	No Limit
<b>EP074E: Halogenated Aliphatic Compounds (QC Lot: 2496299)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP074: 1,1-Dichloroethene	75-35-4	5	µg/L	<100	<100	0.0	No Limit
		EP074: Iodomethane	74-88-4	5	µg/L	<100	<100	0.0	No Limit



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP074E: Halogenated Aliphatic Compounds (QC Lot: 2496299) - continued</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP074: trans-1,2-Dichloroethene	156-60-5	5	µg/L	<100	<100	0.0	No Limit
		EP074: 1,1-Dichloroethane	75-34-3	5	µg/L	<100	<100	0.0	No Limit
		EP074: cis-1,2-Dichloroethene	156-59-2	5	µg/L	<100	<100	0.0	No Limit
		EP074: 1,1,1-Trichloroethane	71-55-6	5	µg/L	<100	<100	0.0	No Limit
		EP074: 1,1-Dichloropropylene	563-58-6	5	µg/L	<100	<100	0.0	No Limit
		EP074: Carbon Tetrachloride	56-23-5	5	µg/L	<100	<100	0.0	No Limit
		EP074: 1,2-Dichloroethane	107-06-2	5	µg/L	<100	<100	0.0	No Limit
		EP074: Trichloroethene	79-01-6	5	µg/L	<100	<100	0.0	No Limit
		EP074: Dibromomethane	74-95-3	5	µg/L	<100	<100	0.0	No Limit
		EP074: 1,1,2-Trichloroethane	79-00-5	5	µg/L	<100	<100	0.0	No Limit
		EP074: 1,3-Dichloropropane	142-28-9	5	µg/L	<100	<100	0.0	No Limit
		EP074: Tetrachloroethene	127-18-4	5	µg/L	<100	<100	0.0	No Limit
		EP074: 1,1,1,2-Tetrachloroethane	630-20-6	5	µg/L	<100	<100	0.0	No Limit
		EP074: trans-1,4-Dichloro-2-butene	110-57-6	5	µg/L	<100	<100	0.0	No Limit
		EP074: cis-1,4-Dichloro-2-butene	1476-11-5	5	µg/L	<100	<100	0.0	No Limit
		EP074: 1,1,2,2-Tetrachloroethane	79-34-5	5	µg/L	<100	<100	0.0	No Limit
		EP074: 1,2,3-Trichloropropane	96-18-4	5	µg/L	<100	<100	0.0	No Limit
		EP074: Pentachloroethane	76-01-7	5	µg/L	<100	<100	0.0	No Limit
		EP074: 1,2-Dibromo-3-chloropropane	96-12-8	5	µg/L	<100	<100	0.0	No Limit
		EP074: Dichlorodifluoromethane	75-71-8	50	µg/L	<1000	<1000	0.0	No Limit
EP074: Chloromethane	74-87-3	50	µg/L	<1000	<1000	0.0	No Limit		
EP074: Vinyl chloride	75-01-4	50	µg/L	<1000	<1000	0.0	No Limit		
EP074: Bromomethane	74-83-9	50	µg/L	<1000	<1000	0.0	No Limit		
EP074: Chloroethane	75-00-3	50	µg/L	<1000	<1000	0.0	No Limit		
EP074: Trichlorofluoromethane	75-69-4	50	µg/L	<1000	<1000	0.0	No Limit		
<b>EP074F: Halogenated Aromatic Compounds (QC Lot: 2496299)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP074: Chlorobenzene	108-90-7	5	µg/L	<100	<100	0.0	No Limit
		EP074: Bromobenzene	108-86-1	5	µg/L	<100	<100	0.0	No Limit
		EP074: 2-Chlorotoluene	95-49-8	5	µg/L	<100	<100	0.0	No Limit
		EP074: 4-Chlorotoluene	106-43-4	5	µg/L	<100	<100	0.0	No Limit
		EP074: 1,2,3-Trichlorobenzene	87-61-6	5	µg/L	<100	<100	0.0	No Limit
<b>EP074G: Trihalomethanes (QC Lot: 2496299)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP074: Chloroform	67-66-3	5	µg/L	<100	<100	0.0	No Limit
		EP074: Bromodichloromethane	75-27-4	5	µg/L	<100	<100	0.0	No Limit
		EP074: Dibromochloromethane	124-48-1	5	µg/L	<100	<100	0.0	No Limit
		EP074: Bromoform	75-25-2	5	µg/L	<100	<100	0.0	No Limit



Sub-Matrix: **WATER**

Laboratory Duplicate (DUP) Report

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP075A: Phenolic Compounds (QC Lot: 2487865)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP075: Phenol	108-95-2	2	µg/L	1250	807	42.8	0% - 20%
		EP075: 2-Chlorophenol	95-57-8	2	µg/L	<200	<200	0.0	No Limit
		EP075: 2-Methylphenol	95-48-7	2	µg/L	1780	1090	48.5	0% - 20%
		EP075: 2-Nitrophenol	88-75-5	2	µg/L	<200	<200	0.0	No Limit
		EP075: 2,4-Dimethylphenol	105-67-9	2	µg/L	1250	749	49.9	0% - 20%
		EP075: 2,4-Dichlorophenol	120-83-2	2	µg/L	<200	<200	0.0	No Limit
		EP075: 2,6-Dichlorophenol	87-65-0	2	µg/L	<200	<200	0.0	No Limit
		EP075: 4-Chloro-3-Methylphenol	59-50-7	2	µg/L	<200	<200	0.0	No Limit
		EP075: 2,4,6-Trichlorophenol	88-06-2	2	µg/L	<200	<200	0.0	No Limit
		EP075: 2,4,5-Trichlorophenol	95-95-4	2	µg/L	<200	<200	0.0	No Limit
		EP075: 3- & 4-Methylphenol	1319-77-3	4	µg/L	1430	871	48.4	0% - 20%
EP075: Pentachlorophenol	87-86-5	4	µg/L	<400	<400	0.0	No Limit		
<b>EP075B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2487865)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP075: Naphthalene	91-20-3	2	µg/L	1200	542	75.7	0% - 20%
		EP075: 2-Methylnaphthalene	91-57-6	2	µg/L	2090	863	# 83.1	0% - 20%
		EP075: 2-Chloronaphthalene	91-58-7	2	µg/L	<200	<200	0.0	No Limit
		EP075: Acenaphthylene	208-96-8	2	µg/L	<200	<200	0.0	No Limit
		EP075: Acenaphthene	83-32-9	2	µg/L	<200	<200	0.0	No Limit
		EP075: Fluorene	86-73-7	2	µg/L	<200	<200	0.0	No Limit
		EP075: Phenanthrene	85-01-8	2	µg/L	268	<200	28.9	No Limit
		EP075: Anthracene	120-12-7	2	µg/L	<200	<200	0.0	No Limit
		EP075: Fluoranthene	206-44-0	2	µg/L	<200	<200	0.0	No Limit
		EP075: Pyrene	129-00-0	2	µg/L	<200	<200	0.0	No Limit
		EP075: N-2-Fluorenyl Acetamide	53-96-3	2	µg/L	<200	<200	0.0	No Limit
		EP075: Benz(a)anthracene	56-55-3	2	µg/L	<200	<200	0.0	No Limit
		EP075: Chrysene	218-01-9	2	µg/L	<200	<200	0.0	No Limit
		EP075: 7,12-Dimethylbenz(a)anthracene	57-97-6	2	µg/L	<200	<200	0.0	No Limit
		EP075: Benzo(a)pyrene	50-32-8	2	µg/L	<200	<200	0.0	No Limit
		EP075: 3-Methylcholanthrene	56-49-5	2	µg/L	<200	<200	0.0	No Limit
		EP075: Indeno(1,2,3.cd)pyrene	193-39-5	2	µg/L	<200	<200	0.0	No Limit
		EP075: Dibenz(a,h)anthracene	53-70-3	2	µg/L	<200	<200	0.0	No Limit
		EP075: Benzo(g,h,i)perylene	191-24-2	2	µg/L	<200	<200	0.0	No Limit
		EP075: Sum of PAHs	----	2	µg/L	1470	542	92.1	0% - 20%
EP075: Benzo(b) & Benzo(k)fluoranthene	205-99-2 207-08-9	4	µg/L	<400	<400	0.0	No Limit		
<b>EP075C: Phthalate Esters (QC Lot: 2487865)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP075: bis(2-ethylhexyl) phthalate	117-81-7	10	µg/L	<1000	<1000	0.0	No Limit





Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP075C: Phthalate Esters (QC Lot: 2487865) - continued</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP075: Dimethyl phthalate	131-11-3	2	µg/L	<200	<200	0.0	No Limit
		EP075: Diethyl phthalate	84-66-2	2	µg/L	<200	<200	0.0	No Limit
		EP075: Di-n-butyl phthalate	84-74-2	2	µg/L	<200	<200	0.0	No Limit
		EP075: Butyl benzyl phthalate	85-68-7	2	µg/L	<200	<200	0.0	No Limit
		EP075: Di-n-octylphthalate	117-84-0	2	µg/L	<200	<200	0.0	No Limit
<b>EP075D: Nitrosamines (QC Lot: 2487865)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP075: N-Nitrosomethylethylamine	10595-95-6	2	µg/L	<200	<200	0.0	No Limit
		EP075: N-Nitrosodiethylamine	55-18-5	2	µg/L	<200	<200	0.0	No Limit
		EP075: N-Nitrosomorpholine	59-89-2	2	µg/L	<200	<200	0.0	No Limit
		EP075: N-Nitrosodi-n-propylamine	621-64-7	2	µg/L	<200	<200	0.0	No Limit
		EP075: N-Nitrosopiperidine	100-75-4	2	µg/L	<200	<200	0.0	No Limit
		EP075: N-Nitrosodibutylamine	924-16-3	2	µg/L	<200	<200	0.0	No Limit
		EP075: Methapyrilene	91-80-5	2	µg/L	<200	<200	0.0	No Limit
		EP075: N-Nitrosopyrrolidine	930-55-2	4	µg/L	<400	<400	0.0	No Limit
EP075: N-Nitrosodiphenyl & Diphenylamine	86-30-6 122-39-4	4	µg/L	<400	<400	0.0	No Limit		
<b>EP075E: Nitroaromatics and Ketones (QC Lot: 2487865)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP075: 2-Picoline	109-06-8	2	µg/L	<200	<200	0.0	No Limit
		EP075: Acetophenone	98-86-2	2	µg/L	<200	<200	0.0	No Limit
		EP075: Nitrobenzene	98-95-3	2	µg/L	<200	<200	0.0	No Limit
		EP075: Isophorone	78-59-1	2	µg/L	<200	<200	0.0	No Limit
		EP075: 1-Naphthylamine	134-32-7	2	µg/L	<200	<200	0.0	No Limit
		EP075: 4-Nitroquinoline-N-oxide	56-57-5	2	µg/L	<200	<200	0.0	No Limit
		EP075: 5-Nitro-o-toluidine	99-55-8	2	µg/L	<200	<200	0.0	No Limit
		EP075: Azobenzene	103-33-3	2	µg/L	<200	<200	0.0	No Limit
		EP075: 1.3.5-Trinitrobenzene	99-35-4	2	µg/L	<200	<200	0.0	No Limit
		EP075: Phenacetin	62-44-2	2	µg/L	<200	<200	0.0	No Limit
		EP075: 4-Aminobiphenyl	92-67-1	2	µg/L	<200	<200	0.0	No Limit
		EP075: Pentachloronitrobenzene	82-68-8	2	µg/L	<200	<200	0.0	No Limit
		EP075: Pronamide	23950-58-5	2	µg/L	<200	<200	0.0	No Limit
		EP075: Dimethylaminoazobenzene	60-11-7	2	µg/L	<200	<200	0.0	No Limit
		EP075: Chlorobenzilate	510-15-6	2	µg/L	<200	<200	0.0	No Limit
EP075: 2.6-Dinitrotoluene	606-20-2	4	µg/L	<400	<400	0.0	No Limit		
EP075: 2.4-Dinitrotoluene	121-14-2	4	µg/L	<400	<400	0.0	No Limit		
<b>EP075F: Haloethers (QC Lot: 2487865)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP075: Bis(2-chloroethyl) ether	111-44-4	2	µg/L	<200	<200	0.0	No Limit



Sub-Matrix: **WATER**

Laboratory Duplicate (DUP) Report

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP075F: Haloethers (QC Lot: 2487865) - continued</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP075: Bis(2-chloroethoxy) methane	111-91-1	2	µg/L	<200	<200	0.0	No Limit
		EP075: 4-Chlorophenyl phenyl ether	7005-72-3	2	µg/L	<200	<200	0.0	No Limit
		EP075: 4-Bromophenyl phenyl ether	101-55-3	2	µg/L	<200	<200	0.0	No Limit
<b>EP075G: Chlorinated Hydrocarbons (QC Lot: 2487865)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP075: Hexachlorocyclopentadiene	77-47-4	10	µg/L	<1000	<1000	0.0	No Limit
		EP075: 1,4-Dichlorobenzene	106-46-7	2	µg/L	<200	<200	0.0	No Limit
		EP075: 1,3-Dichlorobenzene	541-73-1	2	µg/L	<200	<200	0.0	No Limit
		EP075: 1,2-Dichlorobenzene	95-50-1	2	µg/L	<200	<200	0.0	No Limit
		EP075: Hexachloroethane	67-72-1	2	µg/L	<200	<200	0.0	No Limit
		EP075: 1,2,4-Trichlorobenzene	120-82-1	2	µg/L	<200	<200	0.0	No Limit
		EP075: Hexachloropropylene	1888-71-7	2	µg/L	<200	<200	0.0	No Limit
		EP075: Hexachlorobutadiene	87-68-3	2	µg/L	<200	<200	0.0	No Limit
		EP075: Pentachlorobenzene	608-93-5	2	µg/L	<200	<200	0.0	No Limit
EP075: Hexachlorobenzene (HCB)	118-74-1	4	µg/L	<400	<400	0.0	No Limit		
<b>EP075H: Anilines and Benzidines (QC Lot: 2487865)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP075: Aniline	62-53-3	2	µg/L	<200	<200	0.0	No Limit
		EP075: 4-Chloroaniline	106-47-8	2	µg/L	<200	<200	0.0	No Limit
		EP075: Dibenzofuran	132-64-9	2	µg/L	<200	<200	0.0	No Limit
		EP075: 4-Nitroaniline	100-01-6	2	µg/L	<200	<200	0.0	No Limit
		EP075: Carbazole	86-74-8	2	µg/L	<200	<200	0.0	No Limit
		EP075: 3,3'-Dichlorobenzidine	91-94-1	2	µg/L	<200	<200	0.0	No Limit
		EP075: 2-Nitroaniline	88-74-4	4	µg/L	<400	<400	0.0	No Limit
		EP075: 3-Nitroaniline	99-09-2	4	µg/L	<400	<400	0.0	No Limit
<b>EP075I: Organochlorine Pesticides (QC Lot: 2487865)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP075: alpha-BHC	319-84-6	2	µg/L	<200	<200	0.0	No Limit
		EP075: beta-BHC	319-85-7	2	µg/L	<200	<200	0.0	No Limit
		EP075: gamma-BHC	58-89-9	2	µg/L	<200	<200	0.0	No Limit
		EP075: delta-BHC	319-86-8	2	µg/L	<200	<200	0.0	No Limit
		EP075: Heptachlor	76-44-8	2	µg/L	<200	<200	0.0	No Limit
		EP075: Aldrin	309-00-2	2	µg/L	<200	<200	0.0	No Limit
		EP075: Heptachlor epoxide	1024-57-3	2	µg/L	<200	<200	0.0	No Limit
		EP075: alpha-Endosulfan	959-98-8	2	µg/L	<200	<200	0.0	No Limit
		EP075: 4,4'-DDE	72-55-9	2	µg/L	<200	<200	0.0	No Limit
		EP075: Dieldrin	60-57-1	2	µg/L	<200	<200	0.0	No Limit
		EP075: Endrin	72-20-8	2	µg/L	<200	<200	0.0	No Limit



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP075I: Organochlorine Pesticides (QC Lot: 2487865) - continued</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP075: beta-Endosulfan	33213-65-9	2	µg/L	<200	<200	0.0	No Limit
		EP075: 4,4'-DDD	72-54-8	2	µg/L	<200	<200	0.0	No Limit
		EP075: Endosulfan sulfate	1031-07-8	2	µg/L	<200	<200	0.0	No Limit
		EP075: 4,4'-DDT	50-29-3	4	µg/L	<400	<400	0.0	No Limit
<b>EP075J: Organophosphorus Pesticides (QC Lot: 2487865)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP075: Dichlorvos	62-73-7	2	µg/L	<200	<200	0.0	No Limit
		EP075: Dimethoate	60-51-5	2	µg/L	<200	<200	0.0	No Limit
		EP075: Diazinon	333-41-5	2	µg/L	<200	<200	0.0	No Limit
		EP075: Chlorpyrifos-methyl	5598-13-0	2	µg/L	<200	<200	0.0	No Limit
		EP075: Malathion	121-75-5	2	µg/L	<200	<200	0.0	No Limit
		EP075: Fenthion	55-38-9	2	µg/L	<200	<200	0.0	No Limit
		EP075: Chlorpyrifos	2921-88-2	2	µg/L	<200	<200	0.0	No Limit
		EP075: Pirimphos-ethyl	23505-41-1	2	µg/L	<200	<200	0.0	No Limit
		EP075: Chlorfenvinphos	470-90-6	2	µg/L	<200	<200	0.0	No Limit
		EP075: Prothiofos	34643-46-4	2	µg/L	<200	<200	0.0	No Limit
EP075: Ethion	563-12-2	2	µg/L	<200	<200	0.0	No Limit		
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QC Lot: 2487874)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP070-CWG: Aliphatic >C10-C12	TPHCWG-ALE1	50	µg/L	18000	19500	8.0	0% - 20%
		EP070-CWG: Aliphatic >C12-C16	TPHCWG-ALE2	50	µg/L	53600	55100	2.6	0% - 20%
		EP070-CWG: Aliphatic >C16-C21	----	50	µg/L	52500	54500	3.7	0% - 20%
		EP070-CWG: Aliphatic >C21-C35	----	50	µg/L	24900	24700	0.6	0% - 20%
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QC Lot: 2496300)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP079-CWG: Aliphatic >C5-C6	----	20	µg/L	5300	6300	17.2	0% - 20%
		EP079-CWG: Aliphatic >C6-C8	TPHCWG-ALV2	20	µg/L	71400	63800	11.3	0% - 20%
		EP079-CWG: Aliphatic >C8-C10	TPHCWG-ALV3	20	µg/L	103000	101000	2.2	0% - 20%
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QC Lot: 2487874)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP070-CWG: Aromatic >C10-C12	TPHCWG-ARE1	50	µg/L	6050	7150	16.6	0% - 20%
		EP070-CWG: Aromatic >C12-C16	TPHCWG-ARE2	50	µg/L	14900	15700	5.2	0% - 20%
		EP070-CWG: Aromatic >C16-C21	TPHCWG-ARE3	50	µg/L	12900	13600	5.1	0% - 20%
		EP070-CWG: Aromatic >C21-C35	TPHCWG-ARE4	50	µg/L	3610	3920	8.2	0% - 20%
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QC Lot: 2496300)</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP079-CWG: Aromatic >C5-C7	----	5	µg/L	1040	930	10.7	0% - 20%

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 Work Order : EM1210360  
 Client : SANTOS LTD  
 Project : HFRA Fluids Sampling - Extended Analysis



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QC Lot: 2496300) - continued</b>									
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EP079-CWG: Aromatic >C7-C8	TPHCWG-ARV 2	5	µg/L	6490	6140	5.5	0% - 20%
		EP079-CWG: Aromatic >C8-C10	TPHCWG-ARV 3	5	µg/L	17900	18000	0.5	0% - 20%
<b>EP117: Alcohols (QC Lot: 2489354)</b>									
ER1200015-001	Anonymous	EP117: Ethanol	64-17-5	50	µg/L	<50	<50	0.0	No Limit
		EP117: Isopropanol	67-63-0	50	µg/L	<50	<50	0.0	No Limit
		EP117: n-Propanol	71-23-8	50	µg/L	<50	<50	0.0	No Limit
		EP117: Isobutanol	78-83-1	50	µg/L	<50	<50	0.0	No Limit
		EP117: n-Butanol	71-36-3	50	µg/L	<50	<50	0.0	No Limit
ER1200015-003	Anonymous	EP117: Ethanol	64-17-5	50	µg/L	<50	<50	0.0	No Limit
		EP117: Isopropanol	67-63-0	50	µg/L	58	59	2.2	No Limit
		EP117: n-Propanol	71-23-8	50	µg/L	<50	<50	0.0	No Limit
		EP117: Isobutanol	78-83-1	50	µg/L	<50	<50	0.0	No Limit
		EP117: n-Butanol	71-36-3	50	µg/L	<50	<50	0.0	No Limit



## Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: WATER

				Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report				
					Spike Concentration	Spike Recovery (%)		Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit				LCS	Low	High
<b>EA015: Total Dissolved Solids (QCLot: 2487120)</b>									
EA015H: Total Dissolved Solids @180°C	GIS-210-010	10	mg/L	<10	2000 mg/L	99.5	98	104	
<b>ED009: Anions (QCLot: 2489720)</b>									
ED009-X: Bromide	24959-67-9	0.01	mg/L	<0.010	2 mg/L	99.6	90	110	
ED009-X: Iodide	20461-54-5	0.01	mg/L	<0.010	0.5 mg/L	89.6	73	125	
<b>ED037P: Alkalinity by PC Titrator (QCLot: 2487642)</b>									
ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	----	200 mg/L	98.9	77	127	
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2486620)</b>									
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	12.5 mg/L	114	81	125	
<b>ED045G: Chloride Discrete analyser (QCLot: 2486619)</b>									
ED045G: Chloride	16887-00-6	1	mg/L	<1	1000 mg/L	99.3	89	117	
<b>ED093F: Dissolved Major Cations (QCLot: 2486618)</b>									
ED093F: Calcium	7440-70-2	1	mg/L	<1	5 mg/L	104	83	129	
ED093F: Magnesium	7439-95-4	1	mg/L	<1	5 mg/L	101	80	124	
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	98.6	77	125	
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	96.8	77	123	
<b>EG020F: Dissolved Metals by ICP-MS (QCLot: 2494881)</b>									
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	109	80	120	
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	96.0	87	109	
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	104	70	124	
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	96.9	88	110	
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	98.5	88	110	
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	104	86	112	
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	98.1	87	111	
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	101	86	108	
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	95.1	90	110	
EG020A-F: Lithium	7439-93-2	0.001	mg/L	<0.001	0.1 mg/L	100	60	130	
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	101	87	111	
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	103	84	108	
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	107	86	112	
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	98.0	83	111	
EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	0.1 mg/L	104	83	111	
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	104	85	113	
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	97.6	86	120	
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.1 mg/L	100	61	133	



Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
Method: Compound	CAS Number	LOR	Unit		Result	Spike Concentration	Spike Recovery (%) LCS	Recovery Limits (%) Low High
<b>EG020F: Dissolved Metals by ICP-MS (QCLot: 2494881) - continued</b>								
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	103	79	119
<b>EG020F: Dissolved Metals by ICP-MS (QCLot: 2494882)</b>								
EG020B-F: Strontium	7440-24-6	0.001	mg/L	<0.001	0.1 mg/L	98.7	88	108
EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	----	----	----	----
<b>EG035F: Dissolved Mercury by FIMS (QCLot: 2494880)</b>								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.0100 mg/L	108	71	125
<b>EK025SF: Free CN by Segmented Flow Analyser (QCLot: 2487961)</b>								
EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	0.2 mg/L	87.9	73	111
<b>EK026SF: Total CN by Segmented Flow Analyser (QCLot: 2487962)</b>								
EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	0.2 mg/L	91.8	85	125
<b>EK040P: Fluoride by PC Titrator (QCLot: 2487643)</b>								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	101	78	120
<b>EK055: Ammonia as N (QCLot: 2498816)</b>								
EK055: Ammonia as N	7664-41-7	0.1	mg/L	<0.1	25 mg/L	101	80	120
<b>EK057G: Nitrite as N by Discrete Analyser (QCLot: 2486617)</b>								
EK057G: Nitrite as N	----	0.01	mg/L	<0.01	0.5 mg/L	90.8	84	112
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2487853)</b>								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	97.3	73	127
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2487602)</b>								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	75.8	63	117
<b>EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2487603)</b>								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	87.8	73	117
<b>EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2486621)</b>								
EK071G: Reactive Phosphorus as P	----	0.01	mg/L	<0.01	0.5 mg/L	106	84	108
<b>EP005: Total Organic Carbon (TOC) (QCLot: 2496921)</b>								
EP005: Total Organic Carbon	----	1	mg/L	<1	100 mg/L	87.4	81	111
<b>EP010: Formaldehyde (QCLot: 2487151)</b>								
EP010: Formaldehyde	50-00-0	0.1	mg/L	<0.1	5.0 mg/L	107	91	117
<b>EP041A: Nonionic Surfactants (QCLot: 2488667)</b>								
EP041A: Nonionic Surfactants as CTAS	----	5	mg/L	<5	10 mg/L	107	70	128
<b>EP050: Anionic Surfactants as MBAS (QCLot: 2488597)</b>								
EP050: Anionic Surfactants as MBAS		0.1	mg/L	<0.1	1.0 mg/L	100	74	120
<b>EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 2496299)</b>								
EP074: Benzene	71-43-2	1	µg/L	<1	20 µg/L	117	79	121
EP074: Toluene	108-88-3	2	µg/L	<2	20 µg/L	113	80	124
EP074: Ethylbenzene	100-41-4	2	µg/L	<2	20 µg/L	98.9	79	121



Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike	Spike Recovery (%)		Recovery Limits (%)	
					Concentration	LCS	Low	High	
<b>EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 2496299) - continued</b>									
EP074: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	40 µg/L	104	80	122	
EP074: Styrene	100-42-5	5	µg/L	<5	20 µg/L	100	74	122	
EP074: ortho-Xylene	95-47-6	2	µg/L	<2	20 µg/L	109	81	123	
EP074: Isopropylbenzene	98-82-8	5	µg/L	<5	20 µg/L	106	80	120	
EP074: n-Propylbenzene	103-65-1	5	µg/L	<5	20 µg/L	85.0	70	120	
EP074: 1.3.5-Trimethylbenzene	108-67-8	5	µg/L	<5	20 µg/L	86.6	71	119	
EP074: sec-Butylbenzene	135-98-8	5	µg/L	<5	20 µg/L	88.9	72	120	
EP074: 1.2.4-Trimethylbenzene	95-63-6	5	µg/L	<5	20 µg/L	88.8	73	119	
EP074: tert-Butylbenzene	98-06-6	5	µg/L	<5	20 µg/L	90.1	73	119	
EP074: p-Isopropyltoluene	99-87-6	5	µg/L	<5	20 µg/L	86.1	71	121	
EP074: n-Butylbenzene	104-51-8	5	µg/L	<5	20 µg/L	78.0	65	121	
<b>EP074B: Oxygenated Compounds (QCLot: 2496299)</b>									
EP074: Vinyl Acetate	108-05-4	50	µg/L	<50	200 µg/L	104	57	131	
EP074: 2-Butanone (MEK)	78-93-3	50	µg/L	<50	200 µg/L	108	69	135	
EP074: 4-Methyl-2-pentanone (MIBK)	108-10-1	50	µg/L	<50	200 µg/L	108	68	136	
EP074: 2-Hexanone (MBK)	591-78-6	50	µg/L	<50	200 µg/L	103	68	138	
<b>EP074C: Sulfonated Compounds (QCLot: 2496299)</b>									
EP074: Carbon disulfide	75-15-0	5	µg/L	<5	20 µg/L	100	67	127	
<b>EP074D: Fumigants (QCLot: 2496299)</b>									
EP074: 2.2-Dichloropropane	594-20-7	5	µg/L	<5	20 µg/L	101	59	128	
EP074: 1.2-Dichloropropane	78-87-5	5	µg/L	<5	20 µg/L	112	77	121	
EP074: cis-1.3-Dichloropropylene	10061-01-5	5	µg/L	<5	20 µg/L	88.2	70	118	
EP074: trans-1.3-Dichloropropylene	10061-02-6	5	µg/L	<5	20 µg/L	84.5	66	120	
EP074: 1.2-Dibromoethane (EDB)	106-93-4	5	µg/L	<5	20 µg/L	104	78	124	
<b>EP074E: Halogenated Aliphatic Compounds (QCLot: 2496299)</b>									
EP074: Dichlorodifluoromethane	75-71-8	50	µg/L	<50	200 µg/L	108	58	148	
EP074: Chloromethane	74-87-3	50	µg/L	<50	200 µg/L	93.6	62	142	
EP074: Vinyl chloride	75-01-4	50	µg/L	<50	200 µg/L	79.8	61	141	
EP074: Bromomethane	74-83-9	50	µg/L	<50	200 µg/L	64.2	57	131	
EP074: Chloroethane	75-00-3	50	µg/L	<50	200 µg/L	120	64	138	
EP074: Trichlorofluoromethane	75-69-4	50	µg/L	<50	200 µg/L	105	67	131	
EP074: 1.1-Dichloroethene	75-35-4	5	µg/L	<5	20 µg/L	110	71	125	
EP074: Iodomethane	74-88-4	5	µg/L	<5	20 µg/L	62.0	61	135	
EP074: trans-1.2-Dichloroethene	156-60-5	5	µg/L	<5	20 µg/L	109	75	121	
EP074: 1.1-Dichloroethane	75-34-3	5	µg/L	<5	20 µg/L	112	77	121	
EP074: cis-1.2-Dichloroethene	156-59-2	5	µg/L	<5	20 µg/L	112	78	122	
EP074: 1.1.1-Trichloroethane	71-55-6	5	µg/L	<5	20 µg/L	103	70	120	
EP074: 1.1-Dichloropropylene	563-58-6	5	µg/L	<5	20 µg/L	104	74	122	



Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike	Spike Recovery (%)		Recovery Limits (%)	
					Concentration	LCS	Low	High	
<b>EP074E: Halogenated Aliphatic Compounds (QCLot: 2496299) - continued</b>									
EP074: Carbon Tetrachloride	56-23-5	5	µg/L	<5	20 µg/L	96.0	57	123	
EP074: 1,2-Dichloroethane	107-06-2	5	µg/L	<5	20 µg/L	107	75	125	
EP074: Trichloroethene	79-01-6	5	µg/L	<5	20 µg/L	111	77	121	
EP074: Dibromomethane	74-95-3	5	µg/L	<5	20 µg/L	114	76	122	
EP074: 1,1,2-Trichloroethane	79-00-5	5	µg/L	<5	20 µg/L	113	78	126	
EP074: 1,3-Dichloropropane	142-28-9	5	µg/L	<5	20 µg/L	114	79	125	
EP074: Tetrachloroethene	127-18-4	5	µg/L	<5	20 µg/L	96.4	76	122	
EP074: 1,1,1,2-Tetrachloroethane	630-20-6	5	µg/L	<5	20 µg/L	102	65	119	
EP074: trans-1,4-Dichloro-2-butene	110-57-6	5	µg/L	<5	20 µg/L	76.0	46	126	
EP074: cis-1,4-Dichloro-2-butene	1476-11-5	5	µg/L	<5	20 µg/L	67.6	54	132	
EP074: 1,1,1,2,2-Tetrachloroethane	79-34-5	5	µg/L	<5	20 µg/L	114	75	131	
EP074: 1,2,3-Trichloropropane	96-18-4	5	µg/L	<5	20 µg/L	107	75	133	
EP074: Pentachloroethane	76-01-7	5	µg/L	<5	20 µg/L	88.0	46	118	
EP074: 1,2-Dibromo-3-chloropropane	96-12-8	5	µg/L	<5	20 µg/L	78.1	54	124	
<b>EP074F: Halogenated Aromatic Compounds (QCLot: 2496299)</b>									
EP074: Chlorobenzene	108-90-7	5	µg/L	<5	20 µg/L	111	81	121	
EP074: Bromobenzene	108-86-1	5	µg/L	<5	20 µg/L	99.0	75	119	
EP074: 2-Chlorotoluene	95-49-8	5	µg/L	<5	20 µg/L	92.2	73	121	
EP074: 4-Chlorotoluene	106-43-4	5	µg/L	<5	20 µg/L	88.2	72	120	
EP074: 1,2,3-Trichlorobenzene	87-61-6	5	µg/L	<5	20 µg/L	92.6	69	123	
<b>EP074G: Trihalomethanes (QCLot: 2496299)</b>									
EP074: Chloroform	67-66-3	5	µg/L	<5	20 µg/L	107	77	121	
EP074: Bromodichloromethane	75-27-4	5	µg/L	<5	20 µg/L	100	69	117	
EP074: Dibromochloromethane	124-48-1	5	µg/L	<5	20 µg/L	92.8	59	119	
EP074: Bromoform	75-25-2	5	µg/L	<5	20 µg/L	88.0	49	121	
<b>EP075A: Phenolic Compounds (QCLot: 2487865)</b>									
EP075: Phenol	108-95-2	2	µg/L	<2	10 µg/L	23.2	10	65	
EP075: 2-Chlorophenol	95-57-8	2	µg/L	<2	10 µg/L	53.1	29.8	108	
EP075: 2-Methylphenol	95-48-7	2	µg/L	<2	10 µg/L	62.1	21.9	110	
EP075: 3- & 4-Methylphenol	1319-77-3	2	µg/L	----	20 µg/L	21.4	10	108	
		4	µg/L	<4	----	----	----	----	
EP075: 2-Nitrophenol	88-75-5	2	µg/L	<2	10 µg/L	52.3	31.2	123	
EP075: 2,4-Dimethylphenol	105-67-9	2	µg/L	<2	10 µg/L	56.3	36	124	
EP075: 2,4-Dichlorophenol	120-83-2	2	µg/L	<2	10 µg/L	52.7	31.2	125	
EP075: 2,6-Dichlorophenol	87-65-0	2	µg/L	<2	10 µg/L	46.1	33	123	
EP075: 4-Chloro-3-Methylphenol	59-50-7	2	µg/L	<2	10 µg/L	58.4	39	125	
EP075: 2,4,6-Trichlorophenol	88-06-2	2	µg/L	<2	10 µg/L	49.7	23.9	134	
EP075: 2,4,5-Trichlorophenol	95-95-4	2	µg/L	<2	10 µg/L	66.3	31.6	136	





Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike Concentration	Spike Recovery (%)		Recovery Limits (%)	
						LCS	Low	High	
<b>EP075A: Phenolic Compounds (QCLot: 2487865) - continued</b>									
EP075: Pentachlorophenol	87-86-5	2	µg/L	----	10 µg/L	# 10.1	47	153	
		4	µg/L	<4	----	----	----	----	
<b>EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 2487865)</b>									
EP075: Naphthalene	91-20-3	2	µg/L	<2	10 µg/L	53.9	33	117	
EP075: 2-Methylnaphthalene	91-57-6	2	µg/L	<2	10 µg/L	50.8	33	123	
EP075: 2-Chloronaphthalene	91-58-7	2	µg/L	<2	10 µg/L	65.0	22.6	133	
EP075: Acenaphthylene	208-96-8	2	µg/L	<2	10 µg/L	67.5	35	131	
EP075: Acenaphthene	83-32-9	2	µg/L	<2	10 µg/L	59.7	37	127	
EP075: Fluorene	86-73-7	2	µg/L	<2	10 µg/L	58.1	39	133	
EP075: Phenanthrene	85-01-8	2	µg/L	<2	10 µg/L	65.4	42	134	
EP075: Anthracene	120-12-7	2	µg/L	<2	10 µg/L	63.8	41	135	
EP075: Fluoranthene	206-44-0	2	µg/L	<2	10 µg/L	61.1	40	146	
EP075: Pyrene	129-00-0	2	µg/L	<2	10 µg/L	64.8	42	142	
EP075: N-2-Fluorenyl Acetamide	53-96-3	2	µg/L	<2	10 µg/L	69.0	40	146	
EP075: Benz(a)anthracene	56-55-3	2	µg/L	<2	10 µg/L	59.6	41	143	
EP075: Chrysene	218-01-9	2	µg/L	<2	10 µg/L	67.5	40	146	
EP075: Benzo(b) & Benzo(k)fluoranthene	205-99-2	4	µg/L	<4	20 µg/L	79.8	21	151	
	207-08-9								
EP075: 7.12-Dimethylbenz(a)anthracene	57-97-6	2	µg/L	<2	10 µg/L	83.1	39	151	
EP075: Benzo(a)pyrene	50-32-8	2	µg/L	<2	10 µg/L	84.2	39	141	
EP075: 3-Methylcholanthrene	56-49-5	2	µg/L	<2	10 µg/L	66.8	33	139	
EP075: Indeno(1.2.3.cd)pyrene	193-39-5	2	µg/L	<2	10 µg/L	67.9	31.5	139	
EP075: Dibenz(a,h)anthracene	53-70-3	2	µg/L	<2	10 µg/L	67.8	30.1	140	
EP075: Benzo(g,h,i)perylene	191-24-2	2	µg/L	<2	10 µg/L	74.2	29.5	138	
<b>EP075C: Phthalate Esters (QCLot: 2487865)</b>									
EP075: Dimethyl phthalate	131-11-3	2	µg/L	<2	10 µg/L	73.7	41	141	
EP075: Diethyl phthalate	84-66-2	2	µg/L	<2	10 µg/L	68.4	45	139	
EP075: Di-n-butyl phthalate	84-74-2	2	µg/L	<2	10 µg/L	87.5	42	150	
EP075: Butyl benzyl phthalate	85-68-7	2	µg/L	<2	10 µg/L	68.4	36	152	
EP075: bis(2-ethylhexyl) phthalate	117-81-7	10	µg/L	<10	----	----	----	----	
		20	µg/L	----	10 µg/L	74.1	42	158	
EP075: Di-n-octylphthalate	117-84-0	2	µg/L	<2	10 µg/L	81.5	43	141	
<b>EP075D: Nitrosamines (QCLot: 2487865)</b>									
EP075: N-Nitrosomethylethylamine	10595-95-6	2	µg/L	<2	10 µg/L	51.2	10	109	
EP075: N-Nitrosodiethylamine	55-18-5	2	µg/L	<2	10 µg/L	49.8	23.5	124	
EP075: N-Nitrosopyrrolidine	930-55-2	4	µg/L	<4	10 µg/L	43.1	18.8	97	
EP075: N-Nitrosomorpholine	59-89-2	2	µg/L	<2	10 µg/L	50.3	18.3	94	
EP075: N-Nitrosodi-n-propylamine	621-64-7	2	µg/L	<2	10 µg/L	59.0	30.6	129	
EP075: N-Nitrosopiperidine	100-75-4	2	µg/L	<2	10 µg/L	58.0	32	126	



Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
Method: Compound	CAS Number	LOR	Unit		Result	Spike	Spike Recovery (%)		Recovery Limits (%)
				Concentration		LCS	Low	High	
<b>EP075D: Nitrosamines (QCLot: 2487865) - continued</b>									
EP075: N-Nitrosodibutylamine	924-16-3	2	µg/L	<2	10 µg/L	54.6	29.1	135	
EP075: N-Nitrosodiphenyl & Diphenylamine	86-30-6 122-39-4	4	µg/L	<4	10 µg/L	63.6	39	139	
EP075: Methapyrilene	91-80-5	2	µg/L	<2	10 µg/L	33.8	28.1	70	
<b>EP075E: Nitroaromatics and Ketones (QCLot: 2487865)</b>									
EP075: 2-Picoline	109-06-8	2	µg/L	<2	10 µg/L	# 19.0	28.4	57	
EP075: Acetophenone	98-86-2	2	µg/L	<2	10 µg/L	54.9	34	126	
EP075: Nitrobenzene	98-95-3	2	µg/L	<2	10 µg/L	55.8	36	120	
EP075: Isophorone	78-59-1	2	µg/L	<2	10 µg/L	59.1	38	124	
EP075: 2,6-Dinitrotoluene	606-20-2	4	µg/L	<4	10 µg/L	76.1	38	142	
EP075: 2,4-Dinitrotoluene	121-14-2	4	µg/L	<4	10 µg/L	65.5	44	138	
EP075: 1-Naphthylamine	134-32-7	2	µg/L	<2	10 µg/L	45.0	29.8	152	
EP075: 4-Nitroquinoline-N-oxide	56-57-5	2	µg/L	<2	10 µg/L	99.7	25.9	168	
EP075: 5-Nitro-o-tolidine	99-55-8	2	µg/L	<2	10 µg/L	62.1	26.2	138	
EP075: Azobenzene	103-33-3	2	µg/L	<2	10 µg/L	74.1	43	135	
EP075: 1,3,5-Trinitrobenzene	99-35-4	2	µg/L	<2	10 µg/L	56.8	10	158	
EP075: Phenacetin	62-44-2	2	µg/L	<2	10 µg/L	60.8	37	131	
EP075: 4-Aminobiphenyl	92-67-1	2	µg/L	<2	10 µg/L	100	10	150	
EP075: Pentachloronitrobenzene	82-68-8	2	µg/L	<2	10 µg/L	68.4	38	146	
EP075: Pronamide	23950-58-5	2	µg/L	<2	10 µg/L	71.1	45	139	
EP075: Dimethylaminoazobenzene	60-11-7	2	µg/L	<2	10 µg/L	70.3	37	147	
EP075: Chlorobenzilate	510-15-6	2	µg/L	<2	10 µg/L	63.2	42	148	
<b>EP075F: Haloethers (QCLot: 2487865)</b>									
EP075: Bis(2-chloroethyl) ether	111-44-4	2	µg/L	<2	10 µg/L	48.8	10	142	
EP075: Bis(2-chloroethoxy) methane	111-91-1	2	µg/L	<2	10 µg/L	55.5	34	126	
EP075: 4-Chlorophenyl phenyl ether	7005-72-3	2	µg/L	<2	10 µg/L	58.0	39	133	
EP075: 4-Bromophenyl phenyl ether	101-55-3	2	µg/L	<2	10 µg/L	63.2	39	137	
<b>EP075G: Chlorinated Hydrocarbons (QCLot: 2487865)</b>									
EP075: 1,4-Dichlorobenzene	106-46-7	2	µg/L	<2	10 µg/L	51.8	23	109	
EP075: 1,3-Dichlorobenzene	541-73-1	2	µg/L	<2	10 µg/L	50.6	19.8	112	
EP075: 1,2-Dichlorobenzene	95-50-1	2	µg/L	<2	10 µg/L	48.0	25.2	109	
EP075: Hexachloroethane	67-72-1	2	µg/L	<2	10 µg/L	50.6	17.4	115	
EP075: 1,2,4-Trichlorobenzene	120-82-1	2	µg/L	<2	10 µg/L	50.4	25.7	112	
EP075: Hexachloropropylene	1888-71-7	2	µg/L	<2	10 µg/L	46.7	19.1	115	
EP075: Hexachlorobutadiene	87-68-3	2	µg/L	<2	10 µg/L	50.3	21.1	117	
EP075: Hexachlorocyclopentadiene	77-47-4	10	µg/L	<10	10 µg/L	32.5	10	120	
EP075: Pentachlorobenzene	608-93-5	2	µg/L	<2	10 µg/L	59.0	36	130	
EP075: Hexachlorobenzene (HCB)	118-74-1	4	µg/L	<4	20 µg/L	56.9	11.1	135	
<b>EP075H: Anilines and Benzidines (QCLot: 2487865)</b>									



Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
Method: Compound	CAS Number	LOR	Unit		Result	Spike	Spike Recovery (%)		Recovery Limits (%)
				Concentration		LCS	Low	High	
<b>EP075H: Anilines and Benzidines (QCLot: 2487865) - continued</b>									
EP075: Aniline	62-53-3	2	µg/L	<2	10 µg/L	29.8	19.8	96	
EP075: 4-Chloroaniline	106-47-8	2	µg/L	<2	10 µg/L	33.0	16.4	130	
EP075: 2-Nitroaniline	88-74-4	4	µg/L	<4	10 µg/L	75.2	38	138	
EP075: 3-Nitroaniline	99-09-2	4	µg/L	<4	10 µg/L	48.0	10	135	
EP075: Dibenzofuran	132-64-9	2	µg/L	<2	10 µg/L	60.7	39	129	
EP075: 4-Nitroaniline	100-01-6	2	µg/L	<2	10 µg/L	58.3	22.8	133	
EP075: Carbazole	86-74-8	2	µg/L	<2	10 µg/L	67.4	44	138	
EP075: 3,3'-Dichlorobenzidine	91-94-1	2	µg/L	<2	10 µg/L	59.6	14.6	107	
<b>EP075I: Organochlorine Pesticides (QCLot: 2487865)</b>									
EP075: alpha-BHC	319-84-6	2	µg/L	<2	10 µg/L	66.1	41	143	
EP075: beta-BHC	319-85-7	2	µg/L	<2	10 µg/L	57.1	39	145	
EP075: gamma-BHC	58-89-9	2	µg/L	<2	10 µg/L	72.5	39	143	
EP075: delta-BHC	319-86-8	2	µg/L	<2	10 µg/L	72.7	42	142	
EP075: Heptachlor	76-44-8	2	µg/L	<2	10 µg/L	61.0	39	139	
EP075: Aldrin	309-00-2	2	µg/L	<2	10 µg/L	61.9	40	142	
EP075: Heptachlor epoxide	1024-57-3	2	µg/L	<2	10 µg/L	66.2	37	147	
EP075: alpha-Endosulfan	959-98-8	2	µg/L	<2	10 µg/L	88.4	42	146	
EP075: 4,4'-DDE	72-55-9	2	µg/L	<2	10 µg/L	54.1	41	141	
EP075: Dieldrin	60-57-1	2	µg/L	<2	10 µg/L	69.6	42	144	
EP075: Endrin	72-20-8	2	µg/L	<2	10 µg/L	69.1	41	145	
EP075: beta-Endosulfan	33213-65-9	2	µg/L	<2	10 µg/L	70.4	42	146	
EP075: 4,4'-DDD	72-54-8	2	µg/L	<2	10 µg/L	68.7	40	148	
EP075: Endosulfan sulfate	1031-07-8	2	µg/L	<2	10 µg/L	70.0	38	152	
EP075: 4,4'-DDT	50-29-3	4	µg/L	<4	10 µg/L	55.9	33	145	
<b>EP075J: Organophosphorus Pesticides (QCLot: 2487865)</b>									
EP075: Dichlorvos	62-73-7	2	µg/L	<2	10 µg/L	61.3	38	132	
EP075: Dimethoate	60-51-5	2	µg/L	<2	10 µg/L	72.3	36	138	
EP075: Diazinon	333-41-5	2	µg/L	<2	10 µg/L	62.5	43	141	
EP075: Chlorpyrifos-methyl	5598-13-0	2	µg/L	<2	10 µg/L	66.0	43	141	
EP075: Malathion	121-75-5	2	µg/L	<2	10 µg/L	69.5	44	148	
EP075: Fenthion	55-38-9	2	µg/L	<2	10 µg/L	66.7	42	144	
EP075: Chlorpyrifos	2921-88-2	2	µg/L	<2	10 µg/L	65.9	42	142	
EP075: Pirimphos-ethyl	23505-41-1	2	µg/L	<2	10 µg/L	66.1	44	142	
EP075: Chlorfenvinphos	470-90-6	2	µg/L	<2	10 µg/L	62.8	44	146	
EP075: Prothiofos	34643-46-4	2	µg/L	<2	10 µg/L	65.1	40	142	
EP075: Ethion	563-12-2	2	µg/L	<2	10 µg/L	66.7	42	146	
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QCLot: 2487874)</b>									
EP070-CWG: Aliphatic >C10-C12	TPHCWG-AL	50	µg/L	<50	2505 µg/L	81.8	70	130	
	E1								



Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
						LCS	Low	High
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QCLot: 2487874) - continued</b>								
EP070-CWG: Aliphatic >C12-C16	TPHCWG-AL E2	50	µg/L	<50	10590 µg/L	96.0	70	130
EP070-CWG: Aliphatic >C16-C21	----	50	µg/L	<50	9345 µg/L	117	70	130
EP070-CWG: Aliphatic >C21-C35	----	50	µg/L	<50	2253 µg/L	118	70	130
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QCLot: 2496300)</b>								
EP079-CWG: Aliphatic >C5-C6	----	20	µg/L	<20	50 µg/L	92.1	70	130
EP079-CWG: Aliphatic >C6-C8	TPHCWG-AL V2	20	µg/L	<20	100 µg/L	89.5	70	130
EP079-CWG: Aliphatic >C8-C10	TPHCWG-AL V3	20	µg/L	<20	120 µg/L	# 69.4	70	130
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QCLot: 2487874)</b>								
EP070-CWG: Aromatic >C10-C12	TPHCWG-AR E1	50	µg/L	<50	750 µg/L	80.6	70	130
EP070-CWG: Aromatic >C12-C16	TPHCWG-AR E2	50	µg/L	<50	3174 µg/L	102	70	130
EP070-CWG: Aromatic >C16-C21	TPHCWG-AR E3	50	µg/L	<50	2607 µg/L	94.1	70	130
EP070-CWG: Aromatic >C21-C35	TPHCWG-AR E4	50	µg/L	<50	606 µg/L	90.3	70	130
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QCLot: 2496300)</b>								
EP079-CWG: Aromatic >C5-C7	----	1	µg/L	<1	20 µg/L	96.6	70	130
EP079-CWG: Aromatic >C7-C8	TPHCWG-AR V2	2	µg/L	<2	20 µg/L	101	70	130
EP079-CWG: Aromatic >C8-C10	TPHCWG-AR V3	2	µg/L	<2	180 µg/L	77.6	70	130
<b>EP117: Alcohols (QCLot: 2489354)</b>								
EP117: Ethanol	64-17-5	50	µg/L	<50	100 µg/L	104	73	121
EP117: Isopropanol	67-63-0	50	µg/L	<50	100 µg/L	109	73	113
EP117: n-Propanol	71-23-8	50	µg/L	<50	100 µg/L	104	68	116
EP117: Isobutanol	78-83-1	50	µg/L	<50	100 µg/L	95.9	67	117
EP117: n-Butanol	71-36-3	50	µg/L	<50	100 µg/L	98.6	65	119



## Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: WATER

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report			
				Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
					MS	Low	High
<b>ED009: Anions (QCLot: 2489720)</b>							
EM1210339-001	Anonymous	ED009-X: Bromide	24959-67-9	0.2 mg/L	# Not Determined	70	130
		ED009-X: Iodide	20461-54-5	10 mg/L	110	70	130
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2486620)</b>							
EM1210291-005	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	10 mg/L	# Not Determined	70	130
<b>ED045G: Chloride Discrete analyser (QCLot: 2486619)</b>							
EM1210291-005	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	# Not Determined	70	130
<b>EG020F: Dissolved Metals by ICP-MS (QCLot: 2494881)</b>							
EM1210286-010	Anonymous	EG020A-F: Arsenic	7440-38-2	0.2 mg/L	98.2	89	139
		EG020A-F: Beryllium	7440-41-7	0.2 mg/L	101	64	138
		EG020A-F: Barium	7440-39-3	0.2 mg/L	99.2	80	122
		EG020A-F: Cadmium	7440-43-9	0.05 mg/L	100	75	131
		EG020A-F: Chromium	7440-47-3	0.2 mg/L	98.0	70	130
		EG020A-F: Cobalt	7440-48-4	0.2 mg/L	99.6	77	129
		EG020A-F: Copper	7440-50-8	0.2 mg/L	104	71	127
		EG020A-F: Lead	7439-92-1	0.2 mg/L	93.4	71	123
		EG020A-F: Manganese	7439-96-5	0.2 mg/L	93.9	66	132
		EG020A-F: Nickel	7440-02-0	0.2 mg/L	96.7	73	129
		EG020A-F: Vanadium	7440-62-2	0.2 mg/L	98.5	70	130
EG020A-F: Zinc	7440-66-6	0.2 mg/L	101	68	136		
<b>EG035F: Dissolved Mercury by FIMS (QCLot: 2494880)</b>							
EM1210360-001	Tildipie Pad 4-9-2012 Sample1	EG035F: Mercury	7439-97-6	0.0100 mg/L	86.2	70	130
<b>EK025SF: Free CN by Segmented Flow Analyser (QCLot: 2487961)</b>							
EM1210342-009	Anonymous	EK025SF: Free Cyanide	----	0.2 mg/L	88.6	70	130
<b>EK026SF: Total CN by Segmented Flow Analyser (QCLot: 2487962)</b>							
EM1210242-001	Anonymous	EK026SF: Total Cyanide	57-12-5	0.2 mg/L	109	70	130
<b>EK040P: Fluoride by PC Titrator (QCLot: 2487643)</b>							
EM1210350-002	Anonymous	EK040P: Fluoride	16984-48-8	5.0 mg/L	101	70	130
<b>EK055: Ammonia as N (QCLot: 2498816)</b>							
EM1210576-002	Anonymous	EK055: Ammonia as N	7664-41-7	25 mg/L	101	70	130
<b>EK057G: Nitrite as N by Discrete Analyser (QCLot: 2486617)</b>							
EM1210291-005	Anonymous	EK057G: Nitrite as N	----	0.5 mg/L	104	70	130
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2487853)</b>							
EM1210342-012	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	# Not Determined	70	130



Sub-Matrix: WATER

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report			
				Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
					MS	Low	High
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2487602)</b>							
EM1210340-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	84.0	70	130
<b>EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2487603)</b>							
EM1210340-001	Anonymous	EK067G: Total Phosphorus as P	----	1 mg/L	# Not Determined	70	130
<b>EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2486621)</b>							
EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	EK071G: Reactive Phosphorus as P	----	0.5 mg/L	80.6	70	130
<b>EP005: Total Organic Carbon (TOC) (QCLot: 2496921)</b>							
EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	EP005: Total Organic Carbon	----	2000 mg/L	109	70	130
<b>EP010: Formaldehyde (QCLot: 2487151)</b>							
EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	EP010: Formaldehyde	50-00-0	5.0 mg/L	108	70	130
<b>EP041A: Nonionic Surfactants (QCLot: 2488667)</b>							
ES1221506-001	Anonymous	EP041A: Nonionic Surfactants as CTAS	----	5 mg/L	102	70	130
<b>EP050: Anionic Surfactants as MBAS (QCLot: 2488597)</b>							
EP1207391-002	Anonymous	EP050: Anionic Surfactants as MBAS		1.0 mg/L	90.0	70	130
<b>EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 2496299)</b>							
EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	EP074: Benzene	71-43-2	20 µg/L	# Not Determined	64	121
		EP074: Toluene	108-88-3	20 µg/L	# Not Determined	63	125
<b>EP074E: Halogenated Aliphatic Compounds (QCLot: 2496299)</b>							
EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	EP074: 1,1-Dichloroethene	75-35-4	20 µg/L	# Not Determined	52	104
		EP074: Trichloroethene	79-01-6	20 µg/L	# Not Determined	59	120
<b>EP074F: Halogenated Aromatic Compounds (QCLot: 2496299)</b>							
EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	EP074: Chlorobenzene	108-90-7	20 µg/L	# Not Determined	63	132
<b>EP075A: Phenolic Compounds (QCLot: 2487865)</b>							
EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	EP075: Phenol	108-95-2	10 µg/L	# Not Determined	10	51
		EP075: 2-Chlorophenol	95-57-8	10 µg/L	# Not Determined	26.1	104
		EP075: 2-Nitrophenol	88-75-5	10 µg/L	# Not Determined	34	118
		EP075: 4-Chloro-3-Methylphenol	59-50-7	10 µg/L	# Not Determined	24.9	135
		EP075: Pentachlorophenol	87-86-5	10 µg/L	# Not Determined	29.9	194
<b>EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 2487865)</b>							
EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	EP075: Acenaphthene	83-32-9	10 µg/L	# Not Determined	27	133
		EP075: Pyrene	129-00-0	10 µg/L	# Not Determined	28.1	146
<b>EP075D: Nitrosamines (QCLot: 2487865)</b>							
EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	EP075: N-Nitrosodi-n-propylamine	621-64-7	10 µg/L	# Not Determined	22.8	125
<b>EP075E: Nitroaromatics and Ketones (QCLot: 2487865)</b>							
EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	EP075: 2,4-Dinitrotoluene	121-14-2	10 µg/L	# Not Determined	27.9	138
<b>EP075G: Chlorinated Hydrocarbons (QCLot: 2487865)</b>							

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 Work Order : EM1210360  
 Client : SANTOS LTD  
 Project : HFRA Fluids Sampling - Extended Analysis



Sub-Matrix: WATER

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report			
				Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
					MS	Low	High
<b>EP075G: Chlorinated Hydrocarbons (QCLot: 2487865) - continued</b>							
EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	EP075: 1,4-Dichlorobenzene	106-46-7	10 µg/L	# Not Determined	22.1	112
		EP075: 1,2,4-Trichlorobenzene	120-82-1	10 µg/L	# Not Determined	15.3	117
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QCLot: 2496300)</b>							
EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	EP079-CWG: Aliphatic >C5-C6	----	70 µg/L	# Not Determined	70	130
		EP079-CWG: Aliphatic >C6-C8	TPHCWG-AL V2	120 µg/L	# Not Determined	70	130
		EP079-CWG: Aliphatic >C8-C10	TPHCWG-AL V3	120 µg/L	# Not Determined	70	130
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QCLot: 2496300)</b>							
EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	EP079-CWG: Aromatic >C5-C7	----	20 µg/L	# Not Determined	70	130
		EP079-CWG: Aromatic >C7-C8	TPHCWG-AR V2	20 µg/L	# Not Determined	70	130
<b>EP117: Alcohols (QCLot: 2489354)</b>							
ER1200015-002	Anonymous	EP117: Ethanol	64-17-5	100 µg/L	93.6	70	130
		EP117: Isopropanol	67-63-0	100 µg/L	97.1	70	130
		EP117: n-Propanol	71-23-8	100 µg/L	92.6	70	130
		EP117: Isobutanol	78-83-1	100 µg/L	91.0	70	130
		EP117: n-Butanol	71-36-3	100 µg/L	93.1	70	130



Environmental Division

**INTERPRETIVE QUALITY CONTROL REPORT**

Work Order	: <b>EM1210360</b>	Page	: 1 of 16
Client	: SANTOS LTD	Laboratory	: Environmental Division Melbourne
Contact	: MR BARRY RITCHIE	Contact	: Jodie Hancock
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Project	: HFRA Fluids Sampling - Extended Analysis	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----	Date Samples Received	: 06-SEP-2012
C-O-C number	: ----	Issue Date	: 20-SEP-2012
Sampler	: JD, AJ	No. of samples received	: 2
Order number	: 879002/538	No. of samples analysed	: 2
Quote number	: EN/039/11		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

**Environmental Division Melbourne**

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## Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **WATER**

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis			
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
<b>EA005: pH</b>								
Clear Plastic Bottle - Natural Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	----	----	----	07-SEP-2012	04-SEP-2012	*
<b>EA006: Sodium Adsorption Ratio (SAR)</b>								
Clear Plastic Bottle - Natural Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	---	11-SEP-2012	----	07-SEP-2012	11-SEP-2012	✓
<b>EA015: Total Dissolved Solids</b>								
Clear Plastic Bottle - Natural Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	----	----	----	07-SEP-2012	11-SEP-2012	✓
<b>ED009: Anions</b>								
Clear Plastic Bottle - Natural Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	----	----	----	12-SEP-2012	02-OCT-2012	✓
<b>ED037P: Alkalinity by PC Titrator</b>								
Clear Plastic Bottle - Natural Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	---	18-SEP-2012	----	07-SEP-2012	18-SEP-2012	✓
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</b>								
Clear Plastic Bottle - Natural Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	---	02-OCT-2012	----	07-SEP-2012	02-OCT-2012	✓
<b>ED045G: Chloride Discrete analyser</b>								
Clear Plastic Bottle - Natural Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	---	02-OCT-2012	----	07-SEP-2012	02-OCT-2012	✓
<b>ED093F: Dissolved Major Cations</b>								
Clear Plastic Bottle - Natural Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	---	11-SEP-2012	----	07-SEP-2012	11-SEP-2012	✓
<b>EG020F: Dissolved Metals by ICP-MS</b>								
Clear Plastic Bottle - Unspecified; Lab-acidified Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	---	03-MAR-2013	----	13-SEP-2012	03-MAR-2013	✓
<b>EG035F: Dissolved Mercury by FIMS</b>								
Clear Plastic Bottle - Unspecified; Lab-acidified Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	---	18-SEP-2012	----	14-SEP-2012	18-SEP-2012	✓
<b>EK010-1: Chlorine (Field Test)</b>								
Clear Plastic Bottle - Natural Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	----	----	----	07-SEP-2012	04-SEP-2012	*



Matrix: WATER

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis			
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
<b>EK025SF: Free CN by Segmented Flow Analyser</b>								
White Plastic Bottle-NaOH Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	---	18-SEP-2012	----	07-SEP-2012	18-SEP-2012	✓
<b>EK026SF: Total CN by Segmented Flow Analyser</b>								
White Plastic Bottle-NaOH Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	---	18-SEP-2012	----	07-SEP-2012	18-SEP-2012	✓
<b>EK040P: Fluoride by PC Titrator</b>								
Clear Plastic Bottle - Natural Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	---	02-OCT-2012	----	07-SEP-2012	02-OCT-2012	✓
<b>EK055: Ammonia as N</b>								
Clear Plastic Bottle - Sulfuric Acid Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	----	----	----	14-SEP-2012	02-OCT-2012	✓
<b>EK057G: Nitrite as N by Discrete Analyser</b>								
Clear Plastic Bottle - Natural Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	---	06-SEP-2012	----	06-SEP-2012	06-SEP-2012	✓
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>								
Clear Plastic Bottle - Sulfuric Acid Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	---	02-OCT-2012	----	07-SEP-2012	02-OCT-2012	✓
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>								
Clear Plastic Bottle - Sulfuric Acid Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	10-SEP-2012	02-OCT-2012	✓	10-SEP-2012	02-OCT-2012	✓
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>								
Clear Plastic Bottle - Sulfuric Acid Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	10-SEP-2012	02-OCT-2012	✓	10-SEP-2012	02-OCT-2012	✓
<b>EK071G: Reactive Phosphorus as P by discrete analyser</b>								
Clear Plastic Bottle - Natural Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	---	06-SEP-2012	----	06-SEP-2012	06-SEP-2012	✓
<b>EP005: Total Organic Carbon (TOC)</b>								
Amber TOC Vial - Sulfuric Acid Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	----	----	----	13-SEP-2012	02-OCT-2012	✓
<b>EP010: Formaldehyde</b>								
Clear Plastic Bottle - Natural Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	----	----	----	06-SEP-2012	06-SEP-2012	✓
<b>EP041A: Nonionic Surfactants</b>								
Pres. with Formaldehyde on receipt Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	----	----	----	07-SEP-2012	02-OCT-2012	✓
<b>EP050: Anionic Surfactants as MBAS</b>								
Pres. with Formaldehyde on receipt Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	----	----	----	07-SEP-2012	08-SEP-2012	✓
<b>EP074A: Monocyclic Aromatic Hydrocarbons</b>								
Amber VOC Vial - Sulfuric Acid Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	13-SEP-2012	18-SEP-2012	✓	14-SEP-2012	18-SEP-2012	✓



Matrix: **WATER**

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis			
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
<b>EP074B: Oxygenated Compounds</b>								
Amber VOC Vial - Sulfuric Acid Tildilpie Pad 4-9-2012 Sample1, Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	13-SEP-2012	18-SEP-2012	✓	14-SEP-2012	18-SEP-2012	✓	
<b>EP074C: Sulfonated Compounds</b>								
Amber VOC Vial - Sulfuric Acid Tildilpie Pad 4-9-2012 Sample1, Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	13-SEP-2012	18-SEP-2012	✓	14-SEP-2012	18-SEP-2012	✓	
<b>EP074D: Fumigants</b>								
Amber VOC Vial - Sulfuric Acid Tildilpie Pad 4-9-2012 Sample1, Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	13-SEP-2012	18-SEP-2012	✓	14-SEP-2012	18-SEP-2012	✓	
<b>EP074E: Halogenated Aliphatic Compounds</b>								
Amber VOC Vial - Sulfuric Acid Tildilpie Pad 4-9-2012 Sample1, Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	13-SEP-2012	18-SEP-2012	✓	14-SEP-2012	18-SEP-2012	✓	
<b>EP074F: Halogenated Aromatic Compounds</b>								
Amber VOC Vial - Sulfuric Acid Tildilpie Pad 4-9-2012 Sample1, Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	13-SEP-2012	18-SEP-2012	✓	14-SEP-2012	18-SEP-2012	✓	
<b>EP074G: Trihalomethanes</b>								
Amber VOC Vial - Sulfuric Acid Tildilpie Pad 4-9-2012 Sample1, Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	13-SEP-2012	18-SEP-2012	✓	14-SEP-2012	18-SEP-2012	✓	
<b>EP075A: Phenolic Compounds</b>								
Amber Glass Bottle - Unpreserved Tildilpie Pad 4-9-2012 Sample1, Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	11-SEP-2012	11-SEP-2012	✓	13-SEP-2012	17-OCT-2012	✓	
<b>EP075B: Polynuclear Aromatic Hydrocarbons</b>								
Amber Glass Bottle - Unpreserved Tildilpie Pad 4-9-2012 Sample1, Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	11-SEP-2012	11-SEP-2012	✓	13-SEP-2012	17-OCT-2012	✓	
<b>EP075C: Phthalate Esters</b>								
Amber Glass Bottle - Unpreserved Tildilpie Pad 4-9-2012 Sample1, Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	11-SEP-2012	11-SEP-2012	✓	13-SEP-2012	17-OCT-2012	✓	
<b>EP075D: Nitrosamines</b>								
Amber Glass Bottle - Unpreserved Tildilpie Pad 4-9-2012 Sample1, Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	11-SEP-2012	11-SEP-2012	✓	13-SEP-2012	17-OCT-2012	✓	
<b>EP075E: Nitroaromatics and Ketones</b>								
Amber Glass Bottle - Unpreserved Tildilpie Pad 4-9-2012 Sample1, Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	11-SEP-2012	11-SEP-2012	✓	13-SEP-2012	17-OCT-2012	✓	
<b>EP075F: Haloethers</b>								
Amber Glass Bottle - Unpreserved Tildilpie Pad 4-9-2012 Sample1, Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	11-SEP-2012	11-SEP-2012	✓	13-SEP-2012	17-OCT-2012	✓	
<b>EP075G: Chlorinated Hydrocarbons</b>								
Amber Glass Bottle - Unpreserved Tildilpie Pad 4-9-2012 Sample1, Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	11-SEP-2012	11-SEP-2012	✓	13-SEP-2012	17-OCT-2012	✓	
<b>EP075H: Anilines and Benzidines</b>								
Amber Glass Bottle - Unpreserved Tildilpie Pad 4-9-2012 Sample1, Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	11-SEP-2012	11-SEP-2012	✓	13-SEP-2012	17-OCT-2012	✓	



Matrix: **WATER**

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis			
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
<b>EP075I: Organochlorine Pesticides</b>								
<b>Amber Glass Bottle - Unpreserved</b> Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	11-SEP-2012	11-SEP-2012	✓	13-SEP-2012	17-OCT-2012	✓
<b>EP075J: Organophosphorus Pesticides</b>								
<b>Amber Glass Bottle - Unpreserved</b> Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	11-SEP-2012	11-SEP-2012	✓	13-SEP-2012	17-OCT-2012	✓
<b>EP117: Alcohols</b>								
<b>Amber VOC Vial - Sulfuric Acid</b> Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	----	----	----	09-SEP-2012	18-SEP-2012	✓
<b>RIVM Aliphatic Hydrocarbon Fractions</b>								
<b>Amber Glass Bottle - Unpreserved</b> Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	11-SEP-2012	11-SEP-2012	✓	17-SEP-2012	21-OCT-2012	✓
<b>Amber VOC Vial - Sulfuric Acid</b> Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	13-SEP-2012	18-SEP-2012	✓	14-SEP-2012	18-SEP-2012	✓
<b>RIVM Aromatic Hydrocarbon Fractions</b>								
<b>Amber Glass Bottle - Unpreserved</b> Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	11-SEP-2012	11-SEP-2012	✓	17-SEP-2012	21-OCT-2012	✓
<b>Amber VOC Vial - Sulfuric Acid</b> Tildilpie Pad 4-9-2012 Sample1,	Tildilpie Pad 4-9-2012 Sample2	04-SEP-2012	13-SEP-2012	18-SEP-2012	✓	14-SEP-2012	18-SEP-2012	✓



## Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER** Evaluation: \* = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Regular	Actual	Expected	Evaluation	
<b>Laboratory Duplicates (DUP)</b>							
Alcohols by HS-GC-MS	EP117	2	17	11.8	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Alkalinity by PC Titrator	ED037-P	2	11	18.2	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Ammonia as N by Discrete analyser	EK055G	2	10	20.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Anionic Surfactants as MBAS	EP050	2	11	18.2	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	12	16.7	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	2	19	10.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	19	10.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	4	25.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	2	12	16.7	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Formaldehyde	EP010	1	2	50.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Free CN by Segmented Flow Analyser	EK025SF	1	5	20.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	2	13	15.4	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	4	25.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	2	12	16.7	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nonionic Surfactants as CTAS	EP041A	1	3	33.3	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
pH	EA005	1	9	11.1	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	3	33.3	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Semivolatile Organic Compounds	EP075	1	3	33.3	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Standard Anions -by IC (Extended Method)	ED009-X	1	6	16.7	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	13	15.4	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Ammonia as N	EK055	2	10	20.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Cyanide by Segmented Flow Analyser	EK026SF	2	15	13.3	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	2	16	12.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	12	16.7	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	2	17	11.8	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	1	7	14.3	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Speciation (TPH CWG RIVM fractions)	EP070-CWG	1	2	50.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	1	2	50.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Organic Compounds	EP074	1	2	50.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
<b>Laboratory Control Samples (LCS)</b>							
Alcohols by HS-GC-MS	EP117	1	17	5.9	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Alkalinity by PC Titrator	ED037-P	1	11	9.1	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Ammonia as N by Discrete analyser	EK055G	1	10	10.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Anionic Surfactants as MBAS	EP050	1	11	9.1	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	12	16.7	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	19	5.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	5.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	4	25.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement



Matrix: **WATER** Evaluation: \* = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Regular	Actual	Expected	Evaluation	
<b>Analytical Methods</b>							
<b>Laboratory Control Samples (LCS) - Continued</b>							
Formaldehyde	EP010	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Free CN by Segmented Flow Analyser	EK025SF	1	5	20.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	1	13	7.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	4	25.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nonionic Surfactants as CTAS	EP041A	1	3	33.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	3	33.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Semivolatile Organic Compounds	EP075	1	3	33.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Standard Anions -by IC (Extended Method)	ED009-X	1	6	16.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	13	7.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Ammonia as N	EK055	1	10	10.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Cyanide by Segmented Flow Analyser	EK026SF	1	15	6.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	1	16	6.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	1	17	5.9	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	1	7	14.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Speciation (TPH CWG RIVM fractions)	EP070-CWG	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Organic Compounds	EP074	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
<b>Method Blanks (MB)</b>							
Alcohols by HS-GC-MS	EP117	1	17	5.9	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Ammonia as N by Discrete analyser	EK055G	1	10	10.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Anionic Surfactants as MBAS	EP050	1	11	9.1	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	19	5.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	5.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	4	25.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Formaldehyde	EP010	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Free CN by Segmented Flow Analyser	EK025SF	1	5	20.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	1	13	7.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	4	25.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nonionic Surfactants as CTAS	EP041A	1	3	33.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	3	33.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Semivolatile Organic Compounds	EP075	1	3	33.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Standard Anions -by IC (Extended Method)	ED009-X	1	6	16.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	13	7.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Ammonia as N	EK055	1	10	10.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Cyanide by Segmented Flow Analyser	EK026SF	1	15	6.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	1	16	6.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	1	17	5.9	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement



Matrix: **WATER** Evaluation: \* = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Regular	Actual	Expected	Evaluation	
<b>Analytical Methods</b>							
<b>Method Blanks (MB) - Continued</b>							
Total Phosphorus as P By Discrete Analyser	EK067G	1	7	14.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Speciation (TPH CWG RIVM fractions)	EP070-CWG	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Organic Compounds	EP074	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
<b>Matrix Spikes (MS)</b>							
Alcohols by HS-GC-MS	EP117	1	17	5.9	5.0	✓	ALS QCS3 requirement
Ammonia as N by Discrete analyser	EK055G	1	10	10.0	5.0	✓	ALS QCS3 requirement
Anionic Surfactants as MBAS	EP050	1	11	9.1	5.0	✓	ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	12	8.3	5.0	✓	ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	19	5.3	5.0	✓	ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	5.3	5.0	✓	ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	1	12	8.3	5.0	✓	ALS QCS3 requirement
Formaldehyde	EP010	1	2	50.0	5.0	✓	ALS QCS3 requirement
Free CN by Segmented Flow Analyser	EK025SF	1	5	20.0	5.0	✓	ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	4	25.0	5.0	✓	ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	12	8.3	5.0	✓	ALS QCS3 requirement
Nonionic Surfactants as CTAS	EP041A	1	3	33.3	5.0	✓	ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	3	33.3	5.0	✓	ALS QCS3 requirement
Semivolatile Organic Compounds	EP075	1	3	33.3	5.0	✓	ALS QCS3 requirement
Standard Anions -by IC (Extended Method)	ED009-X	1	6	16.7	5.0	✓	ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	13	7.7	5.0	✓	ALS QCS3 requirement
Total Ammonia as N	EK055	1	10	10.0	5.0	✓	ALS QCS3 requirement
Total Cyanide by Segmented Flow Analyser	EK026SF	1	15	6.7	5.0	✓	ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	12	8.3	5.0	✓	ALS QCS3 requirement
Total Organic Carbon	EP005	1	17	5.9	5.0	✓	ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	1	7	14.3	5.0	✓	ALS QCS3 requirement
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	1	2	50.0	5.0	✓	ALS QCS3 requirement
Volatile Organic Compounds	EP074	1	2	50.0	5.0	✓	ALS QCS3 requirement



## Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH	EA005	WATER	APHA 21st ed. 4500 H+ B. pH of water samples is determined by ISE either manually or by automated pH meter. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Dissolved Solids (High Level)	EA015H	WATER	In-House, APHA 21st ed., 2540C A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Hardness as CaCO3	EA065	WATER	APHA 21st ed., 2340 B. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Standard Anions -by IC (Extended Method)	* ED009-X	WATER	APHA 21st ed., 4110. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Alkalinity by PC Titrator	ED037-P	WATER	APHA 21st ed., 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Major Anions - Dissolved	ED040F	WATER	APHA 21st ed., 3120. The 0.45um filtered samples are determined by ICP/AES for Sulfur and/or Silcon content and reported as Sulfate and/or Silica after conversion by gravimetric factor.
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	APHA 21st ed., 4500-SO4 Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Chloride by Discrete Analyser	ED045G	WATER	APHA 21st ed., 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	Major Cations is determined based on APHA 21st ed., 3120; USEPA SW 846 - 6010 The ICPAES technique ionises the 0.45um filtered sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)  Sodium Absorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)  Hardness parameters are calculated based on APHA 21st ed., 2340 B. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): Samples are 0.45 um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite B	EG020B-F	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): Samples are 0.45 um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.





Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Mercury by FIMS	EG035F	WATER	AS 3550, APHA 21st ed. 3112 Hg - B (Flow-injection (SnCl <sub>2</sub> )(Cold Vapour generation) AAS) Samples are 0.45 um filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl <sub>2</sub> which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Silica (Total Dissolved) by ICPAES	EG052F	WATER	APHA 21st ed., 4500-SiO <sub>2</sub> . Silica (Total) determined by calculation from Silicon by ICPAES.
Residual Chlorine by DPD Colourimetry	EK010-1 (Field)	WATER	Adapted from APHA 21st edition, 4500-Cl G, using Palintest Chlorometer 1000
Free CN by Segmented Flow Analyser	EK025SF	WATER	ASTM D7237: Using an automated segmented flow analyser, a sample at high pH (sodium hydroxide preserved) is buffered to pH 6.0. The hydrogen cyanide present passes across a gas dialysis membrane into an acceptor stream consisting of 0.01 M sodium hydroxide. The acceptor stream mixes with a buffer at pH 5.2 and reacts with chloramine-T to form cyanogen chloride. Cyanogen chloride reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour, measured at 600nm. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Cyanide by Segmented Flow Analyser	EK026SF	WATER	APHA 4500-CN-O. Sodium hydroxide preserved samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Fluoride by PC Titrator	EK040P	WATER	APHA 21st ed., 4500 F--C CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Ammonia as N	EK055	WATER	APHA 21st ed., 4500-NH <sub>3</sub> H. This procedure involves a Buchi steam distillation followed by a titrimetric finish to determine ammonia in solid wastes, water and wastewater. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Ammonia as N by Discrete analyser	EK055G	WATER	APHA 21st ed., 4500-NH <sub>3</sub> G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrite as N by Discrete Analyser	EK057G	WATER	APHA 21st ed., 4500-NO <sub>2</sub> - B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrate as N by Discrete Analyser	EK058G	WATER	APHA 21st ed., 4500-NO <sub>3</sub> - F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined separately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrite and Nitrate as N (NO <sub>x</sub> ) by Discrete Analyser	EK059G	WATER	APHA 21st ed., 4500-NO <sub>3</sub> - F. Combined oxidised Nitrogen (NO <sub>2</sub> +NO <sub>3</sub> ) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	APHA 21st ed., 4500-Norg D. 25mL water samples are digested using a traditional Kjeldahl digestion followed by determination by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	APHA 21st ed., 4500-Norg / 4500-NO <sub>3</sub> -. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	APHA 21st ed., 4500-P B&F This procedure involves sulphuric acid digestion of a 100mL sample to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)



Analytical Methods	Method	Matrix	Method Descriptions
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	APHA 21st ed., 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with orthophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	APHA 21st Ed. 1030F. The Ionic Balance is calculated based on the major Anions and Cations. The major anions include Alkalinity, Chloride and Sulfate which determined by PCT and DA. The Cations are determined by Turbi SO4 by DA. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Organic Carbon	EP005	WATER	APHA 21st ed., 5310 B, The automated TOC analyzer determines Total and Inorganic Carbon by IR cell. TOC is calculated as the difference. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Formaldehyde	EP010	WATER	In-house (ASTM D 6303-98) Determined by colourimetry using NASH reagent. The Hantzsch reaction method is based on the reaction of acetylacetone with formaldehyde in the presence of excess ammonium acetate to form a coloured compound.
Nonionic Surfactants as CTAS	EP041A	WATER	APHA 21st ed., 5540 B & D This method estimates the non-ionic surfactant content of waters. Sublation transfers all surfactants into a solvent matrix. Cationic and Anionic surfactants are removed by an ion exchange resin column. The remaining surfactant is coloured up with Cobalt Thiocyanate solution and quantified by UV-vis against LAS standards. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Anionic Surfactants as MBAS	EP050	WATER	APHA 21st ed., 5540 B & C This method comprises three successive extractions from acid aqueous medium containing excess methylene blue, into chloroform, followed by an aqueous backwash and measurement of the colour by spectrophotometry at 652nm. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
TPH Speciation (TPH CWG RIVM fractions)	EP070-CWG	WATER	In-house: Determination of TPH following fractionation by GC-FID. Fractions correspond to those outlined in TPHCWG, 1998, Analysis of Petroleum Hydrocarbons in Environmental Media, TPH Criteria Working Group, Toxicity Technical Action Group, vol I and RIVM report 601501021/2004, Environmental Risk Limits for Mineral Oil (Total Petroleum Hydrocarbons). Aliphatic >C21 - C35 is defined by RIVM only.
Volatile Organic Compounds	EP074	WATER	USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Semivolatile Organic Compounds	EP075	WATER	USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	WATER	In-house. Conventional TPH and MAH data are determined by Purge and Trap GCMS analysis. TIC data (as fractions) and target aromatics (or groups of aromatics) are used to compute aliphatic and aromatic hydrocarbon fractions by addition or difference. Fractions conform to those outlined in TPHCWG, 1998, Analysis of Petroleum Hydrocarbons in Environmental Media, TPH Criteria Working Group, Toxicity Technical Action Group, vol I and RIVM report 601501021/2004, Environmental Risk Limits for Mineral Oil (Total Petroleum Hydrocarbons)
Alcohols by HS-GC-MS	* EP117	WATER	In House. A 10 mL aliquot of sample is mixed with 4 g of sodium chloride, equilibrated at 80 degrees C for 10 minutes and the headspace analysed by GCMS in the selected ion monitoring mode.
Preparation Methods	Method	Matrix	Method Descriptions
Separatory Funnel Extraction of Liquids	ORG14	WATER	USEPA SW 846 - 3510B 500 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2). ALS default excludes sediment which may be resident in the container.

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Work Order : EM1210360  
Client : SANTOS LTD  
Project : HFRA Fluids Sampling - Extended Analysis



<i>Preparation Methods</i>	<i>Method</i>	<i>Matrix</i>	<i>Method Descriptions</i>
Separatory Funnel Extraction of Liquids	ORG14-HX	WATER	Variation of USEPA SW 846 - 3510B: 500 mL to 0.5L of sample is transferred to a separatory funnel and serially extracted three times using 30mL DCM for each extract. The resultant extracts are combined, dehydrated, and exchanged into 5 mL of hexane for analysis. ALS default excludes sediment which may be resident in the container.



## Summary of Outliers

### Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

### Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
<b>Duplicate (DUP) RPDs</b>							
EP074A: Monocyclic Aromatic Hydrocarbons	EM1210360-001	Tildilpie Pad 4-9-2012 Sample 1	p-Isopropyltoluene	99-87-6	23.6 %	0-20%	RPD exceeds LOR based limits
EP075B: Polynuclear Aromatic Hydrocarbons	EM1210360-001	Tildilpie Pad 4-9-2012 Sample 1	2-Methylnaphthalene	91-57-6	83.1 %	0-20%	RPD exceeds LOR based limits
<b>Laboratory Control Spike (LCS) Recoveries</b>							
EP075A: Phenolic Compounds	2948505-001	----	Pentachlorophenol	87-86-5	10.1 %	47-153%	Recovery less than lower control limit
EP075E: Nitroaromatics and Ketones	2948505-001	----	2-Picoline	109-06-8	19.0 %	28.4-57%	Recovery less than lower control limit
EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions	2959034-005	----	Aliphatic >C8-C10	TPHCWG-ALV3	69.4 %	70-130%	Recovery less than lower control limit
<b>Matrix Spike (MS) Recoveries</b>							
ED009: Anions	EM1210339-001	Anonymous	Bromide	24959-67-9	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	EM1210291-005	Anonymous	Sulfate as SO4 - Turbidimetric	14808-79-8	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
ED045G: Chloride Discrete analyser	EM1210291-005	Anonymous	Chloride	16887-00-6	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Ar	EM1210342-012	Anonymous	Nitrite + Nitrate as N	----	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
EK067G: Total Phosphorus as P by Discrete Analyser	EM1210340-001	Anonymous	Total Phosphorus as P	----	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
EP074A: Monocyclic Aromatic Hydrocarbons	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	Benzene	71-43-2	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
EP074A: Monocyclic Aromatic Hydrocarbons	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	Toluene	108-88-3	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
EP074E: Halogenated Aliphatic Compounds	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	1,1-Dichloroethene	75-35-4	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.
EP074E: Halogenated Aliphatic Compounds	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	Trichloroethene	79-01-6	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.
EP074F: Halogenated Aromatic Compounds	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	Chlorobenzene	108-90-7	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.



Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
<b>Matrix Spike (MS) Recoveries - Continued</b>							
EP075A: Phenolic Compounds	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	Phenol	108-95-2	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
EP075A: Phenolic Compounds	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	2-Chlorophenol	95-57-8	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.
EP075A: Phenolic Compounds	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	2-Nitrophenol	88-75-5	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.
EP075A: Phenolic Compounds	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	4-Chloro-3-Methylphenol	59-50-7	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.
EP075A: Phenolic Compounds	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	Pentachlorophenol	87-86-5	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.
EP075B: Polynuclear Aromatic Hydrocarbons	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	Acenaphthene	83-32-9	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.
EP075B: Polynuclear Aromatic Hydrocarbons	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	Pyrene	129-00-0	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.
EP075D: Nitrosamines	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	N-Nitrosodi-n-propylamine	621-64-7	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.
EP075E: Nitroaromatics and Ketones	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	2,4-Dinitrotoluene	121-14-2	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
EP075G: Chlorinated Hydrocarbons	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	1,4-Dichlorobenzene	106-46-7	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.
EP075G: Chlorinated Hydrocarbons	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	1,2,4-Trichlorobenzene	120-82-1	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.
EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	Aliphatic >C5-C6	----	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	Aliphatic >C6-C8	TPHCWG-ALV2	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	Aliphatic >C8-C10	TPHCWG-ALV3	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
EP079/070: TPH CWG Aromatic Hydrocarbon Fractions	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	Aromatic >C5-C7	----	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
EP079/070: TPH CWG Aromatic Hydrocarbon Fractions	EM1210360-002	Tildilpie Pad 4-9-2012 Sample 2	Aromatic >C7-C8	TPHCWG-ARV2	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.

- For all matrices, no Method Blank value outliers occur.

**Regular Sample Surrogates**

Sub-Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
---------------------	----------------------	------------------	---------	------------	------	--------	---------



Sub-Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
<b>Samples Submitted</b>							
EP074S: VOC Surrogates	EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	1,2-Dichloroethane-D4	17060-07-0	71.2 %	72-132 %	Recovery less than lower data quality objective
EP075S: Acid Extractable Surrogates	EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	2-Fluorophenol	367-12-4	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	2-Fluorophenol	367-12-4	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	Phenol-d6	13127-88-3	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	Phenol-d6	13127-88-3	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	2-Chlorophenol-D4	93951-73-6	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	2-Chlorophenol-D4	93951-73-6	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	2,4,6-Tribromophenol	118-79-6	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	2,4,6-Tribromophenol	118-79-6	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	Nitrobenzene-D5	4165-60-0	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	Nitrobenzene-D5	4165-60-0	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	1,2-Dichlorobenzene-D4	2199-69-1	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	1,2-Dichlorobenzene-D4	2199-69-1	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	2-Fluorobiphenyl	321-60-8	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	2-Fluorobiphenyl	321-60-8	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	Anthracene-d10	1719-06-8	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	Anthracene-d10	1719-06-8	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1210360-002	Tildilpie Pad 4-9-2012 Sample2	4-Terphenyl-d14	1718-51-0	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075T: Base/Neutral Extractable Surrogates	EM1210360-001	Tildilpie Pad 4-9-2012 Sample1	4-Terphenyl-d14	1718-51-0	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences

**Outliers : Analysis Holding Time Compliance**

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

Matrix: **WATER**

Method	Extraction / Preparation	Analysis
--------	--------------------------	----------



Matrix: **WATER**

Container / Client Sample ID(s)	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
<b>EA005: pH</b>						
<b>Clear Plastic Bottle - Natural</b> Tildilpie Pad 4-9-2012 Sample1, Tildilpie Pad 4-9-2012 Sample2	----	----	----	07-SEP-2012	04-SEP-2012	<b>3</b>
<b>EK010-1: Chlorine (Field Test)</b>						
<b>Clear Plastic Bottle - Natural</b> Tildilpie Pad 4-9-2012 Sample1, Tildilpie Pad 4-9-2012 Sample2	----	----	----	07-SEP-2012	04-SEP-2012	<b>3</b>

### Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- **No Quality Control Sample Frequency Outliers exist.**



# CHAIN OF CUSTODY

ALS Laboratory: please tick →

□ Sydney: 277 Woodperk Rd, Smithfield NSW 2176  
Ph: 02 8784 8555 E:samples.sydney@alsenviro.com  
□ Newcastle: 5 Rosegum Rd, Warabrook NSW 2304  
Ph: 02 4068 9433 E:samples.newcastle@alsenviro.com

□ Brisbane: 32 Shand St, Stafford QLD 4053  
Ph: 07 3243 7222 E:samples.brisbane@alsenviro.com  
□ Townsville: 14-15 Desma Ct, Bohle QLD 4818  
Ph: 07 4786 0800 E:townsville.environmental@alsenviro.com

✓ Melbourne: 2-4 Westall Rd, Springvale VIC 3171  
Ph: 03 8549 9600 E: samples.melbourne@alsenviro.com  
□ Adelaide: 2-1 Burma Rd, Pooraka SA 5095  
Ph: 08 8350 0890 E:adelaide@alsenviro.com

□ Perth: 10 Hod Way, Malaga WA 6060  
Ph: 08 9209 7656 E: samples.perth@alsenviro.com  
□ Launceston: 27 Wellington St, Launceston TAS 7250  
Ph: 03 6331 2158 E: launceston@alsenviro.com

CLIENT: SANTOS		TURNAROUND REQUIREMENTS : <input checked="" type="checkbox"/> Standard TAT (List due date):		FOR LABORATORY USE ONLY (Circle)	
OFFICE: D&PE, 60 Flinders Street, Adelaide SA		(Standard TAT may be longer for some tests e.g. Ultra Trace Organics) <input type="checkbox"/> Non Standard or urgent TAT (List due date):		COC SEQUENCE NUMBER (Circle)	
PROJECT: HFRA Fluids Sampling - Extended Analysis		ALS QUOTE NO.: EN/039/11		COC: <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7	
ORDER NUMBER: 879002/538				OF: <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7	
PROJECT MANAGER: Barry Ritchie		CONTACT PH:		RECEIVED BY: Thivanka Dedigama	
SAMPLER: Jeff Dzeryk / Andrew Johnston		SAMPLER MOBILE: NA		RELINQUISHED BY: Jeff Dzeryk	
COC emailed to ALS? ( YES / NO)		EDD FORMAT (or default):		DATE/TIME: 4/9/12	
Email Reports to (will default to PM if no other addresses are listed): andrew.johnston@santos.com; frac.rig.rep.completions@santos.com; barry.ritchie@santos.com		Email Invoice to (will default to PM if no other addresses are listed): barry.ritchie@santos.com		DATE/TIME: 5-9-2012 06:00	

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: Dissolved Metals Required are W-3 + Fe, Se, B, Sr, Al, Mo, Sn, U,

LAB ID	SAMPLE ID	DATE / TIME	MATRIX	CONTAINER INFORMATION TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).										Additional Information Samples sent to lab for Mn, Cu, BOD pH Colour Turbidity Formaldehyde Other Date re 4/9/12.
						EA005, EA015H, EK011	NT-1B, NT-2A, NT-8A	EG052, EN065-DA, ED009X	EA065, EK025, EK026, EP005	W-3 and EG020F (See Additional Info)	EP117, TRH-CWG	EP074A-H, EP075	EP010, EP060, EP041			
1	Tindilpe Pad 4-09-2012 Sample 1	4/09/2012 14:00:00	W	1L plastic / green; 60ml plastic green; 125ml plastic purple; 60ml plastic blue; 40ml vial purple; 60ml plastic red; 2 x 40ml vial purple; 3x 100ml glass orange; 2 x 40ml amber glass maroon; 3 x 100ml glass orange; 2 x 500ml amber brown;	18	X	X	X	X	X	X	X	X	X	Sample taken from Frac Fluid at Tindilpe Pad Welliste prior to treatment. Dissolved Metals Required are W-3 + Fe, Se, B, Sr, Al, Mo, Sn, U, Li	
2	Tindilpe Pad 4-09-2012 Sample 2	4/09/2012 14:15:00	W	1L plastic / green; 60ml plastic green; 125ml plastic purple; 60ml plastic blue; 40ml vial purple; 60ml plastic red; 2 x 40ml vial purple; 3x 100ml glass orange; 2 x 40ml amber glass maroon; 3 x 100ml glass orange; 2 x 500ml amber brown;	18	X	X	X	X	X	X	X	X	X	Sample taken from Frac Fluid at Tindilpe Pad Welliste prior to treatment. Dissolved Metals Required are W-3 + Fe, Se, B, Sr, Al, Mo, Sn, U, Li	
					TOTAL	36										

Environmental Division  
Melbourne  
Work Order  
**EM1210360**



Telephone : +61-3-8549 9600

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass; V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airflight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

F = Formaldehyde Preserved Glass;



**Raymond Thai**

---

**From:** Sarah Hodgson  
**Sent:** Thursday, 6 September 2012 11:36 AM  
**To:** Samples Melbourne  
**Subject:** RE: SANTOS HFRA Fluids Sampling - Extended Analysis - EM1210360

Hi Ray,

These would not have been field filtered. Please ask the lab to filter.

Thank you,

Regards,  
How was your customer experience? Please send us your feedback

Sarah Hodgson

PROJECT MANAGER

ALS | Environmental  
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PHONE +61 3 8549 9600  
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[www.alsglobal.com](http://www.alsglobal.com)  
[cid:615291706@05102011-231E](mailto:cid:615291706@05102011-231E)

-----Original Message-----

**From:** Samples Melbourne  
**Sent:** Thursday, 6 September 2012 11:34 AM  
**To:** Sarah Hodgson  
**Subject:** SANTOS HFRA Fluids Sampling - Extended Analysis - EM1210360

Hi Sarah,

With regards to the attached COC, the ID's on the bottles have faded and are barely legible. Ranil has sorted the samples as they have been packaged separately, we have done the best we could with checking whether they are the same samples using the sampling times on the bottles which seem to have matched up well. But we have received a unspecified red/green metals bottle for each of the 2 samples that appear to be unfiltered by their physically appearance. Could you please clarify with the client whether they have been field filtered?

Thanks, Ray



## Environmental Division

### CERTIFICATE OF ANALYSIS

Work Order	: <b>EM1210744</b>	Page	: 1 of 12
Client	: <b>SANTOS LTD</b>	Laboratory	: Environmental Division Melbourne
Contact	: MR BARRY RITCHIE	Contact	: Client Services
Address	: GROUND FLOOR SANTOS CENTRE 60 FLINDERS STREET ADELAIDE SA, AUSTRALIA 5001	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: barry.ritchie@santos.com	E-mail	: Melbourne.Enviro.Services@alsglobal.com
Telephone	: +61 08 8116 5000	Telephone	: +61-3-8549 9600
Facsimile	: +61 08 8116 5050	Facsimile	: +61-3-8549 9601
Project	: HFRA Fluids Sampling- Extended Analysis	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: 879002/538	Date Samples Received	: 14-SEP-2012
C-O-C number	: ----	Issue Date	: 03-OCT-2012
Sampler	: JM, AJ	No. of samples received	: 2
Site	: ----	No. of samples analysed	: 2
Quote number	: EN/039/12		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

**Environmental Division Melbourne**

Part of the **ALS Laboratory Group**

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A Campbell Brothers Limited Company



## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

- Bromide, Iodide and alcohols conducted by ALS Sydney, NATA accreditation no. 825, site no 10911.
- EP071: Poor duplicate precision for sample EM1210744-001 due to sample heterogeneity.
- EP074/079-CWG: Sample EM1210744-001 required dilution due to the presence of high level contaminants. LOR values have been adjusted accordingly.
- EP075: EM1210744-001 & 002 Surrogate recoveries not determined for 2-Fluorophenol, Phenol-d6, 2-Chlorophenol-d4 and 2,4,6-Tribromophenol due to matrix interferences.
- EP075: EM1210744-001 Particular sample required dilution prior to analysis due to matrix interferences. LOR values have been adjusted accordingly.
- EP075: Matrix spike not determined due to matrix interferences.
- EP075: 'Sum of PAH' is the sum of the USEPA 16 priority PAHs
- Ionic balances were calculated using: major anions - chloride, alkalinity and sulfate; and major cations - calcium, magnesium, potassium and sodium.
- MBAS/CTAS conducted by ALS WRG Scoresby, NATA accreditation no. 992, site no. 989.
- Samples were filtered through a 0.45um filter prior to the dissolved metals analysis.



NATA Accredited Laboratory 825

Accredited for compliance with  
ISO/IEC 17025.

## Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Ashesh Patel	Inorganic Chemist	Sydney Inorganics
Danielle White	Committal	WRG Subcontracting
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics
Herman Lin	Laboratory Coordinator	Melbourne Inorganics
Nancy Wang	Senior Semivolatile Instrument Chemist	Melbourne Organics
Nikki Stepniewski	Senior Inorganic Instrument Chemist	Melbourne Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Sarah Millington	Senior Inorganic Chemist	Sydney Inorganics



## Analytical Results

Sub-Matrix: WATER				Client sample ID	FR Water	Crosslink Gel			
				Client sampling date / time	[13-SEP-2012]	[13-SEP-2012]			
Compound	CAS Number	LOR	Unit	EM1210744-001	EM1210744-002				
<b>EA005: pH</b>									
pH Value	----	0.01	pH Unit	6.10	----	----	----	----	----
<b>EA006: Sodium Adsorption Ratio (SAR)</b>									
Sodium Adsorption Ratio	----	0.01	-	4.09	----	----	----	----	----
<b>EA015: Total Dissolved Solids</b>									
Total Dissolved Solids @180°C	GIS-210-010	10	mg/L	1040	----	----	----	----	----
<b>EA065: Total Hardness as CaCO3</b>									
Total Hardness as CaCO3	----	1	mg/L	5	----	----	----	----	----
<b>ED009: Anions</b>									
Bromide	24959-67-9	0.010	mg/L	0.082	----	----	----	----	----
Iodide	20461-54-5	0.010	mg/L	<0.010	----	----	----	----	----
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	10	----	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	10	----	----	----	----	----
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</b>									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	292	----	----	----	----	----
<b>ED045G: Chloride Discrete analyser</b>									
Chloride	16887-00-6	1	mg/L	370	----	----	----	----	----
<b>ED093F: Dissolved Major Cations</b>									
Calcium	7440-70-2	1	mg/L	2	----	----	----	----	----
Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----	----
Sodium	7440-23-5	1	mg/L	21	----	----	----	----	----
Potassium	7440-09-7	1	mg/L	<1	----	----	----	----	----
<b>EG020F: Dissolved Metals by ICP-MS</b>									
Aluminium	7429-90-5	0.01	mg/L	<0.01	----	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	----	----	----	----	----
Barium	7440-39-3	0.001	mg/L	<0.001	----	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	----	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----	----
Copper	7440-50-8	0.001	mg/L	0.003	----	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	0.002	----	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	----	----	----	----	----



## Analytical Results

Sub-Matrix: WATER

Client sample ID  
 Client sampling date / time

Compound	CAS Number	LOR	Unit	FR Water	Crosslink Gel			
				[13-SEP-2012]	[13-SEP-2012]			
				EM1210744-001	EM1210744-002			
<b>EG020F: Dissolved Metals by ICP-MS - Continued</b>								
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<b>0.006</b>	----	----	----	----
Lithium	7439-93-2	0.001	mg/L	<0.001	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	----	----
Strontium	7440-24-6	0.001	mg/L	<b>0.008</b>	----	----	----	----
Tin	7440-31-5	0.001	mg/L	<0.001	----	----	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	----	----	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	----	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----
<b>EG035F: Dissolved Mercury by FIMS</b>								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
<b>EG052F: Dissolved Silica by ICPAES</b>								
Silica	7631-86-9	0.1	mg/L	<0.1	----	----	----	----
<b>EK010-1: Chlorine (Field Test)</b>								
Free Chlorine	----	0.02	mg/L	<b>0.26</b>	----	----	----	----
<b>EK025SF: Free CN by Segmented Flow Analyser</b>								
Free Cyanide	----	0.004	mg/L	<0.004	----	----	----	----
<b>EK026SF: Total CN by Segmented Flow Analyser</b>								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	----	----	----	----
<b>EK040P: Fluoride by PC Titrator</b>								
Fluoride	16984-48-8	0.1	mg/L	<0.1	----	----	----	----
<b>EK055G: Ammonia as N by Discrete Analyser</b>								
Ammonia as N	7664-41-7	0.01	mg/L	<b>90.5</b>	----	----	----	----
<b>EK057G: Nitrite as N by Discrete Analyser</b>								
Nitrite as N	----	0.01	mg/L	<0.01	----	----	----	----
<b>EK058G: Nitrate as N by Discrete Analyser</b>								
Nitrate as N	14797-55-8	0.01	mg/L	<b>0.36</b>	----	----	----	----
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>								
Nitrite + Nitrate as N	----	0.01	mg/L	<b>0.36</b>	----	----	----	----
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<b>185</b>	----	----	----	----
<b>EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser</b>								
Total Nitrogen as N	----	0.1	mg/L	<b>185</b>	----	----	----	----



## Analytical Results

Sub-Matrix: WATER				Client sample ID	FR Water	Crosslink Gel			
				Client sampling date / time	[13-SEP-2012]	[13-SEP-2012]			
Compound	CAS Number	LOR	Unit	EM1210744-001	EM1210744-002				
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>									
Total Phosphorus as P	----	0.01	mg/L	1.42	----	----	----	----	----
<b>EK071G: Reactive Phosphorus as P by discrete analyser</b>									
Reactive Phosphorus as P	----	0.01	mg/L	0.07	----	----	----	----	----
<b>EN055: Ionic Balance</b>									
Total Anions	----	0.01	meq/L	16.7	----	----	----	----	----
Total Cations	----	0.01	meq/L	15.5	----	----	----	----	----
Ionic Balance	----	0.01	%	3.90	----	----	----	----	----
<b>EP005: Total Organic Carbon (TOC)</b>									
Total Organic Carbon	----	1	mg/L	608	23900	----	----	----	----
<b>EP010: Formaldehyde</b>									
Formaldehyde	50-00-0	0.1	mg/L	<0.1	----	----	----	----	----
<b>EP041A: Nonionic Surfactants</b>									
Nonionic Surfactants as CTAS	----	5	mg/L	105	----	----	----	----	----
<b>EP074A: Monocyclic Aromatic Hydrocarbons</b>									
Benzene	71-43-2	1	µg/L	<10	<1	----	----	----	----
Toluene	108-88-3	2	µg/L	26	13	----	----	----	----
Ethylbenzene	100-41-4	2	µg/L	<10	<2	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	50	17	----	----	----	----
Styrene	100-42-5	5	µg/L	<10	<5	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L	<10	<2	----	----	----	----
Isopropylbenzene	98-82-8	5	µg/L	<10	<5	----	----	----	----
n-Propylbenzene	103-65-1	5	µg/L	<10	<5	----	----	----	----
1.3.5-Trimethylbenzene	108-67-8	5	µg/L	<10	<5	----	----	----	----
sec-Butylbenzene	135-98-8	5	µg/L	<10	<5	----	----	----	----
1.2.4-Trimethylbenzene	95-63-6	5	µg/L	<10	<5	----	----	----	----
tert-Butylbenzene	98-06-6	5	µg/L	<10	<5	----	----	----	----
p-Isopropyltoluene	99-87-6	5	µg/L	1450	316	----	----	----	----
n-Butylbenzene	104-51-8	5	µg/L	<10	<5	----	----	----	----
<b>EP074B: Oxygenated Compounds</b>									
Vinyl Acetate	108-05-4	50	µg/L	<100	<50	----	----	----	----
2-Butanone (MEK)	78-93-3	50	µg/L	<100	50	----	----	----	----
4-Methyl-2-pentanone (MIBK)	108-10-1	50	µg/L	<100	<50	----	----	----	----
2-Hexanone (MBK)	591-78-6	50	µg/L	<100	<50	----	----	----	----
<b>EP074C: Sulfonated Compounds</b>									
Carbon disulfide	75-15-0	5	µg/L	<10	<5	----	----	----	----



## Analytical Results

Sub-Matrix: WATER

				Client sample ID	FR Water	Crosslink Gel			
				Client sampling date / time	[13-SEP-2012]	[13-SEP-2012]			
Compound	CAS Number	LOR	Unit	EM1210744-001	EM1210744-002				
<b>EP074D: Fumigants</b>									
2,2-Dichloropropane	594-20-7	5	µg/L	<10	<5				
1,2-Dichloropropane	78-87-5	5	µg/L	<10	<5				
cis-1,3-Dichloropropylene	10061-01-5	5	µg/L	<10	<5				
trans-1,3-Dichloropropylene	10061-02-6	5	µg/L	<10	<5				
1,2-Dibromoethane (EDB)	106-93-4	5	µg/L	<10	<5				
<b>EP074E: Halogenated Aliphatic Compounds</b>									
Dichlorodifluoromethane	75-71-8	50	µg/L	<100	<50				
Chloromethane	74-87-3	50	µg/L	<100	<b>60</b>				
Vinyl chloride	75-01-4	50	µg/L	<100	<50				
Bromomethane	74-83-9	50	µg/L	<100	<50				
Chloroethane	75-00-3	50	µg/L	<100	<50				
Trichlorofluoromethane	75-69-4	50	µg/L	<100	<50				
1,1-Dichloroethene	75-35-4	5	µg/L	<10	<5				
Iodomethane	74-88-4	5	µg/L	<10	<b>19</b>				
trans-1,2-Dichloroethene	156-60-5	5	µg/L	<10	<5				
1,1-Dichloroethane	75-34-3	5	µg/L	<10	<5				
cis-1,2-Dichloroethene	156-59-2	5	µg/L	<10	<5				
1,1,1-Trichloroethane	71-55-6	5	µg/L	<10	<5				
1,1-Dichloropropylene	563-58-6	5	µg/L	<10	<5				
Carbon Tetrachloride	56-23-5	5	µg/L	<10	<5				
1,2-Dichloroethane	107-06-2	5	µg/L	<10	<5				
Trichloroethene	79-01-6	5	µg/L	<10	<5				
Dibromomethane	74-95-3	5	µg/L	<10	<5				
1,1,2-Trichloroethane	79-00-5	5	µg/L	<10	<5				
1,3-Dichloropropane	142-28-9	5	µg/L	<10	<5				
Tetrachloroethene	127-18-4	5	µg/L	<10	<5				
1,1,1,2-Tetrachloroethane	630-20-6	5	µg/L	<10	<5				
trans-1,4-Dichloro-2-butene	110-57-6	5	µg/L	<10	<5				
cis-1,4-Dichloro-2-butene	1476-11-5	5	µg/L	<10	<5				
1,1,2,2-Tetrachloroethane	79-34-5	5	µg/L	<10	<5				
1,2,3-Trichloropropane	96-18-4	5	µg/L	<10	<5				
Pentachloroethane	76-01-7	5	µg/L	<10	<5				
1,2-Dibromo-3-chloropropane	96-12-8	5	µg/L	<10	<5				
<b>EP074F: Halogenated Aromatic Compounds</b>									
Chlorobenzene	108-90-7	5	µg/L	<10	<5				
Bromobenzene	108-86-1	5	µg/L	<10	<5				



## Analytical Results

Sub-Matrix: WATER

Compound	CAS Number	LOR	Unit	Client sample ID		FR Water	Crosslink Gel	---	---	---
				Client sampling date / time						
				EM1210744-001	EM1210744-002					
<b>EP074F: Halogenated Aromatic Compounds - Continued</b>										
2-Chlorotoluene	95-49-8	5	µg/L	<10	6	---	---	---	---	---
4-Chlorotoluene	106-43-4	5	µg/L	<10	<5	---	---	---	---	---
1,2,3-Trichlorobenzene	87-61-6	5	µg/L	<10	<5	---	---	---	---	---
<b>EP074G: Trihalomethanes</b>										
Chloroform	67-66-3	5	µg/L	<10	<5	---	---	---	---	---
Bromodichloromethane	75-27-4	5	µg/L	<10	<5	---	---	---	---	---
Dibromochloromethane	124-48-1	5	µg/L	<10	<5	---	---	---	---	---
Bromoform	75-25-2	5	µg/L	<10	<5	---	---	---	---	---
<b>EP075A: Phenolic Compounds</b>										
Phenol	108-95-2	2	µg/L	<10	<2	---	---	---	---	---
2-Chlorophenol	95-57-8	2	µg/L	<10	<2	---	---	---	---	---
2-Methylphenol	95-48-7	2	µg/L	<10	<2	---	---	---	---	---
3- & 4-Methylphenol	1319-77-3	4	µg/L	<20	<4	---	---	---	---	---
2-Nitrophenol	88-75-5	2	µg/L	<10	<2	---	---	---	---	---
2,4-Dimethylphenol	105-67-9	2	µg/L	<10	<2	---	---	---	---	---
2,4-Dichlorophenol	120-83-2	2	µg/L	<10	<2	---	---	---	---	---
2,6-Dichlorophenol	87-65-0	2	µg/L	<10	<2	---	---	---	---	---
4-Chloro-3-Methylphenol	59-50-7	2	µg/L	<10	<2	---	---	---	---	---
2,4,6-Trichlorophenol	88-06-2	2	µg/L	<10	<2	---	---	---	---	---
2,4,5-Trichlorophenol	95-95-4	2	µg/L	<10	<2	---	---	---	---	---
Pentachlorophenol	87-86-5	4	µg/L	<20	<4	---	---	---	---	---
<b>EP075B: Polynuclear Aromatic Hydrocarbons</b>										
Naphthalene	91-20-3	2	µg/L	<10	<2	---	---	---	---	---
2-Methylnaphthalene	91-57-6	2	µg/L	<10	<2	---	---	---	---	---
2-Chloronaphthalene	91-58-7	2	µg/L	<10	<2	---	---	---	---	---
Acenaphthylene	208-96-8	2	µg/L	<10	<2	---	---	---	---	---
Acenaphthene	83-32-9	2	µg/L	<10	<2	---	---	---	---	---
Fluorene	86-73-7	2	µg/L	<10	<2	---	---	---	---	---
Phenanthrene	85-01-8	2	µg/L	<10	<2	---	---	---	---	---
Anthracene	120-12-7	2	µg/L	<10	<2	---	---	---	---	---
Fluoranthene	206-44-0	2	µg/L	<10	<2	---	---	---	---	---
Pyrene	129-00-0	2	µg/L	<10	<2	---	---	---	---	---
N-2-Fluorenyl Acetamide	53-96-3	2	µg/L	<10	<2	---	---	---	---	---
Benz(a)anthracene	56-55-3	2	µg/L	<10	<2	---	---	---	---	---
Chrysene	218-01-9	2	µg/L	<10	<2	---	---	---	---	---





## Analytical Results

Sub-Matrix: WATER

				Client sample ID	FR Water	Crosslink Gel			
				Client sampling date / time	[13-SEP-2012]	[13-SEP-2012]			
Compound	CAS Number	LOR	Unit	EM1210744-001	EM1210744-002				
<b>EP075B: Polynuclear Aromatic Hydrocarbons - Continued</b>									
Benzo(b) & Benzo(k)fluoranthene	205-99-2 207-08-9	4	µg/L	<20	<4	----	----	----	----
7.12-Dimethylbenz(a)anthracene	57-97-6	2	µg/L	<10	<2	----	----	----	----
Benzo(a)pyrene	50-32-8	2	µg/L	<10	<2	----	----	----	----
3-Methylcholanthrene	56-49-5	2	µg/L	<10	<2	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	2	µg/L	<10	<2	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	2	µg/L	<10	<2	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	2	µg/L	<10	<2	----	----	----	----
^ Sum of PAHs	----	2	µg/L	<10	<2	----	----	----	----
^ Benzo(a)pyrene TEQ (WHO)	----	2	µg/L	<10	<2	----	----	----	----
<b>EP075C: Phthalate Esters</b>									
Dimethyl phthalate	131-11-3	2	µg/L	<10	<2	----	----	----	----
Diethyl phthalate	84-66-2	2	µg/L	<10	<2	----	----	----	----
Di-n-butyl phthalate	84-74-2	2	µg/L	<10	<2	----	----	----	----
Butyl benzyl phthalate	85-68-7	2	µg/L	<10	<2	----	----	----	----
bis(2-ethylhexyl) phthalate	117-81-7	10	µg/L	<50	<10	----	----	----	----
Di-n-octylphthalate	117-84-0	2	µg/L	<10	<2	----	----	----	----
<b>EP075D: Nitrosamines</b>									
N-Nitrosomethylethylamine	10595-95-6	2	µg/L	<10	<2	----	----	----	----
N-Nitrosodiethylamine	55-18-5	2	µg/L	<10	<2	----	----	----	----
N-Nitrosopyrrolidine	930-55-2	4	µg/L	<20	<4	----	----	----	----
N-Nitrosomorpholine	59-89-2	2	µg/L	<10	<2	----	----	----	----
N-Nitrosodi-n-propylamine	621-64-7	2	µg/L	<10	<2	----	----	----	----
N-Nitrosopiperidine	100-75-4	2	µg/L	<10	<2	----	----	----	----
N-Nitrosodibutylamine	924-16-3	2	µg/L	<10	<2	----	----	----	----
N-Nitrosodiphenyl & Diphenylamine	86-30-6 122-39-4	4	µg/L	<20	<4	----	----	----	----
Methapyrilene	91-80-5	2	µg/L	<10	<2	----	----	----	----
<b>EP075E: Nitroaromatics and Ketones</b>									
2-Picoline	109-06-8	2	µg/L	<10	<2	----	----	----	----
Acetophenone	98-86-2	2	µg/L	<10	<2	----	----	----	----
Nitrobenzene	98-95-3	2	µg/L	<10	<2	----	----	----	----
Isophorone	78-59-1	2	µg/L	<10	<2	----	----	----	----
2.6-Dinitrotoluene	606-20-2	4	µg/L	<20	<4	----	----	----	----
2.4-Dinitrotoluene	121-14-2	4	µg/L	<20	<4	----	----	----	----
1-Naphthylamine	134-32-7	2	µg/L	<10	<2	----	----	----	----



## Analytical Results

Sub-Matrix: WATER

Client sample ID  
 Client sampling date / time

Compound	CAS Number	LOR	Unit	FR Water	Crosslink Gel			
				[13-SEP-2012]	[13-SEP-2012]	----	----	----
				EM1210744-001	EM1210744-002	----	----	----
<b>EP075E: Nitroaromatics and Ketones - Continued</b>								
4-Nitroquinoline-N-oxide	56-57-5	2	µg/L	<10	<2	----	----	----
5-Nitro-o-toluidine	99-55-8	2	µg/L	<10	<2	----	----	----
Azobenzene	103-33-3	2	µg/L	<10	<2	----	----	----
1.3.5-Trinitrobenzene	99-35-4	2	µg/L	<10	<2	----	----	----
Phenacetin	62-44-2	2	µg/L	<10	<2	----	----	----
4-Aminobiphenyl	92-67-1	2	µg/L	<10	<2	----	----	----
Pentachloronitrobenzene	82-68-8	2	µg/L	<10	<2	----	----	----
Pronamide	23950-58-5	2	µg/L	<10	<2	----	----	----
Dimethylaminoazobenzene	60-11-7	2	µg/L	<10	<2	----	----	----
Chlorobenzilate	510-15-6	2	µg/L	<10	<2	----	----	----
<b>EP075F: Haloethers</b>								
Bis(2-chloroethyl) ether	111-44-4	2	µg/L	<10	<2	----	----	----
Bis(2-chloroethoxy) methane	111-91-1	2	µg/L	<10	<2	----	----	----
4-Chlorophenyl phenyl ether	7005-72-3	2	µg/L	<10	<2	----	----	----
4-Bromophenyl phenyl ether	101-55-3	2	µg/L	<10	<2	----	----	----
<b>EP075G: Chlorinated Hydrocarbons</b>								
1.3-Dichlorobenzene	541-73-1	2	µg/L	<10	<2	----	----	----
1.4-Dichlorobenzene	106-46-7	2	µg/L	<10	<2	----	----	----
1.2-Dichlorobenzene	95-50-1	2	µg/L	<10	<2	----	----	----
Hexachloroethane	67-72-1	2	µg/L	<10	<2	----	----	----
1.2.4-Trichlorobenzene	120-82-1	2	µg/L	<10	<2	----	----	----
Hexachloropropylene	1888-71-7	2	µg/L	<10	<2	----	----	----
Hexachlorobutadiene	87-68-3	2	µg/L	<10	<2	----	----	----
Hexachlorocyclopentadiene	77-47-4	10	µg/L	<50	<10	----	----	----
Pentachlorobenzene	608-93-5	2	µg/L	<10	<2	----	----	----
Hexachlorobenzene (HCB)	118-74-1	4	µg/L	<20	<4	----	----	----
<b>EP075H: Anilines and Benzidines</b>								
Aniline	62-53-3	2	µg/L	<10	<2	----	----	----
4-Chloroaniline	106-47-8	2	µg/L	<10	<2	----	----	----
2-Nitroaniline	88-74-4	4	µg/L	<20	<4	----	----	----
3-Nitroaniline	99-09-2	4	µg/L	<20	<4	----	----	----
Dibenzofuran	132-64-9	2	µg/L	<10	<2	----	----	----
4-Nitroaniline	100-01-6	2	µg/L	<10	<2	----	----	----
Carbazole	86-74-8	2	µg/L	<10	<2	----	----	----
3,3'-Dichlorobenzidine	91-94-1	2	µg/L	<10	<2	----	----	----
<b>EP075I: Organochlorine Pesticides</b>								



## Analytical Results

Sub-Matrix: WATER

Compound	CAS Number	LOR	Unit	Client sample ID		FR Water	Crosslink Gel	---	---	---
				Client sampling date / time						
				EM1210744-001	EM1210744-002					
<b>EP075I: Organochlorine Pesticides - Continued</b>										
alpha-BHC	319-84-6	2	µg/L	<10	<2	---	---	---	---	---
beta-BHC	319-85-7	2	µg/L	<10	<2	---	---	---	---	---
gamma-BHC	58-89-9	2	µg/L	<10	<2	---	---	---	---	---
delta-BHC	319-86-8	2	µg/L	<10	<2	---	---	---	---	---
Heptachlor	76-44-8	2	µg/L	<10	<2	---	---	---	---	---
Aldrin	309-00-2	2	µg/L	<10	<2	---	---	---	---	---
Heptachlor epoxide	1024-57-3	2	µg/L	<10	<2	---	---	---	---	---
alpha-Endosulfan	959-98-8	2	µg/L	<10	<2	---	---	---	---	---
4.4'-DDE	72-55-9	2	µg/L	<10	<2	---	---	---	---	---
Dieldrin	60-57-1	2	µg/L	<10	<2	---	---	---	---	---
Endrin	72-20-8	2	µg/L	<10	<2	---	---	---	---	---
beta-Endosulfan	33213-65-9	2	µg/L	<10	<2	---	---	---	---	---
4.4'-DDD	72-54-8	2	µg/L	<10	<2	---	---	---	---	---
Endosulfan sulfate	1031-07-8	2	µg/L	<10	<2	---	---	---	---	---
4.4'-DDT	50-29-3	4	µg/L	<20	<4	---	---	---	---	---
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	4	µg/L	<20	<4	---	---	---	---	---
^ Sum of DDD + DDE + DDT	----	4	µg/L	<20	<4	---	---	---	---	---
<b>EP075J: Organophosphorus Pesticides</b>										
Dichlorvos	62-73-7	2	µg/L	<10	<2	---	---	---	---	---
Dimethoate	60-51-5	2	µg/L	<10	<2	---	---	---	---	---
Diazinon	333-41-5	2	µg/L	<10	<2	---	---	---	---	---
Chlorpyrifos-methyl	5598-13-0	2	µg/L	<10	<2	---	---	---	---	---
Malathion	121-75-5	2	µg/L	<10	<2	---	---	---	---	---
Fenthion	55-38-9	2	µg/L	<10	<2	---	---	---	---	---
Chlorpyrifos	2921-88-2	2	µg/L	<10	<2	---	---	---	---	---
Pirimphos-ethyl	23505-41-1	2	µg/L	<10	<2	---	---	---	---	---
Chlorfenvinphos	470-90-6	2	µg/L	<10	<2	---	---	---	---	---
Prothiofos	34643-46-4	2	µg/L	<10	<2	---	---	---	---	---
Ethion	563-12-2	2	µg/L	<10	<2	---	---	---	---	---
<b>EP117: Alcohols</b>										
Ethanol	64-17-5	50	µg/L	138	163	---	---	---	---	---
Isopropanol	67-63-0	50	µg/L	4270	4150	---	---	---	---	---
n-Propanol	71-23-8	50	µg/L	<125	<125	---	---	---	---	---
Isobutanol	78-83-1	50	µg/L	<125	<125	---	---	---	---	---
n-Butanol	71-36-3	50	µg/L	<125	<125	---	---	---	---	---
<b>RIVM Aliphatic Hydrocarbon Fractions</b>										



## Analytical Results

Sub-Matrix: WATER

				Client sample ID	FR Water	Crosslink Gel			
				Client sampling date / time	[13-SEP-2012]	[13-SEP-2012]			
Compound	CAS Number	LOR	Unit	EM1210744-001	EM1210744-002				
<b>RIVM Aliphatic Hydrocarbon Fractions - Continued</b>									
Aliphatic >C5-C6	----	20	µg/L	<200	38	----	----	----	----
Aliphatic >C6-C8	TPHCWG-ALV2	20	µg/L	216	<20	----	----	----	----
Aliphatic >C8-C10	TPHCWG-ALV3	20	µg/L	19200	155	----	----	----	----
Aliphatic >C10-C12	TPHCWG-ALE1	50	µg/L	1980	850	----	----	----	----
Aliphatic >C12-C16	TPHCWG-ALE2	50	µg/L	<50	<50	----	----	----	----
Aliphatic >C16-C21	----	50	µg/L	<50	<50	----	----	----	----
Aliphatic >C21-C35	----	50	µg/L	<50	<50	----	----	----	----
<b>RIVM Aromatic Hydrocarbon Fractions</b>									
Aromatic >C5-C7	----	5	µg/L	<10	<5	----	----	----	----
Aromatic >C7-C8	TPHCWG-ARV2	5	µg/L	23	12	----	----	----	----
Aromatic >C8-C10	TPHCWG-ARV3	5	µg/L	47	18	----	----	----	----
Aromatic >C10-C12	TPHCWG-ARE1	50	µg/L	5200	1640	----	----	----	----
Aromatic >C12-C16	TPHCWG-ARE2	50	µg/L	410	<50	----	----	----	----
Aromatic >C16-C21	TPHCWG-ARE3	50	µg/L	410	<50	----	----	----	----
Aromatic >C21-C35	TPHCWG-ARE4	50	µg/L	205	56	----	----	----	----
<b>Subcontracted Analysis: MBAS</b>									
Anionic Surfactants as MBAS	----	0.1	mg/L	<0.1	----	----	----	----	----
<b>EP074S: VOC Surrogates</b>									
1,2-Dichloroethane-D4	17060-07-0	0.1	%	106	75.0	----	----	----	----
Toluene-D8	2037-26-5	0.1	%	108	94.7	----	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%	117	87.9	----	----	----	----
<b>EP075S: Acid Extractable Surrogates</b>									
2-Fluorophenol	367-12-4	0.1	%	Not Determined	Not Determined	----	----	----	----
Phenol-d6	13127-88-3	0.1	%	Not Determined	Not Determined	----	----	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%	Not Determined	Not Determined	----	----	----	----
2,4,6-Tribromophenol	118-79-6	0.1	%	Not Determined	Not Determined	----	----	----	----
<b>EP075T: Base/Neutral Extractable Surrogates</b>									
Nitrobenzene-D5	4165-60-0	0.1	%	70.0	97.8	----	----	----	----
1,2-Dichlorobenzene-D4	2199-69-1	0.1	%	47.0	91.1	----	----	----	----
2-Fluorobiphenyl	321-60-8	0.1	%	58.8	73.7	----	----	----	----
Anthracene-d10	1719-06-8	0.1	%	82.9	49.3	----	----	----	----
4-Terphenyl-d14	1718-51-0	0.1	%	85.3	97.5	----	----	----	----
<b>EP079/EP070S:TPH Surrogates - semivolatile speciation</b>									
2-Fluorobiphenyl	321-60-8	0.1	%	97.2	101	----	----	----	----
2-Bromonaphthalene	580-13-2	0.1	%	97.7	96.1	----	----	----	----



## Surrogate Control Limits

Sub-Matrix: WATER		Recovery Limits (%)	
Compound	CAS Number	Low	High
<b>EP074S: VOC Surrogates</b>			
1,2-Dichloroethane-D4	17060-07-0	72	132
Toluene-D8	2037-26-5	74	128
4-Bromofluorobenzene	460-00-4	70	132
<b>EP075S: Acid Extractable Surrogates</b>			
2-Fluorophenol	367-12-4	10	83
Phenol-d6	13127-88-3	10	49
2-Chlorophenol-D4	93951-73-6	20.3	101
2,4,6-Tribromophenol	118-79-6	19.5	134
<b>EP075T: Base/Neutral Extractable Surrogates</b>			
Nitrobenzene-D5	4165-60-0	18.2	114
1,2-Dichlorobenzene-D4	2199-69-1	18.8	100
2-Fluorobiphenyl	321-60-8	25.3	122
Anthracene-d10	1719-06-8	35	137
4-Terphenyl-d14	1718-51-0	32	136
<b>EP079/EP070S:TPH Surrogates - semivolatile speciation</b>			
2-Fluorobiphenyl	321-60-8	77	127
2-Bromonaphthalene	580-13-2	67	123



## Environmental Division

### QUALITY CONTROL REPORT

Work Order	: <b>EM1210744</b>	Page	: 1 of 23
Client	: <b>SANTOS LTD</b>	Laboratory	: Environmental Division Melbourne
Contact	: MR BARRY RITCHIE	Contact	: Client Services
Address	: GROUND FLOOR SANTOS CENTRE 60 FLINDERS STREET ADELAIDE SA, AUSTRALIA 5001	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: barry.ritchie@santos.com	E-mail	: Melbourne.Enviro.Services@alsglobal.com
Telephone	: +61 08 8116 5000	Telephone	: +61-3-8549 9600
Facsimile	: +61 08 8116 5050	Facsimile	: +61-3-8549 9601
Project	: HFRA Fluids Sampling- Extended Analysis	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----	Date Samples Received	: 14-SEP-2012
C-O-C number	: ----	Issue Date	: 03-OCT-2012
Sampler	: JM, AJ	No. of samples received	: 2
Order number	: 879002/538	No. of samples analysed	: 2
Quote number	: EN/039/12		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits



NATA Accredited Laboratory 825

Accredited for compliance with  
ISO/IEC 17025.

### *Signatories*

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ashesh Patel	Inorganic Chemist	Sydney Inorganics
Danielle White	Committal	WRG Subcontracting
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics
Herman Lin	Laboratory Coordinator	Melbourne Inorganics
Nancy Wang	Senior Semivolatile Instrument Chemist	Melbourne Organics
Nikki Stepniewski	Senior Inorganic Instrument Chemist	Melbourne Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Sarah Millington	Senior Inorganic Chemist	Sydney Inorganics



## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key :  
Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot  
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.  
LOR = Limit of reporting  
RPD = Relative Percentage Difference  
# = Indicates failed QC





## Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:- No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:- 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EA005: pH (QC Lot: 2505886)</b>									
EM1210744-001	FR Water	EA005: pH Value	----	0.01	pH Unit	6.10	6.08	0.3	0% - 20%
EM1210840-002	Anonymous	EA005: pH Value	----	0.01	pH Unit	6.59	6.59	0.0	0% - 20%
<b>EA015: Total Dissolved Solids (QC Lot: 2505277)</b>									
EM1210744-001	FR Water	EA015H: Total Dissolved Solids @180°C	GIS-210-010	10	mg/L	1040	1010	3.1	0% - 20%
EM1210843-004	Anonymous	EA015H: Total Dissolved Solids @180°C	GIS-210-010	10	mg/L	1080	1060	1.9	0% - 20%
<b>ED009: Anions (QC Lot: 2507802)</b>									
EM1210846-001	Anonymous	ED009-X: Bromide	24959-67-9	0.010	mg/L	<0.010	<0.010	0.0	No Limit
		ED009-X: Iodide	20461-54-5	0.010	mg/L	<0.010	<0.010	0.0	No Limit
EM1210854-006	Anonymous	ED009-X: Bromide	24959-67-9	0.010	mg/L	<0.010	<0.010	0.0	No Limit
		ED009-X: Iodide	20461-54-5	0.010	mg/L	<0.010	<0.010	0.0	No Limit
<b>ED037P: Alkalinity by PC Titrator (QC Lot: 2501656)</b>									
EM1210742-007	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	<1	<1	0.0	No Limit
EM1210755-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	13	11	21.1	0% - 50%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	13	11	21.1	0% - 50%
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 2501638)</b>									
EM1210737-005	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	2490	2480	0.4	0% - 20%
EM1210744-001	FR Water	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	292	298	1.9	0% - 20%
<b>ED045G: Chloride Discrete analyser (QC Lot: 2501641)</b>									
EM1210737-005	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	12300	12000	2.1	0% - 20%
EM1210744-001	FR Water	ED045G: Chloride	16887-00-6	1	mg/L	370	364	1.7	0% - 20%
<b>ED093F: Dissolved Major Cations (QC Lot: 2501640)</b>									
EM1210737-005	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	578	607	4.9	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	777	808	3.9	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	7230	7430	2.8	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	190	194	2.2	0% - 20%
EM1210744-001	FR Water	ED093F: Calcium	7440-70-2	1	mg/L	2	<1	0.0	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	<1	<1	0.0	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	21	20	0.0	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	<1	<1	0.0	No Limit



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EG020F: Dissolved Metals by ICP-MS (QC Lot: 2506756)</b>									
EM1210728-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	0.0834	0.0854	2.5	0% - 20%
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.021	0.022	5.0	0% - 20%
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.043	0.045	4.6	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.011	0.012	0.0	0% - 50%
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.020	0.019	0.0	0% - 50%
		EG020A-F: Lead	7439-92-1	0.001	mg/L	0.019	0.018	0.0	0% - 50%
		EG020A-F: Lithium	7439-93-2	0.001	mg/L	0.174	0.164	6.0	0% - 20%
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	18.1	18.1	0.06	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.005	0.005	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.012	0.015	23.7	0% - 50%
		EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	14.0	14.4	2.9	0% - 20%
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EG020A-F: Boron	7440-42-8	0.05	mg/L	0.70	0.73	4.4	0% - 50%		
EG020A-F: Iron	7439-89-6	0.05	mg/L	0.58	0.60	3.1	0% - 50%		
EM1210728-011	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	0.0002	0.0001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.040	0.039	0.0	0% - 20%
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.032	0.033	0.0	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.004	0.004	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.006	0.005	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	0.002	0.001	0.0	No Limit
		EG020A-F: Lithium	7439-93-2	0.001	mg/L	0.152	0.154	1.5	0% - 20%
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.326	0.328	0.5	0% - 20%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.252	0.252	0.0	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.007	0.005	23.1	No Limit
		EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.012	0.010	15.1	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EG020A-F: Boron	7440-42-8	0.05	mg/L	4.90	4.88	0.3	0% - 20%		
EG020A-F: Iron	7439-89-6	0.05	mg/L	1.14	1.03	10.4	0% - 20%		

**EG020F: Dissolved Metals by ICP-MS (QC Lot: 2506757)**

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 Work Order : EM1210744  
 Client : SANTOS LTD  
 Project : HFRA Fluids Sampling- Extended Analysis



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EG020F: Dissolved Metals by ICP-MS (QC Lot: 2506757) - continued</b>									
EM1210728-001	Anonymous	EG020B-F: Strontium	7440-24-6	0.001	mg/L	3.86	3.94	2.2	0% - 20%
		EG020B-F: Uranium	7440-61-1	0.001	mg/L	0.002	0.002	0.0	No Limit
EM1210728-011	Anonymous	EG020B-F: Strontium	7440-24-6	0.001	mg/L	8.78	8.77	0.1	0% - 20%
		EG020B-F: Uranium	7440-61-1	0.001	mg/L	0.010	0.009	0.0	No Limit
<b>EG035F: Dissolved Mercury by FIMS (QC Lot: 2506755)</b>									
EM1210728-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EM1210728-011	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
<b>EK025SF: Free CN by Segmented Flow Analyser (QC Lot: 2501301)</b>									
EM1210670-001	Anonymous	EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	<0.004	0.0	No Limit
EM1210741-005	Anonymous	EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	<0.004	0.0	No Limit
<b>EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 2501302)</b>									
EM1210670-001	Anonymous	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.0	No Limit
EM1210741-003	Anonymous	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.0	No Limit
<b>EK040P: Fluoride by PC Titrator (QC Lot: 2501652)</b>									
EM1210670-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.8	0.8	0.0	No Limit
EM1210729-006	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	2.9	2.7	7.6	0% - 20%
<b>EK055G: Ammonia as N by Discrete Analyser (QC Lot: 2503677)</b>									
EM1210744-001	FR Water	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	90.5	87.2	3.7	0% - 20%
<b>EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2501639)</b>									
EM1210737-005	Anonymous	EK057G: Nitrite as N	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EM1210744-001	FR Water	EK057G: Nitrite as N	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2503676)</b>									
EM1210701-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.07	0.07	0.0	No Limit
EM1210736-013	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.02	0.02	0.0	No Limit
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2503250)</b>									
EM1210719-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	53.0	63.2	17.6	0% - 20%
EM1210744-001	FR Water	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	185	199	7.3	0% - 20%
<b>EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2503251)</b>									
EM1210719-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	23.8	28.1	16.6	0% - 20%
EM1210744-001	FR Water	EK067G: Total Phosphorus as P	----	0.01	mg/L	1.42	1.67	16.2	0% - 20%
<b>EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 2501642)</b>									
EM1210744-001	FR Water	EK071G: Reactive Phosphorus as P	----	0.01	mg/L	0.07	0.07	0.0	No Limit
<b>EP005: Total Organic Carbon (TOC) (QC Lot: 2519209)</b>									
EM1210744-001	FR Water	EP005: Total Organic Carbon	----	1	mg/L	608	620	2.0	0% - 20%
EM1211004-003	Anonymous	EP005: Total Organic Carbon	----	1	mg/L	2	2	0.0	No Limit
<b>EP010: Formaldehyde (QC Lot: 2501649)</b>									
EM1210744-001	FR Water	EP010: Formaldehyde	50-00-0	0.1	mg/L	<0.1	<0.1	0.0	No Limit
<b>EP041A: Nonionic Surfactants (QC Lot: 2504783)</b>									

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 Work Order : EM1210744  
 Client : SANTOS LTD  
 Project : HFRA Fluids Sampling- Extended Analysis



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)	
<b>EP041A: Nonionic Surfactants (QC Lot: 2504783) - continued</b>										
EP1207681-009	Anonymous	EP041A: Nonionic Surfactants as CTAS	----	5	mg/L	<5	<5	0.0	No Limit	
<b>EP074A: Monocyclic Aromatic Hydrocarbons (QC Lot: 2518778)</b>										
ER1200156-001	Anonymous	EP074: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit	
		EP074: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit	
		EP074: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit	
		EP074: meta- & para-Xylene	108-38-3	2	µg/L	<2	<2	0.0	No Limit	
			106-42-3							
		EP074: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit	
		EP074: Styrene	100-42-5	5	µg/L	<5	<5	0.0	No Limit	
		EP074: Isopropylbenzene	98-82-8	5	µg/L	<5	<5	0.0	No Limit	
		EP074: n-Propylbenzene	103-65-1	5	µg/L	<5	<5	0.0	No Limit	
		EP074: 1,3,5-Trimethylbenzene	108-67-8	5	µg/L	<5	<5	0.0	No Limit	
		EP074: sec-Butylbenzene	135-98-8	5	µg/L	<5	<5	0.0	No Limit	
		EP074: 1,2,4-Trimethylbenzene	95-63-6	5	µg/L	<5	<5	0.0	No Limit	
		EP074: tert-Butylbenzene	98-06-6	5	µg/L	<5	<5	0.0	No Limit	
		EP074: p-Isopropyltoluene	99-87-6	5	µg/L	<5	<5	0.0	No Limit	
EP074: n-Butylbenzene	104-51-8	5	µg/L	<5	<5	0.0	No Limit			
<b>EP074B: Oxygenated Compounds (QC Lot: 2518778)</b>										
ER1200156-001	Anonymous	EP074: Vinyl Acetate	108-05-4	50	µg/L	<50	<50	0.0	No Limit	
		EP074: 2-Butanone (MEK)	78-93-3	50	µg/L	<50	<50	0.0	No Limit	
		EP074: 4-Methyl-2-pentanone (MIBK)	108-10-1	50	µg/L	<50	<50	0.0	No Limit	
		EP074: 2-Hexanone (MBK)	591-78-6	50	µg/L	<50	<50	0.0	No Limit	
<b>EP074C: Sulfonated Compounds (QC Lot: 2518778)</b>										
ER1200156-001	Anonymous	EP074: Carbon disulfide	75-15-0	5	µg/L	<5	<5	0.0	No Limit	
<b>EP074D: Fumigants (QC Lot: 2518778)</b>										
ER1200156-001	Anonymous	EP074: 2,2-Dichloropropane	594-20-7	5	µg/L	<5	<5	0.0	No Limit	
		EP074: 1,2-Dichloropropane	78-87-5	5	µg/L	<5	<5	0.0	No Limit	
		EP074: cis-1,3-Dichloropropylene	10061-01-5	5	µg/L	<5	<5	0.0	No Limit	
		EP074: trans-1,3-Dichloropropylene	10061-02-6	5	µg/L	<5	<5	0.0	No Limit	
		EP074: 1,2-Dibromoethane (EDB)	106-93-4	5	µg/L	<5	<5	0.0	No Limit	
<b>EP074E: Halogenated Aliphatic Compounds (QC Lot: 2518778)</b>										
ER1200156-001	Anonymous	EP074: 1,1-Dichloroethene	75-35-4	5	µg/L	<5	<5	0.0	No Limit	
		EP074: Iodomethane	74-88-4	5	µg/L	<5	<5	0.0	No Limit	
		EP074: trans-1,2-Dichloroethene	156-60-5	5	µg/L	<5	<5	0.0	No Limit	
		EP074: 1,1-Dichloroethane	75-34-3	5	µg/L	<5	<5	0.0	No Limit	
		EP074: cis-1,2-Dichloroethene	156-59-2	5	µg/L	<5	<5	0.0	No Limit	
		EP074: 1,1,1-Trichloroethane	71-55-6	5	µg/L	<5	<5	0.0	No Limit	
		EP074: 1,1-Dichloropropylene	563-58-6	5	µg/L	<5	<5	0.0	No Limit	
		EP074: Carbon Tetrachloride	56-23-5	5	µg/L	<5	<5	0.0	No Limit	



Sub-Matrix: **WATER**

Laboratory Duplicate (DUP) Report

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP074E: Halogenated Aliphatic Compounds (QC Lot: 2518778) - continued</b>									
ER1200156-001	Anonymous	EP074: 1,2-Dichloroethane	107-06-2	5	µg/L	<5	<5	0.0	No Limit
		EP074: Trichloroethene	79-01-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: Dibromomethane	74-95-3	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,1,2-Trichloroethane	79-00-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,3-Dichloropropane	142-28-9	5	µg/L	<5	<5	0.0	No Limit
		EP074: Tetrachloroethene	127-18-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,1,1,2-Tetrachloroethane	630-20-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: trans-1,4-Dichloro-2-butene	110-57-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: cis-1,4-Dichloro-2-butene	1476-11-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,1,2,2-Tetrachloroethane	79-34-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,2,3-Trichloropropane	96-18-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: Pentachloroethane	76-01-7	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,2-Dibromo-3-chloropropane	96-12-8	5	µg/L	<5	<5	0.0	No Limit
		EP074: Dichlorodifluoromethane	75-71-8	50	µg/L	<50	<50	0.0	No Limit
		EP074: Chloromethane	74-87-3	50	µg/L	<50	<50	0.0	No Limit
		EP074: Vinyl chloride	75-01-4	50	µg/L	<50	<50	0.0	No Limit
		EP074: Bromomethane	74-83-9	50	µg/L	<50	<50	0.0	No Limit
EP074: Chloroethane	75-00-3	50	µg/L	<50	<50	0.0	No Limit		
EP074: Trichlorofluoromethane	75-69-4	50	µg/L	<50	<50	0.0	No Limit		
<b>EP074F: Halogenated Aromatic Compounds (QC Lot: 2518778)</b>									
ER1200156-001	Anonymous	EP074: Chlorobenzene	108-90-7	5	µg/L	<5	<5	0.0	No Limit
		EP074: Bromobenzene	108-86-1	5	µg/L	<5	<5	0.0	No Limit
		EP074: 2-Chlorotoluene	95-49-8	5	µg/L	<5	<5	0.0	No Limit
		EP074: 4-Chlorotoluene	106-43-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1,2,3-Trichlorobenzene	87-61-6	5	µg/L	<5	<5	0.0	No Limit
<b>EP074G: Trihalomethanes (QC Lot: 2518778)</b>									
ER1200156-001	Anonymous	EP074: Chloroform	67-66-3	5	µg/L	<5	<5	0.0	No Limit
		EP074: Bromodichloromethane	75-27-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: Dibromochloromethane	124-48-1	5	µg/L	<5	<5	0.0	No Limit
		EP074: Bromoform	75-25-2	5	µg/L	<5	<5	0.0	No Limit
<b>EP075A: Phenolic Compounds (QC Lot: 2501530)</b>									
EM1210744-001	FR Water	EP075: Phenol	108-95-2	2	µg/L	<10	<10	0.0	No Limit
		EP075: 2-Chlorophenol	95-57-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: 2-Methylphenol	95-48-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: 2-Nitrophenol	88-75-5	2	µg/L	<10	<10	0.0	No Limit
		EP075: 2,4-Dimethylphenol	105-67-9	2	µg/L	<10	<10	0.0	No Limit
		EP075: 2,4-Dichlorophenol	120-83-2	2	µg/L	<10	<10	0.0	No Limit
		EP075: 2,6-Dichlorophenol	87-65-0	2	µg/L	<10	<10	0.0	No Limit
		EP075: 4-Chloro-3-Methylphenol	59-50-7	2	µg/L	<10	<10	0.0	No Limit



Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP075A: Phenolic Compounds (QC Lot: 2501530) - continued</b>									
EM1210744-001	FR Water	EP075: 2.4.6-Trichlorophenol	88-06-2	2	µg/L	<10	<10	0.0	No Limit
		EP075: 2.4.5-Trichlorophenol	95-95-4	2	µg/L	<10	<10	0.0	No Limit
		EP075: 3- & 4-Methylphenol	1319-77-3	4	µg/L	<20	<20	0.0	No Limit
		EP075: Pentachlorophenol	87-86-5	4	µg/L	<20	<20	0.0	No Limit
<b>EP075B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2501530)</b>									
EM1210744-001	FR Water	EP075: Naphthalene	91-20-3	2	µg/L	<10	<10	0.0	No Limit
		EP075: 2-Methylnaphthalene	91-57-6	2	µg/L	<10	<10	0.0	No Limit
		EP075: 2-Chloronaphthalene	91-58-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: Acenaphthylene	208-96-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: Acenaphthene	83-32-9	2	µg/L	<10	<10	0.0	No Limit
		EP075: Fluorene	86-73-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: Phenanthrene	85-01-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: Anthracene	120-12-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: Fluoranthene	206-44-0	2	µg/L	<10	<10	0.0	No Limit
		EP075: Pyrene	129-00-0	2	µg/L	<10	<10	0.0	No Limit
		EP075: N-2-Fluorenyl Acetamide	53-96-3	2	µg/L	<10	<10	0.0	No Limit
		EP075: Benz(a)anthracene	56-55-3	2	µg/L	<10	<10	0.0	No Limit
		EP075: Chrysene	218-01-9	2	µg/L	<10	<10	0.0	No Limit
		EP075: 7.12-Dimethylbenz(a)anthracene	57-97-6	2	µg/L	<10	<10	0.0	No Limit
		EP075: Benzo(a)pyrene	50-32-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: 3-Methylcholanthrene	56-49-5	2	µg/L	<10	<10	0.0	No Limit
		EP075: Indeno(1.2.3.cd)pyrene	193-39-5	2	µg/L	<10	<10	0.0	No Limit
		EP075: Dibenz(a.h)anthracene	53-70-3	2	µg/L	<10	<10	0.0	No Limit
		EP075: Benzo(g.h.i)perylene	191-24-2	2	µg/L	<10	<10	0.0	No Limit
		EP075: Sum of PAHs	----	2	µg/L	<10	<10	0.0	No Limit
EP075: Benzo(a)pyrene TEQ (WHO)	----	2	µg/L	<10	<10	0.0	No Limit		
EP075: Benzo(b) & Benzo(k)fluoranthene	205-99-2 207-08-9	4	µg/L	<20	<20	0.0	No Limit		
<b>EP075C: Phthalate Esters (QC Lot: 2501530)</b>									
EM1210744-001	FR Water	EP075: bis(2-ethylhexyl) phthalate	117-81-7	10	µg/L	<50	<50	0.0	No Limit
		EP075: Dimethyl phthalate	131-11-3	2	µg/L	<10	<10	0.0	No Limit
		EP075: Diethyl phthalate	84-66-2	2	µg/L	<10	<10	0.0	No Limit
		EP075: Di-n-butyl phthalate	84-74-2	2	µg/L	<10	<10	0.0	No Limit
		EP075: Butyl benzyl phthalate	85-68-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: Di-n-octylphthalate	117-84-0	2	µg/L	<10	<10	0.0	No Limit
<b>EP075D: Nitrosamines (QC Lot: 2501530)</b>									
EM1210744-001	FR Water	EP075: N-Nitrosomethylethylamine	10595-95-6	2	µg/L	<10	<10	0.0	No Limit
		EP075: N-Nitrosodiethylamine	55-18-5	2	µg/L	<10	<10	0.0	No Limit
		EP075: N-Nitrosomorpholine	59-89-2	2	µg/L	<10	<10	0.0	No Limit



Sub-Matrix: **WATER**

Laboratory Duplicate (DUP) Report

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP075D: Nitrosamines (QC Lot: 2501530) - continued</b>									
EM1210744-001	FR Water	EP075: N-Nitrosodi-n-propylamine	621-64-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: N-Nitrosopiperidine	100-75-4	2	µg/L	<10	<10	0.0	No Limit
		EP075: N-Nitrosodibutylamine	924-16-3	2	µg/L	<10	<10	0.0	No Limit
		EP075: Methapyrilene	91-80-5	2	µg/L	<10	<10	0.0	No Limit
		EP075: N-Nitrosopyrrolidine	930-55-2	4	µg/L	<20	<20	0.0	No Limit
		EP075: N-Nitrosodiphenyl & Diphenylamine	86-30-6 122-39-4	4	µg/L	<20	<20	0.0	No Limit
<b>EP075E: Nitroaromatics and Ketones (QC Lot: 2501530)</b>									
EM1210744-001	FR Water	EP075: 2-Picoline	109-06-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: Acetophenone	98-86-2	2	µg/L	<10	<10	0.0	No Limit
		EP075: Nitrobenzene	98-95-3	2	µg/L	<10	<10	0.0	No Limit
		EP075: Isophorone	78-59-1	2	µg/L	<10	<10	0.0	No Limit
		EP075: 1-Naphthylamine	134-32-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: 4-Nitroquinoline-N-oxide	56-57-5	2	µg/L	<10	<10	0.0	No Limit
		EP075: 5-Nitro-o-toluidine	99-55-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: Azobenzene	103-33-3	2	µg/L	<10	<10	0.0	No Limit
		EP075: 1.3.5-Trinitrobenzene	99-35-4	2	µg/L	<10	<10	0.0	No Limit
		EP075: Phenacetin	62-44-2	2	µg/L	<10	<10	0.0	No Limit
		EP075: 4-Aminobiphenyl	92-67-1	2	µg/L	<10	<10	0.0	No Limit
		EP075: Pentachloronitrobenzene	82-68-8	2	µg/L	<10	<10	0.0	No Limit
		EP075: Pronamide	23950-58-5	2	µg/L	<10	<10	0.0	No Limit
		EP075: Dimethylaminoazobenzene	60-11-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: Chlorobenzilate	510-15-6	2	µg/L	<10	<10	0.0	No Limit
		EP075: 2.6-Dinitrotoluene	606-20-2	4	µg/L	<20	<20	0.0	No Limit
EP075: 2.4-Dinitrotoluene	121-14-2	4	µg/L	<20	<20	0.0	No Limit		
<b>EP075F: Haloethers (QC Lot: 2501530)</b>									
EM1210744-001	FR Water	EP075: Bis(2-chloroethyl) ether	111-44-4	2	µg/L	<10	<10	0.0	No Limit
		EP075: Bis(2-chloroethoxy) methane	111-91-1	2	µg/L	<10	<10	0.0	No Limit
		EP075: 4-Chlorophenyl phenyl ether	7005-72-3	2	µg/L	<10	<10	0.0	No Limit
		EP075: 4-Bromophenyl phenyl ether	101-55-3	2	µg/L	<10	<10	0.0	No Limit
<b>EP075G: Chlorinated Hydrocarbons (QC Lot: 2501530)</b>									
EM1210744-001	FR Water	EP075: Hexachlorocyclopentadiene	77-47-4	10	µg/L	<50	<50	0.0	No Limit
		EP075: 1.4-Dichlorobenzene	106-46-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: 1.3-Dichlorobenzene	541-73-1	2	µg/L	<10	<10	0.0	No Limit
		EP075: 1.2-Dichlorobenzene	95-50-1	2	µg/L	<10	<10	0.0	No Limit
		EP075: Hexachloroethane	67-72-1	2	µg/L	<10	<10	0.0	No Limit
		EP075: 1.2.4-Trichlorobenzene	120-82-1	2	µg/L	<10	<10	0.0	No Limit
		EP075: Hexachloropropylene	1888-71-7	2	µg/L	<10	<10	0.0	No Limit
		EP075: Hexachlorobutadiene	87-68-3	2	µg/L	<10	<10	0.0	No Limit



Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report							
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)		
<b>EP075G: Chlorinated Hydrocarbons (QC Lot: 2501530) - continued</b>											
EM1210744-001	FR Water	EP075: Pentachlorobenzene	608-93-5	2	µg/L	<10	<10	0.0	No Limit		
		EP075: Hexachlorobenzene (HCB)	118-74-1	4	µg/L	<20	<20	0.0	No Limit		
<b>EP075H: Anilines and Benzidines (QC Lot: 2501530)</b>											
EM1210744-001	FR Water	EP075: Aniline	62-53-3	2	µg/L	<10	<10	0.0	No Limit		
		EP075: 4-Chloroaniline	106-47-8	2	µg/L	<10	<10	0.0	No Limit		
		EP075: Dibenzofuran	132-64-9	2	µg/L	<10	<10	0.0	No Limit		
		EP075: 4-Nitroaniline	100-01-6	2	µg/L	<10	<10	0.0	No Limit		
		EP075: Carbazole	86-74-8	2	µg/L	<10	<10	0.0	No Limit		
		EP075: 3,3'-Dichlorobenzidine	91-94-1	2	µg/L	<10	<10	0.0	No Limit		
		EP075: 2-Nitroaniline	88-74-4	4	µg/L	<20	<20	0.0	No Limit		
		EP075: 3-Nitroaniline	99-09-2	4	µg/L	<20	<20	0.0	No Limit		
<b>EP075I: Organochlorine Pesticides (QC Lot: 2501530)</b>											
EM1210744-001	FR Water	EP075: alpha-BHC	319-84-6	2	µg/L	<10	<10	0.0	No Limit		
		EP075: beta-BHC	319-85-7	2	µg/L	<10	<10	0.0	No Limit		
		EP075: gamma-BHC	58-89-9	2	µg/L	<10	<10	0.0	No Limit		
		EP075: delta-BHC	319-86-8	2	µg/L	<10	<10	0.0	No Limit		
		EP075: Heptachlor	76-44-8	2	µg/L	<10	<10	0.0	No Limit		
		EP075: Aldrin	309-00-2	2	µg/L	<10	<10	0.0	No Limit		
		EP075: Heptachlor epoxide	1024-57-3	2	µg/L	<10	<10	0.0	No Limit		
		EP075: alpha-Endosulfan	959-98-8	2	µg/L	<10	<10	0.0	No Limit		
		EP075: 4,4'-DDE	72-55-9	2	µg/L	<10	<10	0.0	No Limit		
		EP075: Dieldrin	60-57-1	2	µg/L	<10	<10	0.0	No Limit		
		EP075: Endrin	72-20-8	2	µg/L	<10	<10	0.0	No Limit		
		EP075: beta-Endosulfan	33213-65-9	2	µg/L	<10	<10	0.0	No Limit		
		EP075: 4,4'-DDD	72-54-8	2	µg/L	<10	<10	0.0	No Limit		
		EP075: Endosulfan sulfate	1031-07-8	2	µg/L	<10	<10	0.0	No Limit		
				EP075: 4,4'-DDT	50-29-3	4	µg/L	<20	<20	0.0	No Limit
<b>EP075J: Organophosphorus Pesticides (QC Lot: 2501530)</b>											
EM1210744-001	FR Water	EP075: Dichlorvos	62-73-7	2	µg/L	<10	<10	0.0	No Limit		
		EP075: Dimethoate	60-51-5	2	µg/L	<10	<10	0.0	No Limit		
		EP075: Diazinon	333-41-5	2	µg/L	<10	<10	0.0	No Limit		
		EP075: Chlorpyrifos-methyl	5598-13-0	2	µg/L	<10	<10	0.0	No Limit		
		EP075: Malathion	121-75-5	2	µg/L	<10	<10	0.0	No Limit		
		EP075: Fenthion	55-38-9	2	µg/L	<10	<10	0.0	No Limit		
		EP075: Chlorpyrifos	2921-88-2	2	µg/L	<10	<10	0.0	No Limit		
		EP075: Pirimphos-ethyl	23505-41-1	2	µg/L	<10	<10	0.0	No Limit		
		EP075: Chlorfenvinphos	470-90-6	2	µg/L	<10	<10	0.0	No Limit		
		EP075: Prothiofos	34643-46-4	2	µg/L	<10	<10	0.0	No Limit		
				EP075: Ethion	563-12-2	2	µg/L	<10	<10	0.0	No Limit





Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QC Lot: 2501533)</b>									
EM1210744-001	FR Water	EP070-CWG: Aliphatic >C10-C12	TPHCWG-ALE1	50	µg/L	1980	1260	# 44.6	0% - 20%
		EP070-CWG: Aliphatic >C12-C16	TPHCWG-ALE2	50	µg/L	<50	<50	0.0	No Limit
		EP070-CWG: Aliphatic >C16-C21	----	50	µg/L	<50	<50	0.0	No Limit
		EP070-CWG: Aliphatic >C21-C35	----	50	µg/L	<50	<50	0.0	No Limit
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QC Lot: 2518779)</b>									
ER1200156-001	Anonymous	EP079-CWG: Aliphatic >C5-C6	----	20	µg/L	<20	<20	0.0	No Limit
		EP079-CWG: Aliphatic >C6-C8	TPHCWG-ALV2	20	µg/L	<20	<20	0.0	No Limit
		EP079-CWG: Aliphatic >C8-C10	TPHCWG-ALV3	20	µg/L	<20	<20	0.0	No Limit
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QC Lot: 2501533)</b>									
EM1210744-001	FR Water	EP070-CWG: Aromatic >C10-C12	TPHCWG-ARE1	50	µg/L	5200	4340	17.9	0% - 20%
		EP070-CWG: Aromatic >C12-C16	TPHCWG-ARE2	50	µg/L	410	265	43.0	No Limit
		EP070-CWG: Aromatic >C16-C21	TPHCWG-ARE3	50	µg/L	410	298	31.6	No Limit
		EP070-CWG: Aromatic >C21-C35	TPHCWG-ARE4	50	µg/L	205	132	43.0	No Limit
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QC Lot: 2518779)</b>									
ER1200156-001	Anonymous	EP079-CWG: Aromatic >C5-C7	----	5	µg/L	<5	<5	0.0	No Limit
		EP079-CWG: Aromatic >C7-C8	TPHCWG-ARV 2	5	µg/L	<5	<5	0.0	No Limit
		EP079-CWG: Aromatic >C8-C10	TPHCWG-ARV 3	5	µg/L	<5	<5	0.0	No Limit
<b>EP117: Alcohols (QC Lot: 2509203)</b>									
EB1224362-001	Anonymous	EP117: Ethanol	64-17-5	50	µg/L	165	180	8.7	No Limit
		EP117: Isopropanol	67-63-0	50	µg/L	<50	<50	0.0	No Limit
		EP117: n-Propanol	71-23-8	50	µg/L	<50	<50	0.0	No Limit
		EP117: Isobutanol	78-83-1	50	µg/L	<50	<50	0.0	No Limit
		EP117: n-Butanol	71-36-3	50	µg/L	<50	<50	0.0	No Limit
EB1224362-002	Anonymous	EP117: Ethanol	64-17-5	50	µg/L	299	296	1.1	No Limit
		EP117: Isopropanol	67-63-0	50	µg/L	<50	<50	0.0	No Limit
		EP117: n-Propanol	71-23-8	50	µg/L	<50	<50	0.0	No Limit
		EP117: Isobutanol	78-83-1	50	µg/L	<50	<50	0.0	No Limit
		EP117: n-Butanol	71-36-3	50	µg/L	<50	<50	0.0	No Limit



## Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: WATER

				Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%)		Recovery Limits (%)
Method: Compound	CAS Number	LOR	Unit				LCS	Low
<b>EA015: Total Dissolved Solids (QCLot: 2505277)</b>								
EA015H: Total Dissolved Solids @180°C	GIS-210-010	10	mg/L	<10	2000 mg/L	101	98	104
<b>ED009: Anions (QCLot: 2507802)</b>								
ED009-X: Bromide	24959-67-9	0.01	mg/L	<0.010	2 mg/L	101	90	110
ED009-X: Iodide	20461-54-5	0.01	mg/L	<0.010	0.5 mg/L	83.8	73	125
<b>ED037P: Alkalinity by PC Titrator (QCLot: 2501656)</b>								
ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	----	200 mg/L	96.4	77	127
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2501638)</b>								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	12.5 mg/L	105	81	125
<b>ED045G: Chloride Discrete analyser (QCLot: 2501641)</b>								
ED045G: Chloride	16887-00-6	1	mg/L	<1	1000 mg/L	96.7	89	117
<b>ED093F: Dissolved Major Cations (QCLot: 2501640)</b>								
ED093F: Calcium	7440-70-2	1	mg/L	<1	5 mg/L	101	83	129
ED093F: Magnesium	7439-95-4	1	mg/L	<1	5 mg/L	99.9	80	124
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	94.1	77	125
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	96.1	77	123
<b>EG020F: Dissolved Metals by ICP-MS (QCLot: 2506756)</b>								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	100	80	120
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	99.1	87	109
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	104	70	124
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	102	88	110
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	101	88	110
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	95.0	86	112
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	99.1	87	111
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	100	86	108
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	103	90	110
EG020A-F: Lithium	7439-93-2	0.001	mg/L	<0.001	0.1 mg/L	105	60	130
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	93.0	87	111
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	103	84	108
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	102	86	112
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	103	83	111
EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	0.1 mg/L	100	83	111
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	98.8	85	113
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	102	86	120
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.1 mg/L	98.9	61	133



Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
				Result	Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
					LCS	Low	High	
<b>EG020F: Dissolved Metals by ICP-MS (QCLot: 2506756) - continued</b>								
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	95.5	79	119
<b>EG020F: Dissolved Metals by ICP-MS (QCLot: 2506757)</b>								
EG020B-F: Strontium	7440-24-6	0.001	mg/L	<0.001	0.1 mg/L	99.1	88	108
EG020B-F: Uranium	7440-61-1	0.001	mg/L	<0.001	----	----	----	----
<b>EG035F: Dissolved Mercury by FIMS (QCLot: 2506755)</b>								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.0100 mg/L	99.5	71	125
<b>EK025SF: Free CN by Segmented Flow Analyser (QCLot: 2501301)</b>								
EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	0.2 mg/L	96.1	73	111
<b>EK026SF: Total CN by Segmented Flow Analyser (QCLot: 2501302)</b>								
EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	0.2 mg/L	88.2	85	125
<b>EK040P: Fluoride by PC Titrator (QCLot: 2501652)</b>								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	103	78	120
<b>EK055G: Ammonia as N by Discrete Analyser (QCLot: 2503677)</b>								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	105	76	122
<b>EK057G: Nitrite as N by Discrete Analyser (QCLot: 2501639)</b>								
EK057G: Nitrite as N	----	0.01	mg/L	<0.01	0.5 mg/L	94.0	84	112
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2503676)</b>								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	103	73	127
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2503250)</b>								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	92.3	63	117
<b>EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2503251)</b>								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	102	73	117
<b>EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2501642)</b>								
EK071G: Reactive Phosphorus as P	----	0.01	mg/L	<0.01	0.5 mg/L	87.8	84	108
<b>EP005: Total Organic Carbon (TOC) (QCLot: 2519209)</b>								
EP005: Total Organic Carbon	----	1	mg/L	<1	100 mg/L	101	81	111
<b>EP010: Formaldehyde (QCLot: 2501649)</b>								
EP010: Formaldehyde	50-00-0	0.1	mg/L	<0.1	5.0 mg/L	102	91	117
<b>EP041A: Nonionic Surfactants (QCLot: 2504783)</b>								
EP041A: Nonionic Surfactants as CTAS	----	5	mg/L	<5	10 mg/L	102	70	128
<b>EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 2518778)</b>								
EP074: Benzene	71-43-2	1	µg/L	<1	20 µg/L	101	79	121
EP074: Toluene	108-88-3	2	µg/L	<2	20 µg/L	102	80	124
EP074: Ethylbenzene	100-41-4	2	µg/L	<2	20 µg/L	101	79	121
EP074: meta- & para-Xylene	108-38-3	2	µg/L	<2	40 µg/L	103	80	122
	106-42-3							



Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike	Spike Recovery (%)		Recovery Limits (%)	
					Concentration	LCS	Low	High	
<b>EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 2518778) - continued</b>									
EP074: Styrene	100-42-5	5	µg/L	<5	20 µg/L	103	74	122	
EP074: ortho-Xylene	95-47-6	2	µg/L	<2	20 µg/L	106	81	123	
EP074: Isopropylbenzene	98-82-8	5	µg/L	<5	20 µg/L	105	80	120	
EP074: n-Propylbenzene	103-65-1	5	µg/L	<5	20 µg/L	95.7	70	120	
EP074: 1,3,5-Trimethylbenzene	108-67-8	5	µg/L	<5	20 µg/L	96.2	71	119	
EP074: sec-Butylbenzene	135-98-8	5	µg/L	<5	20 µg/L	93.5	72	120	
EP074: 1,2,4-Trimethylbenzene	95-63-6	5	µg/L	<5	20 µg/L	97.5	73	119	
EP074: tert-Butylbenzene	98-06-6	5	µg/L	<5	20 µg/L	94.6	73	119	
EP074: p-Isopropyltoluene	99-87-6	5	µg/L	<5	20 µg/L	97.4	71	121	
EP074: n-Butylbenzene	104-51-8	5	µg/L	<5	20 µg/L	96.9	65	121	
<b>EP074B: Oxygenated Compounds (QCLot: 2518778)</b>									
EP074: Vinyl Acetate	108-05-4	50	µg/L	<50	200 µg/L	87.0	57	131	
EP074: 2-Butanone (MEK)	78-93-3	50	µg/L	<50	200 µg/L	92.8	69	135	
EP074: 4-Methyl-2-pentanone (MIBK)	108-10-1	50	µg/L	<50	200 µg/L	93.7	68	136	
EP074: 2-Hexanone (MBK)	591-78-6	50	µg/L	<50	200 µg/L	97.0	68	138	
<b>EP074C: Sulfonated Compounds (QCLot: 2518778)</b>									
EP074: Carbon disulfide	75-15-0	5	µg/L	<5	20 µg/L	85.8	67	127	
<b>EP074D: Fumigants (QCLot: 2518778)</b>									
EP074: 2,2-Dichloropropane	594-20-7	5	µg/L	<5	20 µg/L	77.5	59	128	
EP074: 1,2-Dichloropropane	78-87-5	5	µg/L	<5	20 µg/L	97.2	77	121	
EP074: cis-1,3-Dichloropropylene	10061-01-5	5	µg/L	<5	20 µg/L	76.9	70	118	
EP074: trans-1,3-Dichloropropylene	10061-02-6	5	µg/L	<5	20 µg/L	69.6	66	120	
EP074: 1,2-Dibromoethane (EDB)	106-93-4	5	µg/L	<5	20 µg/L	97.0	78	124	
<b>EP074E: Halogenated Aliphatic Compounds (QCLot: 2518778)</b>									
EP074: Dichlorodifluoromethane	75-71-8	50	µg/L	<50	200 µg/L	101	58	148	
EP074: Chloromethane	74-87-3	50	µg/L	<50	200 µg/L	119	62	142	
EP074: Vinyl chloride	75-01-4	50	µg/L	<50	200 µg/L	110	61	141	
EP074: Bromomethane	74-83-9	50	µg/L	<50	200 µg/L	103	57	131	
EP074: Chloroethane	75-00-3	50	µg/L	<50	200 µg/L	97.1	64	138	
EP074: Trichlorofluoromethane	75-69-4	50	µg/L	<50	200 µg/L	98.5	67	131	
EP074: 1,1-Dichloroethene	75-35-4	5	µg/L	<5	20 µg/L	89.8	71	125	
EP074: Iodomethane	74-88-4	5	µg/L	<5	20 µg/L	109	61	135	
EP074: trans-1,2-Dichloroethene	156-60-5	5	µg/L	<5	20 µg/L	95.0	75	121	
EP074: 1,1-Dichloroethane	75-34-3	5	µg/L	<5	20 µg/L	95.3	77	121	
EP074: cis-1,2-Dichloroethene	156-59-2	5	µg/L	<5	20 µg/L	102	78	122	
EP074: 1,1,1-Trichloroethane	71-55-6	5	µg/L	<5	20 µg/L	85.3	70	120	
EP074: 1,1-Dichloropropylene	563-58-6	5	µg/L	<5	20 µg/L	95.7	74	122	
EP074: Carbon Tetrachloride	56-23-5	5	µg/L	<5	20 µg/L	78.6	57	123	



Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike	Spike Recovery (%)		Recovery Limits (%)	
					Concentration	LCS	Low	High	
<b>EP074E: Halogenated Aliphatic Compounds (QCLot: 2518778) - continued</b>									
EP074: 1,2-Dichloroethane	107-06-2	5	µg/L	<5	20 µg/L	99.8	75	125	
EP074: Trichloroethene	79-01-6	5	µg/L	<5	20 µg/L	97.4	77	121	
EP074: Dibromomethane	74-95-3	5	µg/L	<5	20 µg/L	93.7	76	122	
EP074: 1,1,2-Trichloroethane	79-00-5	5	µg/L	<5	20 µg/L	103	78	126	
EP074: 1,3-Dichloropropane	142-28-9	5	µg/L	<5	20 µg/L	102	79	125	
EP074: Tetrachloroethene	127-18-4	5	µg/L	<5	20 µg/L	98.8	76	122	
EP074: 1,1,1,2-Tetrachloroethane	630-20-6	5	µg/L	<5	20 µg/L	84.8	65	119	
EP074: trans-1,4-Dichloro-2-butene	110-57-6	5	µg/L	<5	20 µg/L	83.9	46	126	
EP074: cis-1,4-Dichloro-2-butene	1476-11-5	5	µg/L	<5	20 µg/L	62.8	54	132	
EP074: 1,1,1,2,2-Tetrachloroethane	79-34-5	5	µg/L	<5	20 µg/L	98.6	75	131	
EP074: 1,2,3-Trichloropropane	96-18-4	5	µg/L	<5	20 µg/L	100	75	133	
EP074: Pentachloroethane	76-01-7	5	µg/L	<5	20 µg/L	75.4	46	118	
EP074: 1,2-Dibromo-3-chloropropane	96-12-8	5	µg/L	<5	20 µg/L	71.2	54	124	
<b>EP074F: Halogenated Aromatic Compounds (QCLot: 2518778)</b>									
EP074: Chlorobenzene	108-90-7	5	µg/L	<5	20 µg/L	103	81	121	
EP074: Bromobenzene	108-86-1	5	µg/L	<5	20 µg/L	86.8	75	119	
EP074: 2-Chlorotoluene	95-49-8	5	µg/L	<5	20 µg/L	98.4	73	121	
EP074: 4-Chlorotoluene	106-43-4	5	µg/L	<5	20 µg/L	100	72	120	
EP074: 1,2,3-Trichlorobenzene	87-61-6	5	µg/L	<5	20 µg/L	106	69	123	
<b>EP074G: Trihalomethanes (QCLot: 2518778)</b>									
EP074: Chloroform	67-66-3	5	µg/L	<5	20 µg/L	98.0	77	121	
EP074: Bromodichloromethane	75-27-4	5	µg/L	<5	20 µg/L	83.2	69	117	
EP074: Dibromochloromethane	124-48-1	5	µg/L	<5	20 µg/L	80.9	59	119	
EP074: Bromoform	75-25-2	5	µg/L	<5	20 µg/L	75.4	49	121	
<b>EP075A: Phenolic Compounds (QCLot: 2501530)</b>									
EP075: Phenol	108-95-2	2	µg/L	<2	10 µg/L	45.7	10	65	
EP075: 2-Chlorophenol	95-57-8	2	µg/L	<2	10 µg/L	86.0	29.8	108	
EP075: 2-Methylphenol	95-48-7	2	µg/L	<2	10 µg/L	80.6	21.9	110	
EP075: 3- & 4-Methylphenol	1319-77-3	2	µg/L	----	20 µg/L	43.6	10	108	
		4	µg/L	<4	----	----	----	----	
EP075: 2-Nitrophenol	88-75-5	2	µg/L	<2	10 µg/L	97.1	31.2	123	
EP075: 2,4-Dimethylphenol	105-67-9	2	µg/L	<2	10 µg/L	94.4	36	124	
EP075: 2,4-Dichlorophenol	120-83-2	2	µg/L	<2	10 µg/L	88.4	31.2	125	
EP075: 2,6-Dichlorophenol	87-65-0	2	µg/L	<2	10 µg/L	90.4	33	123	
EP075: 4-Chloro-3-Methylphenol	59-50-7	2	µg/L	<2	10 µg/L	95.8	39	125	
EP075: 2,4,6-Trichlorophenol	88-06-2	2	µg/L	<2	10 µg/L	85.0	23.9	134	
EP075: 2,4,5-Trichlorophenol	95-95-4	2	µg/L	<2	10 µg/L	79.7	31.6	136	
EP075: Pentachlorophenol	87-86-5	2	µg/L	----	10 µg/L	# 24.5	47	153	
		4	µg/L	<4	----	----	----	----	



Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike Concentration	Spike Recovery (%)		Recovery Limits (%)	
						LCS	Low	High	
<b>EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 2501530)</b>									
EP075: Naphthalene	91-20-3	2	µg/L	<2	10 µg/L	97.9	33	117	
EP075: 2-Methylnaphthalene	91-57-6	2	µg/L	<2	10 µg/L	98.4	33	123	
EP075: 2-Chloronaphthalene	91-58-7	2	µg/L	<2	10 µg/L	95.1	22.6	133	
EP075: Acenaphthylene	208-96-8	2	µg/L	<2	10 µg/L	99.4	35	131	
EP075: Acenaphthene	83-32-9	2	µg/L	<2	10 µg/L	90.0	37	127	
EP075: Fluorene	86-73-7	2	µg/L	<2	10 µg/L	89.9	39	133	
EP075: Phenanthrene	85-01-8	2	µg/L	<2	10 µg/L	108	42	134	
EP075: Anthracene	120-12-7	2	µg/L	<2	10 µg/L	108	41	135	
EP075: Fluoranthene	206-44-0	2	µg/L	<2	10 µg/L	111	40	146	
EP075: Pyrene	129-00-0	2	µg/L	<2	10 µg/L	110	42	142	
EP075: N-2-Fluorenyl Acetamide	53-96-3	2	µg/L	<2	10 µg/L	119	40	146	
EP075: Benz(a)anthracene	56-55-3	2	µg/L	<2	10 µg/L	104	41	143	
EP075: Chrysene	218-01-9	2	µg/L	<2	10 µg/L	116	40	146	
EP075: Benzo(b) & Benzo(k)fluoranthene	205-99-2 207-08-9	4	µg/L	<4	20 µg/L	116	21	151	
EP075: 7.12-Dimethylbenz(a)anthracene	57-97-6	2	µg/L	<2	10 µg/L	119	39	151	
EP075: Benzo(a)pyrene	50-32-8	2	µg/L	<2	10 µg/L	119	39	141	
EP075: 3-Methylcholanthrene	56-49-5	2	µg/L	<2	10 µg/L	104	33	139	
EP075: Indeno(1.2.3.cd)pyrene	193-39-5	2	µg/L	<2	10 µg/L	116	31.5	139	
EP075: Dibenz(a,h)anthracene	53-70-3	2	µg/L	<2	10 µg/L	116	30.1	140	
EP075: Benzo(g,h,i)perylene	191-24-2	2	µg/L	<2	10 µg/L	113	29.5	138	
<b>EP075C: Phthalate Esters (QCLot: 2501530)</b>									
EP075: Dimethyl phthalate	131-11-3	2	µg/L	<2	10 µg/L	103	41	141	
EP075: Diethyl phthalate	84-66-2	2	µg/L	<2	10 µg/L	94.9	45	139	
EP075: Di-n-butyl phthalate	84-74-2	2	µg/L	<2	10 µg/L	126	42	150	
EP075: Butyl benzyl phthalate	85-68-7	2	µg/L	<2	10 µg/L	113	36	152	
EP075: bis(2-ethylhexyl) phthalate	117-81-7	10 20	µg/L	<10 ----	---- 10 µg/L	---- 110	---- 42	---- 158	
EP075: Di-n-octylphthalate	117-84-0	2	µg/L	<2	10 µg/L	110	43	141	
<b>EP075D: Nitrosamines (QCLot: 2501530)</b>									
EP075: N-Nitrosomethylethylamine	10595-95-6	2	µg/L	<2	10 µg/L	107	10	109	
EP075: N-Nitrosodiethylamine	55-18-5	2	µg/L	<2	10 µg/L	98.0	23.5	124	
EP075: N-Nitrosopyrrolidine	930-55-2	4	µg/L	<4	10 µg/L	75.6	18.8	97	
EP075: N-Nitrosomorpholine	59-89-2	2	µg/L	<2	10 µg/L	70.6	18.3	94	
EP075: N-Nitrosodi-n-propylamine	621-64-7	2	µg/L	<2	10 µg/L	104	30.6	129	
EP075: N-Nitrosopiperidine	100-75-4	2	µg/L	<2	10 µg/L	99.4	32	126	
EP075: N-Nitrosodibutylamine	924-16-3	2	µg/L	<2	10 µg/L	104	29.1	135	
EP075: N-Nitrosodiphenyl & Diphenylamine	86-30-6 122-39-4	4	µg/L	<4	10 µg/L	92.6	39	139	



Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike	Spike Recovery (%)		Recovery Limits (%)	
					Concentration	LCS	Low	High	
<b>EP075D: Nitrosamines (QCLot: 2501530) - continued</b>									
EP075: Methapyrilene	91-80-5	2	µg/L	<2	10 µg/L	41.9	28.1	70	
<b>EP075E: Nitroaromatics and Ketones (QCLot: 2501530)</b>									
EP075: 2-Picoline	109-06-8	2	µg/L	<2	10 µg/L	# 10.2	28.4	57	
EP075: Acetophenone	98-86-2	2	µg/L	<2	10 µg/L	98.9	34	126	
EP075: Nitrobenzene	98-95-3	2	µg/L	<2	10 µg/L	96.3	36	120	
EP075: Isophorone	78-59-1	2	µg/L	<2	10 µg/L	95.3	38	124	
EP075: 2,6-Dinitrotoluene	606-20-2	4	µg/L	<4	10 µg/L	103	38	142	
EP075: 2,4-Dinitrotoluene	121-14-2	4	µg/L	<4	10 µg/L	89.7	44	138	
EP075: 1-Naphthylamine	134-32-7	2	µg/L	<2	10 µg/L	114	29.8	152	
EP075: 4-Nitroquinoline-N-oxide	56-57-5	2	µg/L	<2	10 µg/L	138	25.9	168	
EP075: 5-Nitro-o-toluidine	99-55-8	2	µg/L	<2	10 µg/L	102	26.2	138	
EP075: Azobenzene	103-33-3	2	µg/L	<2	10 µg/L	90.0	43	135	
EP075: 1,3,5-Trinitrobenzene	99-35-4	2	µg/L	<2	10 µg/L	92.4	10	158	
EP075: Phenacetin	62-44-2	2	µg/L	<2	10 µg/L	80.7	37	131	
EP075: 4-Aminobiphenyl	92-67-1	2	µg/L	<2	10 µg/L	144	10	150	
EP075: Pentachloronitrobenzene	82-68-8	2	µg/L	<2	10 µg/L	89.0	38	146	
EP075: Pronamide	23950-58-5	2	µg/L	<2	10 µg/L	107	45	139	
EP075: Dimethylaminoazobenzene	60-11-7	2	µg/L	<2	10 µg/L	109	37	147	
EP075: Chlorobenzilate	510-15-6	2	µg/L	<2	10 µg/L	109	42	148	
<b>EP075F: Haloethers (QCLot: 2501530)</b>									
EP075: Bis(2-chloroethyl) ether	111-44-4	2	µg/L	<2	10 µg/L	116	10	142	
EP075: Bis(2-chloroethoxy) methane	111-91-1	2	µg/L	<2	10 µg/L	98.7	34	126	
EP075: 4-Chlorophenyl phenyl ether	7005-72-3	2	µg/L	<2	10 µg/L	88.8	39	133	
EP075: 4-Bromophenyl phenyl ether	101-55-3	2	µg/L	<2	10 µg/L	90.5	39	137	
<b>EP075G: Chlorinated Hydrocarbons (QCLot: 2501530)</b>									
EP075: 1,4-Dichlorobenzene	106-46-7	2	µg/L	<2	10 µg/L	92.3	23	109	
EP075: 1,3-Dichlorobenzene	541-73-1	2	µg/L	<2	10 µg/L	89.7	19.8	112	
EP075: 1,2-Dichlorobenzene	95-50-1	2	µg/L	<2	10 µg/L	92.8	25.2	109	
EP075: Hexachloroethane	67-72-1	2	µg/L	<2	10 µg/L	87.4	17.4	115	
EP075: 1,2,4-Trichlorobenzene	120-82-1	2	µg/L	<2	10 µg/L	93.2	25.7	112	
EP075: Hexachloropropylene	1888-71-7	2	µg/L	<2	10 µg/L	91.5	19.1	115	
EP075: Hexachlorobutadiene	87-68-3	2	µg/L	<2	10 µg/L	92.6	21.1	117	
EP075: Hexachlorocyclopentadiene	77-47-4	10	µg/L	<10	10 µg/L	76.4	10	120	
EP075: Pentachlorobenzene	608-93-5	2	µg/L	<2	10 µg/L	88.1	36	130	
EP075: Hexachlorobenzene (HCB)	118-74-1	4	µg/L	<4	20 µg/L	88.7	11.1	135	
<b>EP075H: Anilines and Benzidines (QCLot: 2501530)</b>									
EP075: Aniline	62-53-3	2	µg/L	<2	10 µg/L	78.6	19.8	96	
EP075: 4-Chloroaniline	106-47-8	2	µg/L	<2	10 µg/L	99.2	16.4	130	



Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike	Spike Recovery (%)		Recovery Limits (%)	
					Concentration	LCS	Low	High	
<b>EP075H: Anilines and Benzidines (QCLot: 2501530) - continued</b>									
EP075: 2-Nitroaniline	88-74-4	4	µg/L	<4	10 µg/L	104	38	138	
EP075: 3-Nitroaniline	99-09-2	4	µg/L	<4	10 µg/L	100	10	135	
EP075: Dibenzofuran	132-64-9	2	µg/L	<2	10 µg/L	91.6	39	129	
EP075: 4-Nitroaniline	100-01-6	2	µg/L	<2	10 µg/L	83.8	22.8	133	
EP075: Carbazole	86-74-8	2	µg/L	<2	10 µg/L	110	44	138	
EP075: 3,3'-Dichlorobenzidine	91-94-1	2	µg/L	<2	10 µg/L	# 124	14.6	107	
<b>EP075I: Organochlorine Pesticides (QCLot: 2501530)</b>									
EP075: alpha-BHC	319-84-6	2	µg/L	<2	10 µg/L	90.0	41	143	
EP075: beta-BHC	319-85-7	2	µg/L	<2	10 µg/L	91.7	39	145	
EP075: gamma-BHC	58-89-9	2	µg/L	<2	10 µg/L	89.4	39	143	
EP075: delta-BHC	319-86-8	2	µg/L	<2	10 µg/L	108	42	142	
EP075: Heptachlor	76-44-8	2	µg/L	<2	10 µg/L	108	39	139	
EP075: Aldrin	309-00-2	2	µg/L	<2	10 µg/L	106	40	142	
EP075: Heptachlor epoxide	1024-57-3	2	µg/L	<2	10 µg/L	110	37	147	
EP075: alpha-Endosulfan	959-98-8	2	µg/L	<2	10 µg/L	85.3	42	146	
EP075: 4,4'-DDE	72-55-9	2	µg/L	<2	10 µg/L	105	41	141	
EP075: Dieldrin	60-57-1	2	µg/L	<2	10 µg/L	108	42	144	
EP075: Endrin	72-20-8	2	µg/L	<2	10 µg/L	113	41	145	
EP075: beta-Endosulfan	33213-65-9	2	µg/L	<2	10 µg/L	108	42	146	
EP075: 4,4'-DDD	72-54-8	2	µg/L	<2	10 µg/L	109	40	148	
EP075: Endosulfan sulfate	1031-07-8	2	µg/L	<2	10 µg/L	119	38	152	
EP075: 4,4'-DDT	50-29-3	4	µg/L	<4	10 µg/L	120	33	145	
<b>EP075J: Organophosphorus Pesticides (QCLot: 2501530)</b>									
EP075: Dichlorvos	62-73-7	2	µg/L	<2	10 µg/L	102	38	132	
EP075: Dimethoate	60-51-5	2	µg/L	<2	10 µg/L	88.7	36	138	
EP075: Diazinon	333-41-5	2	µg/L	<2	10 µg/L	110	43	141	
EP075: Chlorpyrifos-methyl	5598-13-0	2	µg/L	<2	10 µg/L	107	43	141	
EP075: Malathion	121-75-5	2	µg/L	<2	10 µg/L	117	44	148	
EP075: Fenthion	55-38-9	2	µg/L	<2	10 µg/L	111	42	144	
EP075: Chlorpyrifos	2921-88-2	2	µg/L	<2	10 µg/L	109	42	142	
EP075: Pirimphos-ethyl	23505-41-1	2	µg/L	<2	10 µg/L	108	44	142	
EP075: Chlorfenvinphos	470-90-6	2	µg/L	<2	10 µg/L	114	44	146	
EP075: Prothiofos	34643-46-4	2	µg/L	<2	10 µg/L	111	40	142	
EP075: Ethion	563-12-2	2	µg/L	<2	10 µg/L	108	42	146	
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QCLot: 2501533)</b>									
EP070-CWG: Aliphatic >C10-C12	TPHCWG-AL E1	50	µg/L	<50	2505 µg/L	77.9	70	130	
EP070-CWG: Aliphatic >C12-C16	TPHCWG-AL E2	50	µg/L	<50	10590 µg/L	84.9	70	130	



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 Work Order : EM1210744  
 Client : SANTOS LTD  
 Project : HFRA Fluids Sampling- Extended Analysis



Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
				Result	Spike	Spike Recovery (%)	Recovery Limits (%)	
					Concentration	LCS	Low	High
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QCLot: 2501533) - continued</b>								
EP070-CWG: Aliphatic >C16-C21	----	50	µg/L	<50	9345 µg/L	99.6	70	130
EP070-CWG: Aliphatic >C21-C35	----	50	µg/L	<50	2253 µg/L	96.8	70	130
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QCLot: 2518779)</b>								
EP079-CWG: Aliphatic >C5-C6	----	20	µg/L	<20	50 µg/L	100	70	130
EP079-CWG: Aliphatic >C6-C8	TPHCWG-AL V2	20	µg/L	<20	100 µg/L	102	70	130
EP079-CWG: Aliphatic >C8-C10	TPHCWG-AL V3	20	µg/L	<20	100 µg/L	106	70	130
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QCLot: 2501533)</b>								
EP070-CWG: Aromatic >C10-C12	TPHCWG-AR E1	50	µg/L	<50	750 µg/L	78.2	70	130
EP070-CWG: Aromatic >C12-C16	TPHCWG-AR E2	50	µg/L	<50	3174 µg/L	91.1	70	130
EP070-CWG: Aromatic >C16-C21	TPHCWG-AR E3	50	µg/L	<50	2607 µg/L	85.3	70	130
EP070-CWG: Aromatic >C21-C35	TPHCWG-AR E4	50	µg/L	<50	606 µg/L	83.1	70	130
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QCLot: 2518779)</b>								
EP079-CWG: Aromatic >C5-C7	----	1	µg/L	<1	20 µg/L	97.0	70	130
EP079-CWG: Aromatic >C7-C8	TPHCWG-AR V2	2	µg/L	<2	20 µg/L	98.6	70	130
EP079-CWG: Aromatic >C8-C10	TPHCWG-AR V3	2	µg/L	<2	160 µg/L	97.2	70	130
<b>EP117: Alcohols (QCLot: 2509203)</b>								
EP117: Ethanol	64-17-5	50	µg/L	<50	100 µg/L	86.4	73	121
EP117: Isopropanol	67-63-0	50	µg/L	<50	100 µg/L	92.2	73	113
EP117: n-Propanol	71-23-8	50	µg/L	<50	100 µg/L	93.3	68	116
EP117: Isobutanol	78-83-1	50	µg/L	<50	100 µg/L	90.9	67	117
EP117: n-Butanol	71-36-3	50	µg/L	<50	100 µg/L	87.3	65	119



## Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
					MS	Low	High
<b>ED009: Anions (QCLot: 2507802)</b>							
EM1210846-001	Anonymous	ED009-X: Bromide	24959-67-9	0.2 mg/L	112	70	130
		ED009-X: Iodide	20461-54-5	0.2 mg/L	122	70	130
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2501638)</b>							
EM1210737-006	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	10 mg/L	# Not Determined	70	130
<b>ED045G: Chloride Discrete analyser (QCLot: 2501641)</b>							
EM1210737-006	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	# Not Determined	70	130
<b>EG020F: Dissolved Metals by ICP-MS (QCLot: 2506756)</b>							
EM1210728-001	Anonymous	EG020A-F: Arsenic	7440-38-2	0.2 mg/L	116	89	139
		EG020A-F: Beryllium	7440-41-7	0.2 mg/L	112	64	138
		EG020A-F: Barium	7440-39-3	0.2 mg/L	102	80	122
		EG020A-F: Cadmium	7440-43-9	0.05 mg/L	114	75	131
		EG020A-F: Chromium	7440-47-3	0.2 mg/L	97.9	70	130
		EG020A-F: Cobalt	7440-48-4	0.2 mg/L	108	77	129
		EG020A-F: Copper	7440-50-8	0.2 mg/L	104	71	127
		EG020A-F: Lead	7439-92-1	0.2 mg/L	99.3	71	123
		EG020A-F: Manganese	7439-96-5	0.2 mg/L	# Not Determined	66	132
		EG020A-F: Nickel	7440-02-0	0.2 mg/L	101	73	129
		EG020A-F: Vanadium	7440-62-2	0.2 mg/L	98.4	70	130
EG020A-F: Zinc	7440-66-6	0.2 mg/L	# Not Determined	68	136		
<b>EG035F: Dissolved Mercury by FIMS (QCLot: 2506755)</b>							
EM1210728-002	Anonymous	EG035F: Mercury	7439-97-6	0.0100 mg/L	# 58.9	70	130
<b>EK025SF: Free CN by Segmented Flow Analyser (QCLot: 2501301)</b>							
EM1210670-002	Anonymous	EK025SF: Free Cyanide	----	0.2 mg/L	82.3	70	130
<b>EK026SF: Total CN by Segmented Flow Analyser (QCLot: 2501302)</b>							
EM1210670-002	Anonymous	EK026SF: Total Cyanide	57-12-5	0.2 mg/L	88.0	70	130
<b>EK040P: Fluoride by PC Titrator (QCLot: 2501652)</b>							
EM1210670-002	Anonymous	EK040P: Fluoride	16984-48-8	5.0 mg/L	93.2	70	130
<b>EK055G: Ammonia as N by Discrete Analyser (QCLot: 2503677)</b>							
EM1210744-002	Crosslink Gel	EK055G: Ammonia as N	7664-41-7	0.5 mg/L	96.8	70	130
<b>EK057G: Nitrite as N by Discrete Analyser (QCLot: 2501639)</b>							
EM1210737-006	Anonymous	EK057G: Nitrite as N	----	0.5 mg/L	91.7	70	130
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2503676)</b>							
EM1210719-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	# Not Determined	70	130

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 Work Order : EM1210744  
 Client : SANTOS LTD  
 Project : HFRA Fluids Sampling- Extended Analysis



Sub-Matrix: WATER

				Matrix Spike (MS) Report			
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Spike	Spike Recovery (%)	Recovery Limits (%)	
				Concentration	MS	Low	High
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2503250)</b>							
EM1210719-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	# Not Determined	70	130
<b>EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2503251)</b>							
EM1210719-001	Anonymous	EK067G: Total Phosphorus as P	----	1 mg/L	# Not Determined	70	130
<b>EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2501642)</b>							
EM1210743-002	Anonymous	EK071G: Reactive Phosphorus as P	----	0.5 mg/L	112	70	130
<b>EP005: Total Organic Carbon (TOC) (QCLot: 2519209)</b>							
EM1210744-002	Crosslink Gel	EP005: Total Organic Carbon	----	1000 mg/L	# Not Determined	70	130
<b>EP041A: Nonionic Surfactants (QCLot: 2504783)</b>							
EP1207681-009	Anonymous	EP041A: Nonionic Surfactants as CTAS	----	5 mg/L	106	70	130
<b>EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 2518778)</b>							
ER1200156-004	Anonymous	EP074: Benzene	71-43-2	20 µg/L	96.2	64	121
		EP074: Toluene	108-88-3	20 µg/L	99.3	63	125
<b>EP074E: Halogenated Aliphatic Compounds (QCLot: 2518778)</b>							
ER1200156-004	Anonymous	EP074: 1,1-Dichloroethene	75-35-4	20 µg/L	90.4	52	104
		EP074: Trichloroethene	79-01-6	20 µg/L	92.8	59	120
<b>EP074F: Halogenated Aromatic Compounds (QCLot: 2518778)</b>							
ER1200156-004	Anonymous	EP074: Chlorobenzene	108-90-7	20 µg/L	102	63	132
<b>EP075A: Phenolic Compounds (QCLot: 2501530)</b>							
EM1210744-002	Crosslink Gel	EP075: Phenol	108-95-2	10 µg/L	# Not Determined	10	51
		EP075: 2-Chlorophenol	95-57-8	10 µg/L	# Not Determined	26.1	104
		EP075: 2-Nitrophenol	88-75-5	10 µg/L	# Not Determined	34	118
		EP075: 4-Chloro-3-Methylphenol	59-50-7	10 µg/L	# Not Determined	24.9	135
		EP075: Pentachlorophenol	87-86-5	10 µg/L	# Not Determined	29.9	194
<b>EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 2501530)</b>							
EM1210744-002	Crosslink Gel	EP075: Acenaphthene	83-32-9	10 µg/L	# Not Determined	27	133
		EP075: Pyrene	129-00-0	10 µg/L	# Not Determined	28.1	146
<b>EP075D: Nitrosamines (QCLot: 2501530)</b>							
EM1210744-002	Crosslink Gel	EP075: N-Nitrosodi-n-propylamine	621-64-7	10 µg/L	# Not Determined	22.8	125
<b>EP075E: Nitroaromatics and Ketones (QCLot: 2501530)</b>							
EM1210744-002	Crosslink Gel	EP075: 2,4-Dinitrotoluene	121-14-2	10 µg/L	# Not Determined	27.9	138
<b>EP075G: Chlorinated Hydrocarbons (QCLot: 2501530)</b>							
EM1210744-002	Crosslink Gel	EP075: 1,4-Dichlorobenzene	106-46-7	10 µg/L	# Not Determined	22.1	112
		EP075: 1,2,4-Trichlorobenzene	120-82-1	10 µg/L	# Not Determined	15.3	117
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QCLot: 2501533)</b>							
EM1210744-002	Crosslink Gel						



Sub-Matrix: WATER

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report			
				Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
					MS	Low	High
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QCLot: 2501533) - continued</b>							
EM1210744-002	Crosslink Gel	EP070-CWG: Aliphatic >C10-C12	TPHCWG-AL E1	2505 µg/L	72.2	70	130
		EP070-CWG: Aliphatic >C12-C16	TPHCWG-AL E2	10590 µg/L	76.7	70	130
		EP070-CWG: Aliphatic >C16-C21	----	9345 µg/L	91.6	70	130
		EP070-CWG: Aliphatic >C21-C35	----	2253 µg/L	89.5	70	130
<b>EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions (QCLot: 2518779)</b>							
ER1200156-004	Anonymous	EP079-CWG: Aliphatic >C5-C6	----	70 µg/L	87.9	70	130
		EP079-CWG: Aliphatic >C6-C8	TPHCWG-AL V2	140 µg/L	86.6	70	130
		EP079-CWG: Aliphatic >C8-C10	TPHCWG-AL V3	120 µg/L	99.2	70	130
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QCLot: 2501533)</b>							
EM1210744-002	Crosslink Gel	EP070-CWG: Aromatic >C10-C12	TPHCWG-AR E1	750 µg/L	94.7	70	130
		EP070-CWG: Aromatic >C12-C16	TPHCWG-AR E2	3174 µg/L	93.6	70	130
		EP070-CWG: Aromatic >C16-C21	TPHCWG-AR E3	2607 µg/L	88.5	70	130
		EP070-CWG: Aromatic >C21-C35	TPHCWG-AR E4	606 µg/L	85.1	70	130
<b>EP079/070: TPH CWG Aromatic Hydrocarbon Fractions (QCLot: 2518779)</b>							
ER1200156-004	Anonymous	EP079-CWG: Aromatic >C5-C7	----	20 µg/L	95.4	70	130
		EP079-CWG: Aromatic >C7-C8	TPHCWG-AR V2	20 µg/L	99.7	70	130
<b>EP117: Alcohols (QCLot: 2509203)</b>							
EB1224362-001	Anonymous	EP117: Ethanol	64-17-5	100 µg/L	101	70	130
		EP117: Isopropanol	67-63-0	100 µg/L	104	70	130
		EP117: n-Propanol	71-23-8	100 µg/L	94.1	70	130
		EP117: Isobutanol	78-83-1	100 µg/L	102	70	130
		EP117: n-Butanol	71-36-3	100 µg/L	89.2	70	130



## Environmental Division

### INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: <b>EM1210744</b>	Page	: 1 of 14
Client	: SANTOS LTD	Laboratory	: Environmental Division Melbourne
Contact	: MR BARRY RITCHIE	Contact	: Client Services
Address	: GROUND FLOOR SANTOS CENTRE 60 FLINDERS STREET ADELAIDE SA, AUSTRALIA 5001	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: barry.ritchie@santos.com	E-mail	: Melbourne.Enviro.Services@alsglobal.com
Telephone	: +61 08 8116 5000	Telephone	: +61-3-8549 9600
Facsimile	: +61 08 8116 5050	Facsimile	: +61-3-8549 9601
Project	: HFRA Fluids Sampling- Extended Analysis	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----	Date Samples Received	: 14-SEP-2012
C-O-C number	: ----	Issue Date	: 03-OCT-2012
Sampler	: JM, AJ	No. of samples received	: 2
Order number	: 879002/538	No. of samples analysed	: 2
Quote number	: EN/039/12		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

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## Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **WATER**

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
<b>EA005: pH</b>							
Clear Plastic Bottle - Natural FR Water	13-SEP-2012	----	----	----	19-SEP-2012	13-SEP-2012	*
<b>EA006: Sodium Adsorption Ratio (SAR)</b>							
Clear Plastic Bottle - Natural FR Water	13-SEP-2012	---	20-SEP-2012	----	18-SEP-2012	20-SEP-2012	✓
<b>EA015: Total Dissolved Solids</b>							
Clear Plastic Bottle - Natural FR Water	13-SEP-2012	---	20-SEP-2012	----	19-SEP-2012	20-SEP-2012	✓
<b>ED009: Anions</b>							
Clear Plastic Bottle - Natural FR Water	13-SEP-2012	----	----	----	20-SEP-2012	11-OCT-2012	✓
<b>ED037P: Alkalinity by PC Titrator</b>							
Clear Plastic Bottle - Natural FR Water	13-SEP-2012	---	27-SEP-2012	----	17-SEP-2012	27-SEP-2012	✓
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</b>							
Clear Plastic Bottle - Natural FR Water	13-SEP-2012	---	11-OCT-2012	----	18-SEP-2012	11-OCT-2012	✓
<b>ED045G: Chloride Discrete analyser</b>							
Clear Plastic Bottle - Natural FR Water	13-SEP-2012	---	11-OCT-2012	----	18-SEP-2012	11-OCT-2012	✓
<b>ED093F: Dissolved Major Cations</b>							
Clear Plastic Bottle - Natural FR Water	13-SEP-2012	---	20-SEP-2012	----	18-SEP-2012	20-SEP-2012	✓
<b>EG020F: Dissolved Metals by ICP-MS</b>							
Clear Plastic Bottle - Natural FR Water	13-SEP-2012	---	12-MAR-2013	----	21-SEP-2012	12-MAR-2013	✓
<b>EG035F: Dissolved Mercury by FIMS</b>							
Clear Plastic Bottle - Natural FR Water	13-SEP-2012	---	11-OCT-2012	----	20-SEP-2012	11-OCT-2012	✓
<b>EK010-1: Chlorine (Field Test)</b>							
Clear Plastic Bottle - Natural FR Water	13-SEP-2012	----	----	----	14-SEP-2012	13-SEP-2012	*



Matrix: **WATER**

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
<b>EK025SF: Free CN by Segmented Flow Analyser</b>							
White Plastic Bottle-NaOH FR Water	13-SEP-2012	---	27-SEP-2012	----	17-SEP-2012	27-SEP-2012	✓
<b>EK026SF: Total CN by Segmented Flow Analyser</b>							
White Plastic Bottle-NaOH FR Water	13-SEP-2012	---	27-SEP-2012	----	17-SEP-2012	27-SEP-2012	✓
<b>EK040P: Fluoride by PC Titrator</b>							
Clear Plastic Bottle - Natural FR Water	13-SEP-2012	---	11-OCT-2012	----	17-SEP-2012	11-OCT-2012	✓
<b>EK055G: Ammonia as N by Discrete Analyser</b>							
Clear Plastic Bottle - Sulfuric Acid FR Water, Crosslink Gel	13-SEP-2012	---	11-OCT-2012	----	19-SEP-2012	11-OCT-2012	✓
<b>EK057G: Nitrite as N by Discrete Analyser</b>							
Clear Plastic Bottle - Natural FR Water	13-SEP-2012	---	15-SEP-2012	----	14-SEP-2012	15-SEP-2012	✓
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>							
Clear Plastic Bottle - Sulfuric Acid FR Water	13-SEP-2012	---	11-OCT-2012	----	19-SEP-2012	11-OCT-2012	✓
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>							
Clear Plastic Bottle - Sulfuric Acid FR Water	13-SEP-2012	19-SEP-2012	11-OCT-2012	✓	19-SEP-2012	11-OCT-2012	✓
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>							
Clear Plastic Bottle - Sulfuric Acid FR Water	13-SEP-2012	19-SEP-2012	11-OCT-2012	✓	19-SEP-2012	11-OCT-2012	✓
<b>EK071G: Reactive Phosphorus as P by discrete analyser</b>							
Clear Plastic Bottle - Natural FR Water	13-SEP-2012	---	15-SEP-2012	----	14-SEP-2012	15-SEP-2012	✓
<b>EP005: Total Organic Carbon (TOC)</b>							
Amber TOC Vial - Sulfuric Acid FR Water, Crosslink Gel	13-SEP-2012	----	----	----	26-SEP-2012	11-OCT-2012	✓
<b>EP010: Formaldehyde</b>							
Clear Plastic Bottle - Natural FR Water	13-SEP-2012	----	----	----	14-SEP-2012	15-SEP-2012	✓
<b>EP041A: Nonionic Surfactants</b>							
Pres. with Formaldehyde on receipt FR Water	13-SEP-2012	----	----	----	20-SEP-2012	11-OCT-2012	✓
<b>EP074A: Monocyclic Aromatic Hydrocarbons</b>							
Amber VOC Vial - Sulfuric Acid FR Water, Crosslink Gel	13-SEP-2012	27-SEP-2012	27-SEP-2012	✓	27-SEP-2012	27-SEP-2012	✓
<b>EP074B: Oxygenated Compounds</b>							
Amber VOC Vial - Sulfuric Acid FR Water, Crosslink Gel	13-SEP-2012	27-SEP-2012	27-SEP-2012	✓	27-SEP-2012	27-SEP-2012	✓



Matrix: **WATER**

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis			
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
<b>EP074C: Sulfonated Compounds</b>								
Amber VOC Vial - Sulfuric Acid FR Water, Crosslink Gel	13-SEP-2012	27-SEP-2012	27-SEP-2012	✓	27-SEP-2012	27-SEP-2012	✓	
<b>EP074D: Fumigants</b>								
Amber VOC Vial - Sulfuric Acid FR Water, Crosslink Gel	13-SEP-2012	27-SEP-2012	27-SEP-2012	✓	27-SEP-2012	27-SEP-2012	✓	
<b>EP074E: Halogenated Aliphatic Compounds</b>								
Amber VOC Vial - Sulfuric Acid FR Water, Crosslink Gel	13-SEP-2012	27-SEP-2012	27-SEP-2012	✓	27-SEP-2012	27-SEP-2012	✓	
<b>EP074F: Halogenated Aromatic Compounds</b>								
Amber VOC Vial - Sulfuric Acid FR Water, Crosslink Gel	13-SEP-2012	27-SEP-2012	27-SEP-2012	✓	27-SEP-2012	27-SEP-2012	✓	
<b>EP074G: Trihalomethanes</b>								
Amber VOC Vial - Sulfuric Acid FR Water, Crosslink Gel	13-SEP-2012	27-SEP-2012	27-SEP-2012	✓	27-SEP-2012	27-SEP-2012	✓	
<b>EP075A: Phenolic Compounds</b>								
Amber Glass Bottle - Unpreserved FR Water, Crosslink Gel	13-SEP-2012	17-SEP-2012	20-SEP-2012	✓	19-SEP-2012	27-OCT-2012	✓	
<b>EP075B: Polynuclear Aromatic Hydrocarbons</b>								
Amber Glass Bottle - Unpreserved FR Water, Crosslink Gel	13-SEP-2012	17-SEP-2012	20-SEP-2012	✓	19-SEP-2012	27-OCT-2012	✓	
<b>EP075C: Phthalate Esters</b>								
Amber Glass Bottle - Unpreserved FR Water, Crosslink Gel	13-SEP-2012	17-SEP-2012	20-SEP-2012	✓	19-SEP-2012	27-OCT-2012	✓	
<b>EP075D: Nitrosamines</b>								
Amber Glass Bottle - Unpreserved FR Water, Crosslink Gel	13-SEP-2012	17-SEP-2012	20-SEP-2012	✓	19-SEP-2012	27-OCT-2012	✓	
<b>EP075E: Nitroaromatics and Ketones</b>								
Amber Glass Bottle - Unpreserved FR Water, Crosslink Gel	13-SEP-2012	17-SEP-2012	20-SEP-2012	✓	19-SEP-2012	27-OCT-2012	✓	
<b>EP075F: Haloethers</b>								
Amber Glass Bottle - Unpreserved FR Water, Crosslink Gel	13-SEP-2012	17-SEP-2012	20-SEP-2012	✓	19-SEP-2012	27-OCT-2012	✓	
<b>EP075G: Chlorinated Hydrocarbons</b>								
Amber Glass Bottle - Unpreserved FR Water, Crosslink Gel	13-SEP-2012	17-SEP-2012	20-SEP-2012	✓	19-SEP-2012	27-OCT-2012	✓	
<b>EP075H: Anilines and Benzidines</b>								
Amber Glass Bottle - Unpreserved FR Water, Crosslink Gel	13-SEP-2012	17-SEP-2012	20-SEP-2012	✓	19-SEP-2012	27-OCT-2012	✓	
<b>EP075I: Organochlorine Pesticides</b>								
Amber Glass Bottle - Unpreserved FR Water, Crosslink Gel	13-SEP-2012	17-SEP-2012	20-SEP-2012	✓	19-SEP-2012	27-OCT-2012	✓	





Matrix: **WATER**

Evaluation: \* = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis			
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
<b>EP075J: Organophosphorus Pesticides</b>								
<b>Amber Glass Bottle - Unpreserved</b> FR Water, Crosslink Gel	13-SEP-2012	17-SEP-2012	20-SEP-2012	✓	19-SEP-2012	27-OCT-2012	✓	
<b>EP117: Alcohols</b>								
<b>Amber VOC Vial - Sulfuric Acid</b> FR Water, Crosslink Gel	13-SEP-2012	----	----	----	20-SEP-2012	27-SEP-2012	✓	
<b>RIVM Aliphatic Hydrocarbon Fractions</b>								
<b>Amber Glass Bottle - Unpreserved</b> FR Water, Crosslink Gel	13-SEP-2012	17-SEP-2012	20-SEP-2012	✓	19-SEP-2012	27-OCT-2012	✓	
<b>Amber VOC Vial - Sulfuric Acid</b> FR Water, Crosslink Gel	13-SEP-2012	27-SEP-2012	27-SEP-2012	✓	27-SEP-2012	27-SEP-2012	✓	
<b>RIVM Aromatic Hydrocarbon Fractions</b>								
<b>Amber Glass Bottle - Unpreserved</b> FR Water, Crosslink Gel	13-SEP-2012	17-SEP-2012	20-SEP-2012	✓	19-SEP-2012	27-OCT-2012	✓	
<b>Amber VOC Vial - Sulfuric Acid</b> FR Water, Crosslink Gel	13-SEP-2012	27-SEP-2012	27-SEP-2012	✓	27-SEP-2012	27-SEP-2012	✓	



## Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER** Evaluation: \* = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Regular	Actual	Expected	Evaluation	
<b>Laboratory Duplicates (DUP)</b>							
Alcohols by HS-GC-MS	EP117	2	13	15.4	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Alkalinity by PC Titrator	ED037-P	2	16	12.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Ammonia as N by Discrete analyser	EK055G	1	3	33.3	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	9	22.2	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	2	19	10.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	19	10.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite B	EG020B-F	2	19	10.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	2	12	16.7	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Formaldehyde	EP010	1	1	100.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Free CN by Segmented Flow Analyser	EK025SF	2	17	11.8	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	2	9	22.2	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	11	18.2	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	2	12	16.7	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nonionic Surfactants as CTAS	EP041A	1	2	50.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
pH	EA005	2	19	10.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	3	33.3	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Semivolatile Organic Compounds	EP075	1	3	33.3	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Standard Anions -by IC (Extended Method)	ED009-X	2	17	11.8	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	18	11.1	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Cyanide by Segmented Flow Analyser	EK026SF	2	18	11.1	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	2	14	14.3	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	13	15.4	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	2	20	10.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	2	10	20.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Speciation (TPH CWG RIVM fractions)	EP070-CWG	1	2	50.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	1	4	25.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Organic Compounds	EP074	1	4	25.0	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
<b>Laboratory Control Samples (LCS)</b>							
Alcohols by HS-GC-MS	EP117	1	13	7.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Alkalinity by PC Titrator	ED037-P	1	16	6.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Ammonia as N by Discrete analyser	EK055G	1	3	33.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	9	22.2	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	19	5.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	5.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	19	5.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Formaldehyde	EP010	1	1	100.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Free CN by Segmented Flow Analyser	EK025SF	1	17	5.9	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	1	9	11.1	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement



Matrix: **WATER** Evaluation: \* = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Regular	Actual	Expected	Evaluation	
<b>Analytical Methods</b>							
<b>Laboratory Control Samples (LCS) - Continued</b>							
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	11	9.1	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nonionic Surfactants as CTAS	EP041A	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	3	33.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Semivolatile Organic Compounds	EP075	1	3	33.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Standard Anions -by IC (Extended Method)	ED009-X	1	17	5.9	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	18	5.6	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Cyanide by Segmented Flow Analyser	EK026SF	1	18	5.6	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	1	14	7.1	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	13	7.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	1	10	10.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Speciation (TPH CWG RIVM fractions)	EP070-CWG	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	1	4	25.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Organic Compounds	EP074	1	4	25.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
<b>Method Blanks (MB)</b>							
Alcohols by HS-GC-MS	EP117	1	13	7.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Ammonia as N by Discrete analyser	EK055G	1	3	33.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	9	11.1	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	19	5.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	5.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite B	EG020B-F	1	19	5.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Formaldehyde	EP010	1	1	100.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Free CN by Segmented Flow Analyser	EK025SF	1	17	5.9	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	1	9	11.1	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	11	9.1	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	12	8.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nonionic Surfactants as CTAS	EP041A	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	3	33.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Semivolatile Organic Compounds	EP075	1	3	33.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Standard Anions -by IC (Extended Method)	ED009-X	1	17	5.9	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	18	5.6	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Cyanide by Segmented Flow Analyser	EK026SF	1	18	5.6	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	1	14	7.1	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	13	7.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Organic Carbon	EP005	1	20	5.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	1	10	10.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Speciation (TPH CWG RIVM fractions)	EP070-CWG	1	2	50.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	1	4	25.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Organic Compounds	EP074	1	4	25.0	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
<b>Matrix Spikes (MS)</b>							
Alcohols by HS-GC-MS	EP117	1	13	7.7	5.0	✓	ALS QCS3 requirement



Matrix: **WATER** Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Regular	Actual	Expected	Evaluation	
<b>Analytical Methods</b>							
<b>Matrix Spikes (MS) - Continued</b>							
Ammonia as N by Discrete analyser	EK055G	1	3	33.3	5.0	✔	ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	9	11.1	5.0	✔	ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	19	5.3	5.0	✔	ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	5.3	5.0	✔	ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	1	12	8.3	5.0	✔	ALS QCS3 requirement
Free CN by Segmented Flow Analyser	EK025SF	1	17	5.9	5.0	✔	ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	11	9.1	5.0	✔	ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	12	8.3	5.0	✔	ALS QCS3 requirement
Nonionic Surfactants as CTAS	EP041A	1	2	50.0	5.0	✔	ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	3	33.3	5.0	✔	ALS QCS3 requirement
Semivolatile Organic Compounds	EP075	1	3	33.3	5.0	✔	ALS QCS3 requirement
Standard Anions -by IC (Extended Method)	ED009-X	1	17	5.9	5.0	✔	ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	18	5.6	5.0	✔	ALS QCS3 requirement
Total Cyanide by Segmented Flow Analyser	EK026SF	1	18	5.6	5.0	✔	ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	13	7.7	5.0	✔	ALS QCS3 requirement
Total Organic Carbon	EP005	1	20	5.0	5.0	✔	ALS QCS3 requirement
Total Phosphorus as P By Discrete Analyser	EK067G	1	10	10.0	5.0	✔	ALS QCS3 requirement
TPH Speciation (TPH CWG RIVM fractions)	EP070-CWG	1	2	50.0	5.0	✔	ALS QCS3 requirement
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	1	4	25.0	5.0	✔	ALS QCS3 requirement
Volatile Organic Compounds	EP074	1	4	25.0	5.0	✔	ALS QCS3 requirement



## Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH	EA005	WATER	APHA 21st ed. 4500 H+ B. pH of water samples is determined by ISE either manually or by automated pH meter. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Dissolved Solids (High Level)	EA015H	WATER	In-House, APHA 21st ed., 2540C A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Hardness as CaCO3	EA065	WATER	APHA 21st ed., 2340 B. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Standard Anions -by IC (Extended Method)	* ED009-X	WATER	APHA 21st ed., 4110. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Alkalinity by PC Titrator	ED037-P	WATER	APHA 21st ed., 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Major Anions - Dissolved	ED040F	WATER	APHA 21st ed., 3120. The 0.45um filtered samples are determined by ICP/AES for Sulfur and/or Silcon content and reported as Sulfate and/or Silica after conversion by gravimetric factor.
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	APHA 21st ed., 4500-SO4 Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Chloride by Discrete Analyser	ED045G	WATER	APHA 21st ed., 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	Major Cations is determined based on APHA 21st ed., 3120; USEPA SW 846 - 6010 The ICPAES technique ionises the 0.45um filtered sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)  Sodium Absorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)  Hardness parameters are calculated based on APHA 21st ed., 2340 B. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): Samples are 0.45 um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Metals by ICP-MS - Suite B	EG020B-F	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): Samples are 0.45 um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.



Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Mercury by FIMS	EG035F	WATER	AS 3550, APHA 21st ed. 3112 Hg - B (Flow-injection (SnCl <sub>2</sub> )(Cold Vapour generation) AAS) Samples are 0.45 um filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl <sub>2</sub> which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Silica (Total Dissolved) by ICPAES	EG052F	WATER	APHA 21st ed., 4500-SiO <sub>2</sub> . Silica (Total) determined by calculation from Silicon by ICPAES.
Residual Chlorine by DPD Colourimetry	EK010-1 (Field)	WATER	Adapted from APHA 21st edition, 4500-Cl G, using Palintest Chlorometer 1000
Free CN by Segmented Flow Analyser	EK025SF	WATER	ASTM D7237: Using an automated segmented flow analyser, a sample at high pH (sodium hydroxide preserved) is buffered to pH 6.0. The hydrogen cyanide present passes across a gas dialysis membrane into an acceptor stream consisting of 0.01 M sodium hydroxide. The acceptor stream mixes with a buffer at pH 5.2 and reacts with chloramine-T to form cyanogen chloride. Cyanogen chloride reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour, measured at 600nm. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Cyanide by Segmented Flow Analyser	EK026SF	WATER	APHA 4500-CN-O. Sodium hydroxide preserved samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Fluoride by PC Titrator	EK040P	WATER	APHA 21st ed., 4500 F--C CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Ammonia as N by Discrete analyser	EK055G	WATER	APHA 21st ed., 4500-NH <sub>3</sub> G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrite as N by Discrete Analyser	EK057G	WATER	APHA 21st ed., 4500-NO <sub>2</sub> - B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrate as N by Discrete Analyser	EK058G	WATER	APHA 21st ed., 4500-NO <sub>3</sub> - F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined separately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrite and Nitrate as N (NO <sub>x</sub> ) by Discrete Analyser	EK059G	WATER	APHA 21st ed., 4500-NO <sub>3</sub> - F. Combined oxidised Nitrogen (NO <sub>2</sub> +NO <sub>3</sub> ) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	APHA 21st ed., 4500-Norg D. 25mL water samples are digested using a traditional Kjeldahl digestion followed by determination by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Nitrogen as N (TKN + No <sub>x</sub> ) By Discrete Analyser	EK062G	WATER	APHA 21st ed., 4500-Norg / 4500-NO <sub>3</sub> -. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	APHA 21st ed., 4500-P B&F This procedure involves sulphuric acid digestion of a 100mL sample to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)



Analytical Methods	Method	Matrix	Method Descriptions
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	APHA 21st ed., 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with orthophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	APHA 21st Ed. 1030F. The Ionic Balance is calculated based on the major Anions and Cations. The major anions include Alkalinity, Chloride and Sulfate which determined by PCT and DA. The Cations are determined by Turbi SO4 by DA. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Organic Carbon	EP005	WATER	APHA 21st ed., 5310 B, The automated TOC analyzer determines Total and Inorganic Carbon by IR cell. TOC is calculated as the difference. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Formaldehyde	EP010	WATER	In-house (ASTM D 6303-98) Determined by colourimetry using NASH reagent. The Hantzsch reaction method is based on the reaction of acetylacetone with formaldehyde in the presence of excess ammonium acetate to form a coloured compound.
Nonionic Surfactants as CTAS	EP041A	WATER	APHA 21st ed., 5540 B & D. This method estimates the non-ionic surfactant content of waters. Sublation transfers all surfactants into a solvent matrix. Cationic and Anionic surfactants are removed by an ion exchange resin column. The remaining surfactant is coloured up with Cobalt Thiocyanate solution and quantified by UV-vis against LAS standards. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
TPH Speciation (TPH CWG RIVM fractions)	EP070-CWG	WATER	In-house: Determination of TPH following fractionation by GC-FID. Fractions correspond to those outlined in TPHCWG, 1998, Analysis of Petroleum Hydrocarbons in Environmental Media, TPH Criteria Working Group, Toxicity Technical Action Group, vol I and RIVM report 601501021/2004, Environmental Risk Limits for Mineral Oil (Total Petroleum Hydrocarbons). Aliphatic >C21 - C35 is defined by RIVM only.
Volatile Organic Compounds	EP074	WATER	USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Semivolatile Organic Compounds	EP075	WATER	USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Volatile Hydrocarbon Speciation (TPH CWG fractions)	EP079-CWG	WATER	In-house. Conventional TPH and MAH data are determined by Purge and Trap GCMS analysis. TIC data (as fractions) and target aromatics (or groups of aromatics) are used to compute aliphatic and aromatic hydrocarbon fractions by addition or difference. Fractions conform to those outlined in TPHCWG, 1998, Analysis of Petroleum Hydrocarbons in Environmental Media, TPH Criteria Working Group, Toxicity Technical Action Group, vol I and RIVM report 601501021/2004, Environmental Risk Limits for Mineral Oil (Total Petroleum Hydrocarbons)
Alcohols by HS-GC-MS	* EP117	WATER	In House. A 10 mL aliquot of sample is mixed with 4 g of sodium chloride, equilibrated at 80 degrees C for 10 minutes and the headspace analysed by GCMS in the selected ion monitoring mode.
Anionic Surfactants as MBAS	W-MBAS	WATER	APHA 5540 C. Analysis subcontracted to ALS Scoresby (NATA Accredited Laboratory No. 992).
Preparation Methods	Method	Matrix	Method Descriptions
Separatory Funnel Extraction of Liquids	ORG14	WATER	USEPA SW 846 - 3510B 500 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2). ALS default excludes sediment which may be resident in the container.
Separatory Funnel Extraction of Liquids	ORG14-HX	WATER	Variation of USEPA SW 846 - 3510B: 500 mL to 0.5L of sample is transferred to a separatory funnel and serially extracted three times using 30mL DCM for each extract. The resultant extracts are combined, dehydrated, and exchanged into 5 mL of hexane for analysis. ALS default excludes sediment which may be resident in the container.



## Summary of Outliers

### Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

#### Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
<b>Duplicate (DUP) RPDs</b>							
EP079/070: TPH CWG Aliphatic Hydrocarbon Fractions	EM1210744-001	FR Water	<b>Aliphatic &gt;C10-C12</b>	TPHCWG-ALE1	44.6 %	0-20%	<b>RPD exceeds LOR based limits</b>
<b>Laboratory Control Spike (LCS) Recoveries</b>							
EP075A: Phenolic Compounds	2965492-022	----	<b>Pentachlorophenol</b>	87-86-5	24.5 %	47-153%	<b>Recovery less than lower control limit</b>
EP075E: Nitroaromatics and Ketones	2965492-022	----	<b>2-Picoline</b>	109-06-8	10.2 %	28.4-57%	<b>Recovery less than lower control limit</b>
EP075H: Anilines and Benzidines	2965492-022	----	<b>3,3'-Dichlorobenzidine</b>	91-94-1	124 %	14.6-107%	<b>Recovery greater than upper control limit</b>
<b>Matrix Spike (MS) Recoveries</b>							
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	EM1210737-006	Anonymous	<b>Sulfate as SO4 - Turbidimetric</b>	14808-79-8	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
ED045G: Chloride Discrete analyser	EM1210737-006	Anonymous	<b>Chloride</b>	16887-00-6	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
EG020F: Dissolved Metals by ICP-MS	EM1210728-001	Anonymous	<b>Manganese</b>	7439-96-5	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
EG020F: Dissolved Metals by ICP-MS	EM1210728-001	Anonymous	<b>Zinc</b>	7440-66-6	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
EG035F: Dissolved Mercury by FIMS	EM1210728-002	Anonymous	<b>Mercury</b>	7439-97-6	58.9 %	70-130%	<b>Recovery less than lower data quality objective</b>
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Ar	EM1210719-001	Anonymous	<b>Nitrite + Nitrate as N</b>	----	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser	EM1210719-001	Anonymous	<b>Total Kjeldahl Nitrogen as N</b>	----	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
EK067G: Total Phosphorus as P by Discrete Analyser	EM1210719-001	Anonymous	<b>Total Phosphorus as P</b>	----	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
EP005: Total Organic Carbon (TOC)	EM1210744-002	Crosslink Gel	<b>Total Organic Carbon</b>	----	Not Determined	----	<b>MS recovery not determined, background level greater than or equal to 4x spike level.</b>
EP075A: Phenolic Compounds	EM1210744-002	Crosslink Gel	<b>Phenol</b>	108-95-2	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>
EP075A: Phenolic Compounds	EM1210744-002	Crosslink Gel	<b>2-Chlorophenol</b>	95-57-8	Not Determined	----	<b>Matrix spike recovery not determined due to sample matrix interference.</b>





Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
<b>Matrix Spike (MS) Recoveries - Continued</b>							
EP075A: Phenolic Compounds	EM1210744-002	Crosslink Gel	<b>2-Nitrophenol</b>	88-75-5	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.
EP075A: Phenolic Compounds	EM1210744-002	Crosslink Gel	<b>4-Chloro-3-Methylphenol</b>	59-50-7	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.
EP075A: Phenolic Compounds	EM1210744-002	Crosslink Gel	<b>Pentachlorophenol</b>	87-86-5	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.
EP075B: Polynuclear Aromatic Hydrocarbons	EM1210744-002	Crosslink Gel	<b>Acenaphthene</b>	83-32-9	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.
EP075B: Polynuclear Aromatic Hydrocarbons	EM1210744-002	Crosslink Gel	<b>Pyrene</b>	129-00-0	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.
EP075D: Nitrosamines	EM1210744-002	Crosslink Gel	<b>N-Nitrosodi-n-propylamine</b>	621-64-7	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.
EP075E: Nitroaromatics and Ketones	EM1210744-002	Crosslink Gel	<b>2,4-Dinitrotoluene</b>	121-14-2	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.
EP075G: Chlorinated Hydrocarbons	EM1210744-002	Crosslink Gel	<b>1,4-Dichlorobenzene</b>	106-46-7	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.
EP075G: Chlorinated Hydrocarbons	EM1210744-002	Crosslink Gel	<b>1,2,4-Trichlorobenzene</b>	120-82-1	Not Determined	----	Matrix spike recovery not determined due to sample matrix interference.

- For all matrices, no Method Blank value outliers occur.

**Regular Sample Surrogates**

Sub-Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
<b>Samples Submitted</b>							
EP075S: Acid Extractable Surrogates	EM1210744-002	Crosslink Gel	<b>2-Fluorophenol</b>	367-12-4	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1210744-001	FR Water	<b>2-Fluorophenol</b>	367-12-4	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1210744-002	Crosslink Gel	<b>Phenol-d6</b>	13127-88-3	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1210744-001	FR Water	<b>Phenol-d6</b>	13127-88-3	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1210744-002	Crosslink Gel	<b>2-Chlorophenol-D4</b>	93951-73-6	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1210744-001	FR Water	<b>2-Chlorophenol-D4</b>	93951-73-6	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1210744-002	Crosslink Gel	<b>2,4,6-Tribromophenol</b>	118-79-6	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences
EP075S: Acid Extractable Surrogates	EM1210744-001	FR Water	<b>2,4,6-Tribromophenol</b>	118-79-6	Not Determined	----	Surrogate recovery not determined due to (target or non-target) matrix interferences

**Outliers : Analysis Holding Time Compliance**

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.



Matrix: **WATER**

Method Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
<b>EA005: pH</b>						
Clear Plastic Bottle - Natural FR Water	----	----	----	19-SEP-2012	13-SEP-2012	6
<b>EK010-1: Chlorine (Field Test)</b>						
Clear Plastic Bottle - Natural FR Water	----	----	----	14-SEP-2012	13-SEP-2012	1

### Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- No Quality Control Sample Frequency Outliers exist.



**Ranil Weerakkody**

---

**From:** on behalf of Samples Melbourne  
**To:** Sarah Hodgson  
**Subject:** EM1210744  
**Attachments:** img-914132707-0001.pdf

Hi Sarah,

For this work order we received unspecified red metal bottles for sample 1 and 2 . please clarify.  
Cheers,  
RU

-----Original Message-----

**From:** DocuCentre-IV C2260 [mailto:ALSEMLP011@a1s.com.au]  
**Sent:** Friday, 14 September 2012 1:27 PM  
**To:** Samples Melbourne  
**Subject:** Scan Data from FX-A0CD7E

**Number of Images:** 1  
**Attachment File Type:** PDF  
**Device Name:** DocuCentre-IV C2260  
**Device Location:**



CHAIN OF CUSTODY

ALS Laboratory: please tick ->

127 Westbank Dr, Adelaide SA 5000
Ph: 08 833 8338 Fax: 08 833 8339
Email: sales@als.com.au

127 Westbank Dr, Adelaide SA 5000
Ph: 08 833 8338 Fax: 08 833 8339
Email: sales@als.com.au

127 Westbank Dr, Adelaide SA 5000
Ph: 08 833 8338 Fax: 08 833 8339
Email: sales@als.com.au

127 Westbank Dr, Adelaide SA 5000
Ph: 08 833 8338 Fax: 08 833 8339
Email: sales@als.com.au

CLIENT: SANTOS
OFFICE: Eastern Australia D&C, 60 Flinders Street, Adelaide SA
PROJECT: HFRA Fluids Sampling - Extended Analysis
TURNAROUND REQUIREMENTS: Non Standard or urgent TAT (List due date): 19/09/2012
COC SEQUENCE NUMBER (Circle): 2 3 4 5 6 7
RECEIVED BY: [Signature]

Table with columns: LAB ID, SAMPLE ID, DATE / TIME, MATRIX, CONTAINER INFORMATION, ANALYSIS REQUIRED including SUITES (NS Suite Codes must be listed to attract suite price), Additional Information. Includes handwritten notes like 'FR Water', 'Crosslink Gel', and 'Samples sent to lab for Micro Nitrate BOD pH Colour Turbidity (RP)'.

COPIED

Environmental Division
Melbourne
Work Order
EM1210744
Barcode
Telephone: +61-3-8549 9600

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

**Ranil Weerakkody**

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**To:** Samples Melbourne  
**Subject:** Scan Data from FX-A0CD7E

**Number of Images:** 1  
**Attachment File Type:** PDF  
**Device Name:** DocuCentre-IV C2260  
**Device Location:**

**Raymond Thai**

---

**From:** Sarah Hodgson  
**Sent:** Friday, 14 September 2012 4:02 PM  
**To:** Samples Melbourne  
**Subject:** RE: EM1210744

Hi Ray,

I don't think the metals bottle would be filtered -- can you please ask the lab to filter from the green?

Thank you,

Regards,  
How was your customer experience? Please send us your feedback

Sarah Hodgson

PROJECT MANAGER

ALS | Environmental  
Address  
4 Westall Road  
Springvale VIC 3171  
PHONE +61 3 8549 9600  
FAX +61 3 8549 9601  
[www.alsglobal.com](http://www.alsglobal.com)  
[cid:615291706@5102011-231E](mailto:cid:615291706@5102011-231E)

-----Original Message-----  
**From:** Samples Melbourne  
**Sent:** Friday, 14 September 2012 4:01 PM  
**To:** Sarah Hodgson  
**Subject:** RE: EM1210744

Hi Sarah,

I believe there was green bottles also received for both these samples.

Thanks, Ray

-----Original Message-----  
**From:** Sarah Hodgson  
**Sent:** Friday, 14 September 2012 1:52 PM  
**To:** Samples Melbourne  
**Subject:** RE: EM1210744

Hi Ru,

Did you get any other metals bottles for these 2 samples?

Regards,  
How was your customer experience? Please send us your feedback

Sarah Hodgson

PROJECT MANAGER

ALS | Environmental

Address

4 Westall Road

Springvale VIC 3171

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FAX +61 3 8549 9601

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[cid:615291706@05102011-231E](mailto:cid:615291706@05102011-231E)

-----Original Message-----

From: Samples Melbourne

Sent: Friday, 14 September 2012 1:36 PM

To: Sarah Hodgson

Subject: EM1210744

Hi Sarah,

For this work order we received unspecified red metal bottles for sample 1 and 2 . please clarify.

Cheers,

RU

-----Original Message-----

From: DocuCentre-IV C2260 [mailto:ALSEMLP011@als.com.au]

Sent: Friday, 14 September 2012 1:27 PM

To: Samples Melbourne

Subject: Scan Data from FX-A0CD7E

Number of Images: 1

Attachment File Type: PDF

Device Name: DocuCentre-IV C2260

Device Location:





**[golder.com](http://golder.com)**