Modification Notice - Regulation 22

Interest Holder	Santos QNT Pty Ltd	EMP Title	EP161 Beetaloo Basin Appraisal Pilot	Unique EMP ID No.	STO8-2	Change/ Mod No.	2	Date	04/09/2026
Brief Description	This modification updates the EMP and Chemical Risk Assessment (Appendix D) to incorporate additional chemicals identified. The change affects only the composition of chemicals that may be used during drilling phase; existing controls to manage loss of containment remain in place and the revised assessment confirms that risks continue to be managed to ALARP and acceptable levels.								
Geospatial Files Included?	No								

Does the proposed change result in a new, or increased, potential or actual environmental impact or risk?	If an INCREASE in an existing potential or actual environmental impact or risk, is it provided for in the approved EMP?	Does the proposed change require additional mitigation measures to be included?	Has additional stakeholder engagement been conducted?	Does it require additional environmental performance standards and measurement criteria?	Does it affect compliance with Sacred Site Authority Certificates?	Does it affect current rehabilitation, weed, fire, wastewater, erosion and sediment control, spill or emergency response plans?	Will the environmental outcome continue to be achieved and will the impacts and risks be managed to ALARP and acceptable?
No	N/A	No	No	No	No	No. The only document affected is Appendix D (Chemical Risk Assessment).	Yes

Current EMP Text	Amended EMP Text
	There are no changes to the EMP text. The modification is an update to Chemical Risk Assessment (Appendix D), capturing additional chemicals that may be used during the drilling phase.

MEMO

To: [redacted]

From: [redacted]

CC: [redacted]

Date: September 3, 2026

Re: EP 161 – McArthur Appraisal Drilling and Cementing Fluid Modifications for Halad 344L - Chemical Risk Assessment

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Introduction

Santos Ltd. ("Santos") is conducting an exploration and appraisal program within Exploration Permit (EP) 161, which is located in the Beetaloo Sub-basin of the broader McArthur Basin. The McArthur Basin is located southeast of Katherine, Northern Territory, and covers approximately 180,000 square kilometres. An overview of the project location is provided in **Figure 1**.

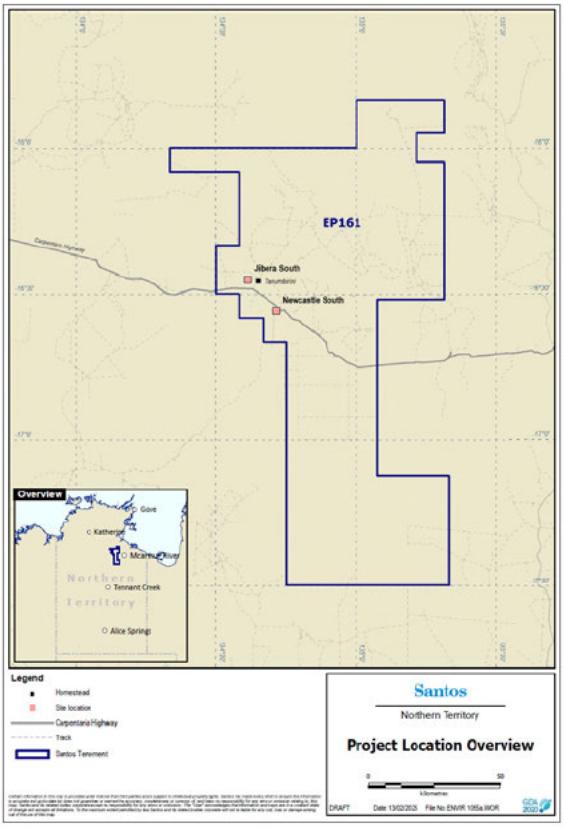

FIGURE 1 LOCATION OF NEW REGULATED ACTIVITIES

Since becoming the Operator of EP 161 in December 2012, Santos has:

- Acquired and processed 700 kilometres (km) of 2D seismic within EP 161 (including 193km during its recent 2024 campaign); and,
- Completed drilling the following wells: Tanumbirini 1 (2014), Marmbulligan 1 (2016), Tanumbirini 1, Tanumbirini 2HST1 and Tanumbirini 3HST1 (2019-2022).

Santos previously prepared an Environment Management Plan (EMP) for McArthur Basin 2019 – 2020 Hydraulic Fracturing Program in the Northern Territory EP 161. The EMP proposed Hydraulic Fracture Stimulation (HFS) to be conducted through 2019-2020 at the Tanumbirini 1, Tanumbirini 2H and Inacumba 1/1H well locations. Pursuant to the approval conditions of the EMP, a risk assessment of the hydraulic fracturing wastewater at the well locations is required.

As part of the EMP, a tiered chemical risk assessment (CRA) was completed in July 2019 for the flowback/produced water after hydraulic fracturing. This CRA evaluated the chemistry of the hydraulic fracturing fluid systems, estimated the probable concentration of these chemicals in flowback and completed a quantitative evaluation of risks. No unacceptable risks to human health and the environment were demonstrated (EHS Support, 2019).

A drilling fluid CRA was also completed in August 2021 to assess the use of an additional (contingency) chemical in the drilling fluid system. The additional chemical did not introduce a new environmental impact or environmental risk not provided for in the current plan for the activity (EHS Support, 2021).

Updates to the prior assessments were prepared by EHS Support in November 2025 (EHS Support, 2025a and 2025b) to evaluate proposed hydraulic fracturing fluids and tracer chemicals in future stimulation activities outlined in the EP 161 McArthur Appraisals EMP (Santos, 2025). The hydraulic fracturing fluid systems assessed in the CRA included chemicals proposed by Santos as part of their Coil Tubing Hydraulic Fracturing System (Coil Chemicals) and Standard Hydraulic Fracturing System (Hydraulic Fracturing Chemicals). In addition, the assessment also evaluated 11 new drilling fluid chemicals proposed for use in the installation of two new wells: one located at Jibera South and one at Newcastle South.

An additional drilling fluid CRA was completed in April 2026 to evaluate two additional new drilling fluid chemicals for the MMO mud system (EHS Support, 2026a) and in August 2026 to evaluate an additional 124 chemicals associated with modifications to the Baker Hughes and Halliburton drilling and cementing fluids for new well installations (EHS Support, 2026b).

This technical memorandum assesses three new chemicals associated with Halliburton product HALAD 344L:

- Alcohols, C9-11-iso, C10-rich (CAS RN 68526-85-2)
- Propylene glycol (CAS RN 57-55-6)
- Glycerides, C14-18 mono- and di-, ethoxylated (CAS RN 68153-76-4)

Other chemicals identified in the product have been previously assessed.

This assessment uses a screening of potential human health and ecological hazards that should be considered for potential exposure to the drilling fluids and cuttings during transportation, drilling operations, and recycling and disposal of drilling mud and cuttings. This CRA is supported by a broader assessment of environmental conditions and risks and recommended avoidance, mitigation and management strategies which are outlined in the EMP for McArthur Basin (Santos, 2025). The

current EMP includes regulated activities that were authorised by existing EMPs. This is to allow Santos to operate under a single, contemporary EMP and cease to operate under the existing EMPs.

Purpose and Approach

The purpose of this assessment was to determine if the additional chemicals introduce a new environmental impact or environmental risk not provided for in the current plan for the activity; or, an increase, not provided for in the current plan for the activity, in an existing environmental impact or environmental risk.

The assessment included the following components:

- Human health and environmental hazard assessment consistent with National Industrial Chemicals Notification and Assessment Scheme (NICNAS) assessment reports published as a result of the National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia - https://www.dcceew.gov.au/water/coal-and-coal-seam-gas/national-assessment-chemicals/assessment-reports (CSG Guidance);
- Predicted No Effect Concentrations (PNECs) for water and soil derived to assess aquatic and terrestrial receptors, respectively
- Persistent, Bioaccumulative and Toxic (PBT) assessment

Findings

Table 1 presents the information compiled for the chemicals and the assessment results. Additional information is provided in the risk assessment dossiers (**Attachment A**) and the Safety Data Sheet (SDS) (**Attachment B**).

The information for the new chemicals were then compared to the environmental fate properties (such as persistence, bioavailability and bioaccumulation), ecotoxicity and human health toxicity/hazards for the chemicals in the existing drilling fluid system. The existing drilling fluid system (refer **Table 2**) contains both low and high toxicity chemicals.

Based on this assessment, the additional new drilling chemicals exhibits similar or lesser PBT to the chemicals in the existing drilling fluid and cementing systems. As such the additional chemicals do not introduce a new environmental impact or environmental risk not provided for in the current plan for the activity.

References

EHS Support. (2015). Santos GLNG Upstream Hydraulic Fracturing Risk Assessment Compendium of Assessed Fluid Systems. Revision 1. 23 November 2015.

EHS Support. (2019). Beetaloo McArthur Basin Hydraulic Fracturing Fluid System – Chemical Risk Assessment.

EHS Support. (2021). McArthur Basin New Drilling Fluid Chemical Risk Assessment. August 12, 2021.

EHS Support. (2025a). EP 161 – Beetaloo Basin Appraisal Pilot Hydraulic Fracturing Fluid System, Drilling Fluid and Cementing Chemicals - Chemical Risk Assessment. November 3, 2025.

EHS Support. (2025b). EP 161- McArthur Appraisal Tracer Chemicals – Chemical Risk Assessment. November 2, 2025.

EHS Support. (2026a). EP 161 - McArthur Appraisal MMO Mud System – Chemical Risk Assessment. April 8, 2026.

EHS Support. (2026b). EP 161 – McArthur Appraisal Drilling and Cementing Fluid Modifications - Chemical Risk Assessment. August 18, 2026.

Santos QNT Pty Ltd (Santos). (2019). Environment Management Plan: McArthur Basin 2019 Drilling Program NT Exploration Permit (EP) 161.

Santos. (2025). EP 161 McArthur Appraisal EMP.

Tables

Table 1
Evaluation of Proposed Drilling Fluid Chemicals - HALAD 344L
Beetaloo McArthur Basin, Northern Territory Chemical Risk Assessment

Chemical Name	CAS Number	Ecotoxicity[1]	Toxicity[1]	Biodegradation[1]	Bioaccummulative[1]	Discussion
Alcohols, C9-11-iso, C10-rich	68526-85-2	**Aquatic Toxicity** Acute Aquatic - Fish -96-hr LC50 *Oncorhynchus mykiss* - 3.1 mg/L Acute Aquatic - Invertebrate -48-hr EL50 Daphnia Magna - 6.2 mg/L Acute Aquatic - Algae and other plants -96-hr EC50 *green algae* - 3.12 mg/L (QSAR) Chronic Aquatic Experimental studies were not available for fish, invertebrates or algae. QSAR estimations using ECOSAR resulted in the following: -30-day chronic value (ChV) to fish of 0.374 mg/L, equivalent to a NOEC of 0.264mg/L -16-day ChV to daphnids of 0.326 mg/L, equivalent to a NOEC of 0.231mg/L -96-hr ChV to green algae of 1.18 mg/L, equivalent to a NOEC of 0.84 mg/L. **Terrestrial Toxicity** -Low toxicity concern. **$PNEC_{water}$** - 0.00231 mg/L (chronic invertebrate) **$PNEC_{soil}$** -0.013 mg/kg dw (equilibrium partitioning)	Qualitative Assessment: Human Health Hazard - Low concern. It is not a skin sensitiser or irritating to the eye. Low acute toxicity. Some systemic toxicity to the kidney at high doses. Ecological Hazard - Low Concern PBT Assessment: Does not meet the screening criteria for toxicity.	Environmental Hazard Assessment: Readily biodegradable PBT Assessment: Does not meet the screening criteria for persistence.	Environmental Fate Properties: Experimental BCF is 21.4 L/Kg. PBT Assessment: Does not meet the screening criteria for bioaccumulation.	**PBT Assessment:** The overall conclusion is that alcohols, C9-11-iso, C10-rich is not a PBT substance. Qualitative Assessment indicated some systemic toxicity at high doses. It is a low concern to the environment. **Management:** Safe Work Australia and Santos Occupational Health & Safety procedures will be used to minimise human health exposure.
Propylene glycol	57-55-6	**Aquatic Toxicity** Acute Aquatic - Fish -96-hr LC_{50} *Oncorhynchus mykiss* - 40,613 mg/L Acute Aquatic - Invertebrate -48-hr EC_{50} *Ceriodaphnia dubia - 18,340 mg/L* Acute Aquatic - Algae and other plants -72-hr EC_{50} *Raphidocelis subcapitata* - 19,000 mg/L Chronic Aquatic -30-day NOEC fish - 1,768 mg/L (QSAR) -7-day NOEC *Ceriodaphnia dubia* - 13,020 mg/L -14-day NOEC Raphidocelis subcapitata - 15,000 mg/L **Terrestrial Toxicity** -No studies available. Low concern. **$PNEC_{water}$** - not derived **$PNEC_{soil}$** -not derived	Qualitative Assessment: Human Health Hazard - Low concern. Not irritating to the skin and eyes. It is not a skin sensitiser. Low acute toxicity. It has low repeat dose toxicity. Ecological Hazard - Low Concern PBT Assessment: Does not meet the screening criteria for toxicity.	Environmental Fate Properties: Readily biodegradable PBT Assessment: Does not meet the criteria for persistence.	Environmental Fate Properties: Log Kow is -1.07 PBT Assessment: Does not meet the screening criteria for bioaccumulation.	**NICNAS:** Poses no unreasonable risk to the environment based on Tier I assessment under the NICNAS IMAP assessment framework. **PBT Assessment:** The overall conclusion is that propylene glycol is not a PBT substance. Qualitative Assessment indicated a low concern to human health and the environment. **Management:** No additional management required, Tier 1 screening satisfied.
Glycerides, C14-18 mono- and di-, ethoxylated	68153-76-4	**Aquatic Toxicity** Acute Aquatic - Fish -96-hr LC_{50} *Danio rerio - >10,000 mg/L* Acute Aquatic - Invertebrate -48-hr EC_{50} Daphnia magna (Water Flea) - >100 mg/L Acute Aquatic - Algae and other plants -72-hr EC_{50} *Desmodesmus subspicatus* - >100 mg/L *Based on read-across of fatty glyceride group members, studies showed no effect up to the limit of water solubility Chronic Aquatic -No effects were seen in group members up to the limit of water solubility. **Terrestrial Toxicity** -No studies available. Low toxicity concern. Fatty acid glycerides are rapidly biodegradable in both aquatic and terrestrial environments, making environmental persistence unlikely. **$PNEC_{water}$** -not derived **$PNEC_{soil}$** -not derived	Qualitative Assessment: Human Health Hazard - Low concern. Not irritating to the skin or eye. It is not a skin sensitiser. Non-toxic via acute routes. Low systemic toxicity. Ecological Hazard - Low Concern PBT Assessment: Does not meet the screening criteria for toxicity.	Environmental Fate Properties: Readily biodegradable PBT Assessment: Does not meet the screening criteria for persistence.	Environmental Fate Properties: Fatty acid glycerides have a low potential for bioaccumulation due to their physico-chemical properties and metabolic fate. PBT Assessment: Does not meet the screening criteria for bioaccumulation.	**PBT Assessment:** The overall conclusion is that glycerides, C14-18 mono- and di-, ethoxylated is not a PBT substance. Qualitative Assessment indicated it is a low concern to human health and the environment. **Management:** No additional management required, Tier 1 screening satisfied.

Table Notes:
BCF = bioconcentration factor
EC_{50} = effects concentration of half the maximal response
Kow = n-octanol-water partition coefficient
LC_{50} = lethal concentration of 50 percent of population
L/kg = litres per kilogram
mg/kg = milligram per kilogram
N/A = not applicable
NICNAS = National Industrial Chemicals Notification and Assessment Scheme
PBT = persistent, bioaccumulative, toxic
PNEC = predicted no effect concentration
1/ Refer to dossier for additional information

Table 2
Existing Drilling Fluid and Cementing Chemicals
Beetaloo McArthur Basin, Northern Territory Chemical Risk Assessment

Chemical	CAS No.
1,2-Benzisothiazolin-3-one	2634-33-5
1,2-Diaminocyclohexane	694-83-7
1,2-Ethanediamine, N-(2-aminoethyl)-	111-40-0
1-Methoxy-2-propanol	107-98-2
1-Propanesulfonic acid, 2-methyl-2-((1-oxo-2-propenyl)amino)-, monosodium salt, polymer with 2-propenamide	38193-60-1
2,4,6 Tridimethylaminomethyl phenol	90-72-2
2-Bromo-2-(bromomethyl)pentanedinitrile	35691-65-7
2-methoxy-1-propanol	1589-47-5
2-Methyl-4-isothiazolin-3-one	2682-20-4
2-methylbut-3-yn-2-ol	115-19-5
2-methylpropan-2-ol	75-65-0
2-Naphthalenesulfonic acid, polymer with formaldehyde, sodium salt	36290-04-7
2-Propenenitrile, polymer with 1,3-butadiene	9003-18-3
2-Propenoic acid, polymer with 1,3-butadiene and ethenylbenzene	25085-39-6
2-Propenoic acid, sodium salt (1:1)	107097-75-6
3, 3'-Methylene bis (5-methyl oxazolidine)	66204-44-2
3,6-diazaoctanethylenediamin	112-24-3
4-Vinylcyclohexene	100-40-3
5-Chloro-2-methyl-3(2H)-isothiazolone mixture with 2-methyl-3(2H)-isothiazolone	55965-84-9
9-Octadecenamide, n,n-bis-2(hydroxy-ethyl)-,(Z)	93-83-4
9-Octadecenoic acid (9Z)-, monoester with 1,2,3-propanetriol	25496-72-4
Acrylamide	79-06-1
Acrylamide, sodium acrylate polymer	25085-02-3
Acrylic acid polymer with sodium AMPS, sodium salt	37350-42-8
Alcohol ethoxy sulfate, sodium salt	68585-34-2
Alcohols, C16-18, ethoxylated propoxylated	68002-96-0
Alcohols, C6-10, ethoxylated	70879-83-3
Aliphatic alcohol ethoxylate	9004-77-7
Alkenes, C15-C18	93762-80-2
Alkyl phenoxy ether sulfate, sodium salt	9014-90-8
Aluminium stearate	637-12-7
Aluminum	7429-90-5
Aluminum oxide	1344-28-1
Ammonium chloride	12125-02-9
ammonium hydrogensulphite	10192-30-0
Ammonium hydroxide	1336-21-6
Ammonium sulfate	7783-20-2
Amylodextrin	9005-84-9
ascorbic acid	50-81-7
Barium Sulfate	7727-43-7
Bentonite	1302-78-9
Benzene, 1,1'-oxybis-, tetratpropylene derivs., sulfonated, sodium salts	119345-04-9
Benzenemethanol	100-51-6
Benzenesulfonic acid, dimethyl-, sodium salt	1300-72-7
Bisphenol A / Epichlorohydrin resin	25068-38-6
Boric acid	10043-35-3
Butadiene	106-99-0
Butanedioic acid, 2-sulfo-, 1,4-bis(1,3-dimethylbutyl) ester, sodium salt (1:1)	2373-38-8
Butanedioic acid, 2-sulfo-, 1,4-bis(2-methylpropyl) ester, sodium salt (1:1)	127-39-9
Butanedioic acid, sulfo-, 1,4-bis-(2-ethylhexyl) ester, sodium salt	577-11-7
Butyl glycidyl ether	2426-08-6
Butylated hydroxytoluene	128-37-0
C.I. Basic Violet 10 (Rhodamine B or D&C Red No 19)	81-88-9
Calcined Petroleum coke	64743-05-1

Table 2
Existing Drilling Fluid and Cementing Chemicals
Beetaloo McArthur Basin, Northern Territory Chemical Risk Assessment

Chemical	CAS No.
Calcium aluminate	12042-68-1
Calcium aluminate cement	65997-16-2
Calcium carbonate	471-34-1
Calcium chloride	10043-52-4
Calcium Chloride, dihydrate	10035-04-8
Calcium hydroxide	1305-62-0
Calcium lignosulfonate	8061-52-7
Calcium oxide	1305-78-8
Calcium sulfate	7778-18-9
Calcium sulfate dihydrate	10101-41-4
Calcium sulfate hemihydrate	10034-76-1
Carbon	7440-44-0
Carbon black	1333-86-4
Cellophane	9005-81-6
Cellulose	9004-34-6
Choline chloride	67-48-1
Citric Acid	77-92-9
Crystalline silica, cristobalite	14464-46-1
Crystalline silica, quartz	14808-60-7
Crystalline silica, tridymite	15468-32-3
Cyclohexanedimethanol diglydicyl ether	14228-73-0
d-Glucopyranoside, C9-C11 alkyl oligomeric	132778-08-6
Diatomaceous earth	61790-53-2
Diethylene glycol monoethyl ether	111-90-0
Diethyltoluenediamine	68479-98-1
Dilutan Gum	125005-87-0
Dimethyl polysiloxane	63148-62-9
Dimethylaminopropylamine	109-55-7
Dipropylene glycol	25265-71-8
Epichlorohydrin	106-89-8
Ethanol, 2,2'-oxybis-, reaction products with ammonia, morpholine derivatives residues	68909-77-3
Ethanol, 2-amino-, compounds with polyethylene glycol hydrogen sulfate C6-10-alkyl ether	70914-35-1
Ethoxylated branched C11-14, C13-rich alcohols	78330-21-9
Ethylenediaminetetraacetic acid, tetrasodium salt	64-02-8
Fatty acids, C14-18 and C16-18-unsatd.	67701-06-8
Fatty acids, C8-18 and C18-unsatd., esters with pentaerythritol	85049-33-8
FD&C Blue 1	3844-45-9
Ferrous Sulfate	17375-41-6
Fly ash	68131-74-8
Functionalized Styrene Butadiene Latex	403824-26-0
Glutaraldehyde	111-30-8
Glycine, n,n-{bis{2-bis(carboxymethyl)amino}ethyl}-, pentasodium salt	140-01-2
Glyoxal	107-22-2
Granulated Blast Furnace Slag	65996-69-2
Gypsum	13397-24-5
Heterocyclic polymer containing nitrogen compounds	9003-39-8
Hexamethylenediamine	124-09-4
Hexylene glycol	107-41-5
Humic acids, potassium salts, polymers with acrylamide, 2-methyl-2-[(1-oxo-2-propenyl)amino]-1-propanesulfonic acid, 4-(1-oxo-2-propenyl) morpholine and sodium 4- ethenylbenzenesulfonate, sodium salts	227951-37-3
Humic acids, sodium salts, polymers with N,N-dimethyl-2-propenamide, sodium 2-methyl-2-[(1-oxo-2-propen-1-yl)amino]-1-propanesulfonate (1:1) and 2-propenenitrile, sodium bisulfite-terminated	473268-27-8
Hydrotreated light petroleum distillate	64742-47-8
Hydroxyethyl cellulose	9004-62-0
Iron oxide	1309-37-1

Table 2
Existing Drilling Fluid and Cementing Chemicals
Beetaloo McArthur Basin, Northern Territory Chemical Risk Assessment

Chemical	CAS No.
Isopropanol	67-63-0
Kaolin	1332-58-7
Lecithins	8002-43-5
Limestone	1317-65-3
Magnesium chloride hexahydrate	7791-18-6
Magnesium oxide	1309-48-4
Metaphosphoric acid hexasodium salt	10124-56-8
Methanol	67-56-1
Methyloxirane polymer with oxirane, monbutyl ether	9038-95-3
Mica-group minerals	12001-26-2
Monoethanolamine	141-43-5
Monopropylene glycol monooleate	1330-80-9
N,N-dimethylacrylamide copolymer with calcium AMPS	103115-52-2
Natural graphite	7782-42-5
Nitrilotriacetic acid, trisodium salt monohydrate	5064-31-3
Paraffin based petroleum oil	8012-95-1
Paraffins, petroleum, normal C5-20	64771-72-8
Poly(oxy-1,2-ethandiyl), a-(nonylphenyl)-w-hydroxy-	9016-45-9
Poly(oxy-1,2-ethanediyl), alpha-sulfo-omega-(dodecyloxy)-, ammonium salt	32612-48-9
Poly(oxy-1,2-ethanediyl), alpha-sulfo-omega-(tetradecyloxy)-, ammonium salt	27731-61-9
Poly(vinyl acetate)-poly(vinyl alcohol) polymer	25213-24-5
Poly[oxy(methyl-1,2-ethanediyl)], α-(2-aminomethylethyl)-ω-(2-aminomethylethoxy)-	9046-10-0
Polyethylene	9002-88-4
Polyethylene glycol (C6-C10) alkyl ether, sulfate ammonium salt	68037-05-8
Polyethylene terephthalate	25038-59-9
Polyoxyethylene sorbitan trioleate	9005-70-3
Polyproplylene and polyethylene oxide copolymer	9003-11-6
Polypropylene	9003-07-0
Polypropylene glycol	25322-69-4
Polypropylene glycol monododecyl ether	9002-92-0
Polyvinyl alcohol	9002-89-5
Portland cement	65997-15-1
Potassium chloride	7447-40-7
Potassium hydroxide	1310-58-3
Potassium pyrophosphate	7320-34-5
Propanesulfonic acid, 2-methyl-2-[(1-oxo-2-propenyl)amino]-, monosodium salt, polymer with N,N-dimethyl-2-propenamide	92815-96-8
Pumice	1332-09-8
Quaternary ammonium compounds, bis(hydrogenated tallow alkyl) dimethyl,salts with bentonite	68953-58-2
Quaternary ammonium compounds, bis(hydrogenated tallow alkyl)dimethyl, salts with attapulgite	68953-57-1
Quaternary ammonium compounds, di-C16-18-alkyldimethyl, chlorides	92129-33-4
Rape Oil	8002-13-9
Sepiolite	63800-37-3
Silane, dichlorodimethyl-, reaction products with silica	68611-44-9
Silica, amorphous - fumed	7631-86-9
Silica, amorphous precipitated	67762-90-7
Silicic acid, lithium magnesium sodium salt	53320-86-8
Silicic acid, potassium salt	1312-76-1
Soda Lime Borosilicate Glass	65997-17-3
Sodium acid pyrophosphate	7758-16-9
Sodium aluminate	1302-42-7
Sodium Carbonate	497-19-8
Sodium carboxymethyl cellulose	9004-32-4
Sodium Chloride	7647-14-5

Table 2
Existing Drilling Fluid and Cementing Chemicals
Beetaloo McArthur Basin, Northern Territory Chemical Risk Assessment

Chemical	CAS No.
Sodium dicyclohexyl sulfosuccinate	23386-52-9
Sodium erythorbate	6381-77-7
Sodium fluoroescein	518-47-8
Sodium Formate	141-53-7
Sodium gluconate	527-07-1
Sodium Hydroxide	1310-73-2
Sodium lauryl ether sulfate	9004-82-4
Sodium Lignosulfonate	8061-51-6
Sodium nitrate	7631-99-4
Sodium polyphosphate	68915-31-1
Sodium salt of sulfonated naphthaleneformaldehyde condensate	9084-06-4
Sodium silicate	1344-09-8
Sodium sulfate	7757-82-6
Sorbitan, monopalmitate	26266-57-9
Sorbitan, tri,(9Z)-9-octadecenoate	26266-58-0
Starch	9005-25-8
Starch, carboxymethyl ether	9057-06-1
Starch, carboxymethyl ether, sodium salt	9063-38-1
Strontium chloride	10476-85-4
Styrene	100-42-5
Styrene / 1,3 Butadiene copolymer	9003-55-8
Sulfomethylated Quebracho	68201-64-9
Sulfonated organic polymer	526203-62-3
Sulfurous acid, monosodium salt, polymer with formaldehyde and acetone	40104-76-5
Tartaric acid	87-69-4
Tetrahydro-3,5-dimethyl-1,3,5-thiadiazine-2-thione	533-74-4
Tetrakis(hydroxymethyl)phosphonium sulfate (THPS)	55566-30-8
Triazine	290-87-9
Triazinetriethanol	4719-04-4
Walnut, Juglans regia, ext	84012-43-1
Welan gum	72121-88-1
Xanthan Gum	11138-66-2
Zinc oxide	1314-13-2

Attachment A Risk Dossiers

ALCOHOLS, C9-C11-ISO, C10-RICH

This dossier on alcohols, C9-C11-iso,C10-rich (also referred to as isodecanol) presents the most critical studies pertinent to the risk assessment of the substance in its use in coal seam gas extraction activities. It does not represent an exhaustive or critical review of all available data. The information presented in this dossier was obtained primarily from the ECHA database that provides information on chemicals that have been registered under the EU REACH (ECHA). Where possible, study quality was evaluated using the Klimisch scoring system (Klimisch *et al.*, 1997).

Screening Assessment Conclusion – Isodecanol was not identified in chemical databases used by NICNAS as an indicator that the chemical is of concern and is not a PBT substance. Isodecanol was assessed as a tier 2 chemical for acute and chronic toxicity. Therefore, isodecanol is classified overall as a **tier 2** chemical and requires a hazard assessment and qualitative assessment of risk.

1 BACKGROUND

Isodecanol has reported uses as non-ionic surfactants, wetting agents, and emulsifiers.

Isodecanol is readily biodegradable, has a moderate potential to adsorb to soil or sediment, and has a low potential for bioaccumulation.

The acute toxicity of isodecanol is low by oral, dermal and inhalation routes with most of the absorbed dose quickly eliminated. Dermal studies have shown some mild irritation, but isodecanol is not a skin sensitising agent or irritating to the eye. Repeated dose toxicity studies on similar alcohols in rats indicate some toxicity to kidney effects at higher doses. Isodecanol is not genotoxic nor known to be carcinogenic or a reproductive/developmental toxicant.

Isodecanol is a non-polar narcotic. It is of moderate concern to aquatic organisms and is of low concern to terrestrial organisms.

2 CHEMICAL NAME AND IDENTIFICATION

Chemical Name (IUPAC): 8-methylnonan-1-ol

CAS RN: 68526-85-2

Molecular formula: Unspecified (UVCB substance)

Molecular weight: Not available (UVCB substance)

Synonyms: Alcohols, C9-C11-iso, C10-rich; isodecanol; isodecyl alcohol; branched alcohols, C9-11, C10 rich

3 PHYSICO-CHEMICAL PROPERTIES

Key physical and chemical properties for the substance are shown in Table 1.

Table 1 Overview of the Physico-chemical Properties of Isodecanol

Property	Value	Klimisch score	Reference
Physical state at 20°C and 101.3 kPa	clear, colourless liquid with a mild odour	2	ECHA
Melting point	-78 °C @ 101.3 kPa (pour point)	2	ECHA
Boiling point	217-224 °C @ 101.3 kPa	2	ECHA
Density	838 kg/m^3@ 20 °C	2	ECHA
Vapour pressure	3.67 Pa @ 25°C	2	ECHA
Partition coefficient (log K_{ow})	3.8 @ 22°C	2	ECHA
Dissociation constant (pKa)	Not relevant	-	ECHA
Water solubility	0.075 g/L @ 20°C	2	ECHA
Viscosity	17.6 mPa s @ 20°C	2	ECHA

4 DOMESTIC AND INTERNATIONAL REGULATORY INFORMATION

A review of international and national environmental regulatory information was undertaken (Table 2). This chemical is listed on the Australian Inventory of Chemical Substances – AICS (Inventory). No conditions for its use were identified. No other specific environmental regulatory controls or concerns were identified within Australia and internationally for alcohols, C9-C11-iso,C10-rich.

Table 2 Existing International Controls

Convention, Protocol or other international control	Listed Yes or No?
Montreal Protocol	No
Synthetic Greenhouse Gases (SGG)	No
Rotterdam Convention	No
Stockholm Convention	No
REACH (Substances of Very High Concern)	No
United States Endocrine Disrupter Screening Program	No
European Commission Endocrine Disruptors Strategy	No

5 ENVIRONMENTAL FATE SUMMARY

A. Summary

Isodecanol is readily biodegradable, has a moderate potential to adsorb to soil or sediment, and has a low potential for bioaccumulation.

B. Partitioning

The Mackay Level III equilibrium model estimates that isodecanol will partition largely to the soil compartment (approximately 72%), followed by the water (approximately 26%), air (approximately 2%), and sediment (<1%) compartments, based on all available measured data. Based on a Henry's Law Constant of 7.74 Pa m^3/mole volatilisation from water is not expected to occur at a rapid rate but may occur at a significant rate (ECHA).

C. Biodegradation

Isodecanol is readily biodegradable. In an OECD Guideline 301 F (Ready Biodegradability: Manometric Respirometry Test), isodecanol biodegraded 83% in 28 days, and surpassed 60% within a 10-day window (ECHA). [Kl. Score = 1]

If a chemical is found to be inherently or readily biodegradable, it is categorised as Not Persistent since its half-life is substantially less than 60 days (DoEE, 2017).

D. Environmental Distribution

No experimental data for isodecanol is available. Using KOCWIN in EPISUITE™ (USEPA, 2019), the estimated K_{oc} value for the substance was 413 using the log K_{ow} method (ECHA). [KI Score = 2]

Based upon this K_{oc} value, if released to soil, isodecanol is expected to have moderate potential for adsorption and mobility. If released to water, based on its K_{oc} and water solubility values, isodecanol is likely to preferentially partition to water.

E. Bioaccumulation

An aqueous bioconcentration study with isodecanol was conducted with the rainbow trout (*Oncorhynchus mykiss*) according to OECD Guideline 305E. There was no difference in mortality, growth, or lipid content between the exposure solutions and the control after 16 days of exposure or at the end of the study (26 days). The exposed trout reached steady-state within the 16 -day exposure period. The calculated mean lipid normalized steady state bioconcentration factor (BCF) was 21.4 L/kg wet fish weight. Therefore, this substance exhibits a low potential to bioconcentrate (ECHA). [Kl. Score = 2]

6 HUMAN HEALTH HAZARD ASSESSMENT

A. Summary

The acute toxicity of isodecanol is low by oral, dermal and inhalation routes with most of the absorbed dose quickly eliminated. Dermal studies have shown some mild irritation, but isodecanol is not a skin sensitising agent or irritating to the eye. Repeated dose toxicity studies on similar alcohols in rats indicate some toxicity to kidney effects at higher doses. Isodecanol is not genotoxic nor known to be carcinogenic or a reproductive/developmental toxicant.

B. Toxicokinetics

After oral ingestion, isodecanol is almost completely absorbed in the gastrointestinal tract, is rapidly metabolised in the liver and 94-100% of the dose is excreted within 24 hours (hrs) via the urine,

faeces, and expired air. Once absorbed, the tissue concentrations are detected throughout the body with higher concentrations in tissue associated with metabolism and excretion (e.g., liver, kidneys). Linear and branched chain alcohols are similar in absorption, metabolism and excretion and are primarily oxidated by alcohol dehydrogenase to corresponding aldehydes (ECHA).

C. Acute Toxicity

Oral

An OECD Guideline 420 (Acute Oral Toxicity – Fixed Dose Method) test was conducted in male Sprague-Dawley rats orally gavaged with a single dose of isodecanol at a series of doses (26.4, 83.8, 264, 838, 2648, and 8380 milligrams per kilograms body weight (mg/kg-bw)). Observations for toxicity were recorded following administration and continued for 7 days post treatment. All animals in the highest dose group (8380 mg/kg-bw) died within 4 hours of administration. For the remaining groups, no mortality was recorded although some clinical signs (inactivity, ataxia, laboured respiration) were observed and at 24 hours, oily fur was observed in some rodents. Based on this study, an LD_{50} for isodecanol is >2648 mg/kg-bw is identified for oral toxicity (ECHA). [Kl. Score = 1].

Inhalation

The acute inhalation toxicity of isodecanol was evaluated following an OECD Guideline 403 study for three mammalian species; Swiss albino mice, Wistar rats and English short-hair guinea pigs. Test animals (all male) were exposed for 6 hrs to vapour concentrations of isodecanol in a stainless-steel inhalation chamber at a theoretical concentration of 95.3 parts per million in air (ppm). Although some signs of toxicity were observed during the exposure period (e.g., nasal discharge, salivation), these signs resolved within 30 minutes of experiment termination. No mortality was recorded for any species at any time during the experiment or during the observation period. Therefore, an inhalation LD_{50} of >95.3 ppm is identified for isodecanol (ECHA). [Kl. Score = 1]

Dermal

In an acute dermal toxicity study following OECD Guideline 402 (Acute Dermal Toxicity), male and female rabbits were dermally exposed to concentrations of 83.8, 264, 838, or 2648 mg/kg-bw isodecanol for 24 hours. Mild dermal effects (erythema) were observed but resolved in the lower dose groups after exposure and prior to sacrifice. No mortality was observed in any exposure group during the study or observation period (7 days). From this study, an LD_{50} of >2648 mg/kg-bw for dermal exposure to isodecanol is identified (ECHA). [Kl. Score = 1]

D. Irritation

Skin

An OECD Guideline 404 (Acute Dermal Irritation/Corrosion) study was conducted on six New Zealand White rabbits exposed to 0.5 mL of undiluted isodecanol for four hours. Clinical observations for dermal irritation were conducted at 0.75, 24, 48 and 72 hrs and 7 days post exposure. Irritation (as erythema) was observed at 0.75 hrs and increased throughout the observation period. Based on this study, isodecanol is classified as Category 2 (skin irritant) based on GHS criteria (ECHA). [Kl. Score = 1]

Eye

In an OECD Guideline 405 (Acute Eye Irritation/Corrosion), 0.1 mL of undiluted isodecanol was applied to the conjunctival sacs of six White New Zealand rabbits and clinical findings recorded at 24, 48, 72 hrs and 4, 7 and 10 days after exposure. All test subjects developed signs of slight to moderate irritation (corneal opacity, slight iritis and conjunctivitis) that resolved by day 7 of the observation period. Based on this study, isodecanol is not classified as irritating to the eye (ECHA). [Kl. Score = 2]

E. Sensitisation

In an OECD Guideline 406 (Skin Sensitisation) study, ten Dunkin-Hartley guinea pigs were injected intradermally four times with 0.1 millilitres (mL) of undiluted isodecanol via to induce sensitisation. After fourteen days, the test subjects were challenged with 0.1 mL aliquots of isodecanol intradermally and topically on either flank. This treatment was repeated at 7 days to confirm findings. After each challenge, clinical observations for evidence of skin sensitisation (as irritation) were conducted at 24 hours. No localized skin sensitisation was observed during either observation period. Based on this study, isodecanol is not classified as a skin sensitiser (ECHA). [Kl. Score = 2]

F. Repeated Dose Toxicity

Oral

There are no repeated dose oral toxicity studies for isodecanol, however, there have been tests conducted on structurally analogous compounds. For example, in an OECD Guideline 408 (Repeated Dose 90-Day Oral Toxicity Study in Rodents) study for branched alcohols, C7-9,C8-rich (CAS RN 68526-83-0), ten male and female Sprague-Dawley rats orally gavaged with branched alcohols, C7-9,C8-rich in corn oil at doses of 100, 300, and 700 mg/kg-bw/day for 90 days. Aside from nonadverse findings for clinical biochemistry (higher triglycerides), histopathology (microscopic findings in liver and kidney) and organ weights (alterations in the two higher dosing groups), no mortality or adverse systemic effects were observed. Based on this study, a NOAEL of >700 mg/kg-day is identified (ECHA). [Kl. Score = 1]

For another structurally analogous compound, branched alcohols, C11-14,C13-rich (CAS RN 68526-86-3), an OECD Guideline 408 study was conducted on ten male and female Sprague-Dawley rats orally gavaged for 90 days at doses of 100, 300, and 1000 mg/kg-bw/day. At the highest dose, histopathologic findings in the kidneys as renal tubule degeneration/necrosis were observed in males and wet fur was observed in both males and females. Based on this study, a NOAEL of 300 mg/kg-day is identified (ECHA). [Kl. Score = 1]

Inhalation

No inhalation toxicity studies are available for this compound.

Dermal

No studies are available.

G. Genotoxicity

Based on the available *in vitro* genotoxicity studies, isodecanol is not considered to be genotoxic.

In Vitro Studies

The key *in vitro* genotoxicity studies on isodecanol are presented in Table 3.

Table 3 In vitro Genotoxicity Studies on Isodecanol

Test System	Results*		Klimisch Score	Reference
	-S9	+S9		
OECD Guideline 471 (Bacterial Reverse Mutation Assay) (*Salmonella typhimurium TA1535, TA1537, TA98, TA100*)	-	-	1	ECHA
OECD Guideline 473 (*In vitro* Mammalian Chromosome Aberration Test) (Chinese hamster ovary (CHO))	-	-	1	ECHA
OECD Guideline 476 (*In vitro* Mammalian Cell Gene Mutation Test) (mouse lymphoma L5178Y cells)	-	-	1	ECHA
OECD Guideline 487 (*In vitro* Mammalian Cell Micronucleus Test) (CHO)	-	-	1	ECHA

*+, positive; -, negative

In Vivo Studies

No studies were available.

H. Carcinogenicity

Studies have not been performed to test the carcinogenic potential of isodecanol. However, based on other endpoints, it is not expected to present a carcinogenic hazard (ECHA).

I. Reproductive Toxicity

There are no reproductive toxicity studies for this compound.

J. Developmental Toxicity

There are no developmental toxicity studies for this compound, however, a developmental study for a structurally analogous compound, branched alcohols, C7-9,C8-rich (CAS RN 91994-92-2) is available. For this compound, an OECD Guideline 414 (Prenatal Developmental Toxicity Study) was conducted on female Cr:CD BR VAF/Plus rats orally gavaged with branched alcohols, C7-9,C8-rich in corn oil for gestation days 6 through 15 at doses of 100, 500, and 1000 mg/kg-day. In the highest dose group, maternal effects on body weight gain suppression and decreased food consumption were observed. No other statistically significant effects were observed in the females or in the offspring. Based on this study, a developmental NOAEL of 1000 mg/kg-day is identified for foetuses and a NOAEL of 500 mg/kg-day is identified (ECHA). [Kl. Score = 1]

K. Derivation of Toxicological Reference and Drinking Water Guidance Values

The toxicological reference values developed for isodecanol follow the methodology discussed in enHealth (2012). The approach used to develop drinking water guidance values is described in the Australian Drinking Water Guidelines (ADWG, 2011).

Non-Cancer

The lowest NOAEL from these studies is 300 mg/kg bw/day based on observed kidney effects (as renal degeneration/necrosis) and other clinical findings (wet fur) for a structurally surrogate compound, branched alcohols, C11-14,C13-rich (CAS RN 68526-86-3). The NOAEL of 300 mg/kg bw/day will be used for determining the oral Reference dose (RfD) and the drinking water guidance value.

Oral Reference Dose (oral RfD)

Oral RfD = NOAEL / (UF_A x UF_H x UF_L x UF_{Sub} x UF_D)

Where:
UF_A (interspecies variability) = 10
UF_H (intraspecies variability) = 10
UF_L (LOAEL to NOAEL) = 1
UF_{Sub} (subchronic to chronic) = 10
UF_D (database uncertainty) = 1

Oral RfD = 300/(10 x 10 x 1 x 10 x 1) = 300/1000 = <u>0.03 mg/kg bw/day</u>

Drinking water guidance value

Drinking water guidance value = (animal dose) x (human weight) x (proportion of intake from water) / (volume of water consumed) x (safety factor)

Using the oral RfD,

Drinking water guidance value = (oral RfD) x (human weight) x (proportion of water consumed) / (volume of water consumed)

where:
Human weight = 70 kg (ADWG, 2011)
Proportion of water consumed = 10% (ADWG, 2011)
Volume of water consumed = 2L (ADWG, 2011)

Drinking water guidance value = (0.03 x 70 x 0.1)/2 = 0.11 mg/L

<u>Cancer</u>

There was no available carcinogenicity studies conducted on isodecanol. Thus, a cancer reference value was not derived.

L. Human Health Hazard Assessment Of Physico-Chemical Properties

Isodecanol does not exhibit the following physico-chemical properties:

- Explosivity
- Flammability
- Oxidising potential

7 ENVIRONMENTAL HAZARD ASSESSMENT

A. Summary

Isodecanol is a non-polar narcotic. It is of moderate concern to aquatic organisms and is of low concern to terrestrial organisms.

B. Aquatic Toxicity

Acute Studies

Table 4 lists the results of acute aquatic toxicity studies conducted on isodecanol.

Table 4 Acute Aquatic Toxicity Studies on Isodecanol

Test Species	Endpoint	Results (mg/L)	Klimisch score	Reference
Oncorhynchus mykiss	96-hr LC_{50}	3.1	1	ECHA
Daphnia magna	48-hr EL_{50}	6.2	2	ECHA
Green algae	96-hr EC_{50}	3.12 (QSAR)	2	ECHA

Chronic Studies

Experimental studies were not available for fish, invertebrates or algae. QSAR estimations using ECOSAR resulted in the following:

- 30-day chronic value (ChV) to fish of 0.374 mg/L, equivalent to a NOEC of 0.264mg/L
- 16-day ChV to daphnids of 0.326 mg/L, equivalent to a NOEC of 0.231mg/L
- 96-hr ChV to green algae of 1.18 mg/L, equivalent to a NOEC of 0.84 mg/L.

C. Terrestrial Toxicity

No studies are available.

Isodecanol is a non-polar narcotic, therefore, the application of EqP Theory is appropriate for assessing the hazard of isodecanol to terrestrial species. Modelled earthworm data would suggest that alcohols, C9 -11 -iso, C10 -rich has a low order of toxicity to soil dwelling organisms. Based on QSAR calculations using the weighted measured log K_{ow} value, the C10 alcohol may not be soluble enough to measure the predicted 14-day LC_{50} of 179 mg/kg soil. The ECOSAR model has been shown to correlate well with experimental test results using aliphatic alcohols. These results are expected to represent a reasonable simulation of long-term effects with terrestrial macroorganisms (ECHA).

Based on mammalian test data, isodecanol is expected to have a low order of toxicity to birds and other terrestrial animals. Isodecanol is also expected to have a low order of toxicity to terrestrial plants, as plants are generally less sensitive than other terrestrial organisms (ECHA).

D. Calculation of PNEC

The PNEC calculations for isodecanol follow the methodology discussed in DEWHA (2009).

PNEC water

Experimental results are available for three trophic levels. Acute E(L)C_{50} values are available for fish (3.1 mg/L), invertebrates (6.2 mg/L) and algae (3.12 mg/L). Results from chronic studies are available for fish (0.264 mg/L), invertebrates (0.231 mg/L) and algae (0.84 mg/L). On the basis that the data consists of short-term studies for three trophic levels and long-term results from model estimates for three trophic levels, an assessment factor of 100 has been applied to the lowest reported NOEC of 0.231 mg/L for invertebrates. The $PNEC_{water}$ is 0.00231 mg/L.

PNEC sediment

There are no toxicity data for sediment-dwelling organisms. Moreover, the substance is not expected to substantially partition to sediments. Nonetheless, a $PNEC_{sed}$ was calculated using the equilibrium partitioning method. The $PNEC_{sed}$ is 0.016 mg/kg sediment wet weight.

The calculations are as follows:
$PNEC_{sed} = (K_{sed\text{-}water}/BD_{sed}) \times 1000 \times PNEC_{water}$
$= 8.73/1280 \times 1000 \times 0.00231$
$= 0.0157$ mg/kg

Where:
$K_{sed\text{-}water}$ = suspended matter-water partition coefficient (m^3/m^3)
BD_{sed} = bulk density of sediment (kg/m^3) = 1,280 kg/m^3[default]
$PNEC_{water}$ = 0.00231 mg/L

$K_{sed\text{-}water} = 0.8 + [(0.2 \times Kp_{sed})/1000 \times BD_{solid}]$
$= 0.8 + [(0.2 \times 16.52)/1000 \times 2400]$
$= 8.73\ m^3/m^3$

And:
Kp_{sed} = solid-water partition coefficient (L/kg)
BD_{solid} = bulk density of the solid phase (kg/m^3) = 2,400 kg/m^3[default]

$Kp_{sed} = K_{oc} \times f_{oc}$
$= 413 \times 0.04$
$= 16.52$ L/kg

Where:
K_{oc} = organic carbon normalised distribution coefficient (L/kg). The K_{oc} for isodecanol based on the log K_{ow} is 413 L/kg (EPA, 2019).
f_{oc} = fraction of organic carbon in sediment = 0.04 [default].

PNEC soil

There are no toxicity data for terrestrial or soil organisms. Therefore, the $PNEC_{soil}$ was calculated using the equilibrium partitioning method. The $PNEC_{soil}$ is 0.013 mg/kg soil dry weight.

The calculations are as follows:

$PNEC_{soil} = (Kp_{soil}/BD_{soil}) \times 1000 \times PNEC_{water}$
$= (8.26/1500) \times 1000 \times 0.00231$
$= 0.0127 mg/kg$

Where:
Kp_{soil} = soil-water partition coefficient (m^3/m^3)
BD_{soil} = bulk density of soil (kg/m^3) = 1,500 kg/m^3 [default]

$Kp_{soil} = K_{oc} \times f_{oc}$
$= 413 \times 0.02$
$= 8.26\ m^3/m^3$

Where:
K_{oc} = organic carbon normalised distribution coefficient (L/kg). The K_{oc} for isodecanol based on the log K_{ow} is 413 L/kg (EPA, 2019).
f_{oc} = fraction of organic carbon in soil = 0.02 [default].

8 CATEGORISATION AND OTHER CHARACTERISTICS OF CONCERN

A. PBT Categorisation

The methodology for the Persistent, Bioaccumulative and Toxic (PBT) substances assessment is based on the Australian and EU REACH Criteria methodology (IChEMS, 2022; ECHA, 2023).

Isodecanol is readily biodegradable; thus, it does not meet the screening criteria for persistence.

Based on a measured BCF of 21 L/kg, isodecanol does not meet the screening criteria for bioaccumulation.

The lowest chronic NOEC for isodecanol is >0.1 mg/L. The acute $E(L)C_{50}$ values are >1 mg/L. Thus, isodecanol does not meet the screening criteria for toxicity.

The overall conclusion is that isodecanol is not a PBT substance.

B. Other Characteristics of Concern

No other characteristics of concern were identified for isodecanol.

9 SCREENING ASSESSMENT

Chemical Name	CAS No.	Overall PBT Assessment [1]	Chemical Databases of Concern Assessment Step		Persistence Assessment Step		Bioaccumulative Assessment Step	Toxicity Assessment Step			Risk Assessment Actions Required[3]
			Listed as a COC on relevant databases?	Identified as Polymer of Low Concern	P criteria fulfilled?	Other P Concerns	B criteria fulfilled?	T criteria fulfilled?	Acute Toxicity [2]	Chronic Toxicity[2]	
Isodecanol	68526-85-2	Not a PBT	No	No	No	No	No	No	2	2	2

Footnotes:

1 - PBT Assessment based on PBT Framework.

2 - Acute and chronic aquatic toxicity evaluated consistent with assessment criteria (see Framework).

3 - Tier 2 - Hazard Assessment and Qualitative Assessment Only. Develop toxicological profile and PNECs for water and soil and provide qualitative discussion of risk.

Notes:

NA = not applicable

PBT = Persistent, Bioaccumulative and Toxic

B = bioaccumulative

P = persistent

T = toxic

10 REFERENCES, ABBREVIATIONS AND ACRONYMS

A. References

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B. Abbreviations and Acronyms

°C	degrees Celsius
ADWG	Australian Drinking Water Guidelines
AICIS	Australian Industrial Chemicals Introduction Scheme
AICS	Australian Inventory of Chemical Substances
ChV	chronic value
COC	constituent of concern
DEWHA	Department of the Environment, Water, Heritage and the Arts
EC	effective concentration
ECHA	European Chemicals Agency
EU	European Union
g/L	grams per litre
HHRA	enHealth Human Risk Assessment
IChEMS	Industrial Chemicals Environmental Management Standard
IUPAC	International Union of Pure and Applied Chemistry
kg	kilograms
KI	Klimisch scoring system
KOCWIN™	USEPA organic carbon partition coefficient estimation model
kPa	kilopascal
L	litre
L/kg	litres per kilogram
LC	lethal concentration
LD	lethal dose
LOAEL	lowest observed adverse effect level
m^3	cubic metre
MCI	molecular connectivity index
mg/kg	milligrams per kilogram
mg/L	milligrammes per litre
mg/m^3	milligrams per cubic metre
mL	millilitre
mPa s	millipascal second
NICNAS	The National Industrial Chemicals Notification and Assessment Scheme
NOAEL	no observed adverse effect level
Pa	pascal
PBT	Persistent, Bioaccumulative and Toxic

ppm	parts per million
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RfD	Reference Dose
SGG	Synthetic Greenhouse Gases
USEPA	United States Environmental Protection Agency

GLYCERIDES, C14-18 MONO- AND DI-, ETHOXYLATED

This dossier on glycerides, C14-18 mono- and di-, ethoxylated presents the most critical studies pertinent to the risk assessment of the substance in its use in coal seam gas extraction activities. It does not represent an exhaustive or critical review of all available data. Limited information is available for glycerides, C14-18 mono- and di-, ethoxylated. The majority of information presented in this dossier was obtained from read-across substance glycerides, C16-18 mono- and di- (CAS RN 85251-77-00) and other fatty acid glyceride group members described in the OECD-SIDS documents on glycerides (OECD, 2014), and from the ECHA database that provides information on chemicals that have been registered under the EU REACH (ECHA). Where possible, study quality was evaluated using the Klimisch scoring system (Klimisch et al., 1997).

Screening Assessment Conclusion – Glycerides, C14-18 mono- and di-, ethoxylated is classified as a **tier 1** chemical and requires a hazard assessment only.

1 BACKGROUND

Glycerides are a group of lipids commonly called fats (solid at room temperature) and oils (liquid at room temperature). Due to the structural similarities of the glycerides, their physico-chemical properties are similar and a clear correlation with chain length is observed (OECD, 2014).

Based on read-across to fatty acid glyceride group members, glycerides, C14-18 mono- and di-, ethoxylated have a high potential for adsorption to soil. However, since they are readily biodegradable, they are not expected to persist in the environment. Their bioaccumulation in aquatic organisms is assumed to be low. It is of low toxicity concern to aquatic and terrestrial organisms.

2 CHEMICAL NAME AND IDENTIFICATION

Chemical Name (IUPAC): Glycerides, C14-18 mono- and di-, ethoxylated

CAS RN: 68153-76-4

Molecular formula: Unspecified (UVCB substance)

Molecular weight: Unspecified (UVCB substance)

Synonyms: (C14-C18) Alkylcarboxylic acid; PEG-50 Shea Butter

3 PHYSICO-CHEMICAL PROPERTIES

No experimental data was available for glycerides, C14-18 mono- and di-, ethoxylated. Key physical and chemical properties for the read-across substance are shown in Table 1.

Table 1 Overview of the Physico-chemical Properties of Glycerides, C16-18 mono- and di- (CAS RN 85251-77-0)

Property	Value	Klimisch score	Reference
Physical state at 20°C and 101.3 kPa	Organic solid	-	ECHA
Melting Point	56°C @ 101.3 kPa	2	ECHA
Boiling Point	>300°C @ 101.3 kPa, decomposes before boiling	-	ECHA
Density	920-960 kg/m^3 @ 20°C (based on QSAR)	2	ECHA
Vapor Pressure	Negligible @ 20°C (based on QSAR)	2	ECHA
Partition Coefficient (log K_{ow})	>5.63 @ 25°C (measured) (based on QSAR)	2	ECHA
Water Solubility	<0.001 g/L @ 25°C	2	ECHA
Dissociation Constant (pKa)	No dissociation	-	ECHA
Viscosity	Not applicable, substance is a solid	-	ECHA

4 DOMESTIC AND INTERNATIONAL REGULATORY INFORMATION

A review of international and national environmental regulatory information was undertaken (Table 2). This chemical is listed on the Australian Inventory of Chemical Substances – AICS (Inventory). No conditions for its use were identified. No specific environmental regulatory controls or concerns were identified within Australia and internationally for glycerides, C14-18 mono- and di-, ethoxylated.

NICNAS has assessed read-across substance glycerides, C16-18 mono- and di- in an Inventory Multi-tiered Assessment and Prioritisation (IMAP) Tier 1 assessment and concluded that it poses no unreasonable risk to human health and the environment.[1][2]

Table 2 Existing International Controls

Convention, Protocol or Other International Control	Listed Yes or No?
Montreal Protocol	No
Synthetic Greenhouse Gases (SGG)	No
Rotterdam Convention	No
Stockholm Convention	No
REACH (Substances of Very High Concern)	No
United States Endocrine Disrupter Screening Program	No
European Commission Endocrine Disruptors Strategy	No

[1] https://services.industrialchemicals.gov.au/assessment-detail/?id=1fe9433e-f36b-1410-8e4e-00f1fcf8411a
[2] https://services.industrialchemicals.gov.au/assessment-detail/?id=e2ac433e-f36b-1410-8de4-00e8f2afc108

5 ENVIRONMENTAL FATE SUMMARY

A. Summary

Based on read-across to fatty acid glyceride group members, glycerides, C14-18 mono- and di-, ethoxylated have a high potential for adsorption to soil. However, since they are readily biodegradable, they are not expected to persist in the environment. Their bioaccumulation in aquatic organisms is assumed to be low.

B. Biodegradation

Six studies investigating the ready biodegradability of Fatty Acid Glycerides are available (CAS RN 8001-78-3, 67701-33-1, 73398-61-5, 91744-20-6, 97722-02-6). In the key study, glycerides, C16-18 mono- and di- was readily biodegradable in an OECD 301D test. Degradation was 76% after 7 days (ECHA) [Kl. score = 2].

If a chemical is found to be readily biodegradable, it is categorised as Not Persistent since its half-life is substantially less than 60 days (DoEE, 2017).

C. Environmental Distribution

No experimental data are available for read-across substance glycerides, C16-18 mono- and di-. Using KOCWIN in EPISuite™ (USEPA, 2019), the estimated K_{oc} value from log K_{ow} ranged between 1,415 for C16 monoglycerides to 1.086×10^{14} for C18 triglycerides (ECHA). [Kl. Score = 2]

Based upon these K_{oc} values, if released to soil, fatty acid glycerides group is expected to strongly adsorb to soil and has a low potential for mobility. However, based on their ready biodegradability they are not expected to be persistent in the environment (ECHA).

D. Bioaccumulation

No bioconcentration studies have been conducted on read-across substance glycerides, C16-18 mono- and di-.

Due to the properties of the category members Fatty Acid Glycerides, their bioaccumulation in aquatic organisms is assumed to be low. As Fatty Acid Glycerides are readily biodegradable and have a very low water solubility (< 1 mg/L), only low concentrations in the aquatic environment and thus a low exposure of aquatic organisms can be expected. Furthermore, Fatty Acid Glycerides (mono-, di-, and tri-esters of fatty acids with glycerol) have in mammals a common metabolic fate that involves stepwise hydrolysis to the fatty acids and glycerol. Fatty acids and glycerol feed into physiological pathways like the citric acid cycle, sugar synthesis, and lipid synthesis. Furthermore mono- and diglycerides have an amphiphilic character and can be part of biological membranes or act as emulsifier and thus, are naturally present in all living organism. Fatty Acid Glycerides are stored deliberately in the fatty tissue as energy source and will be metabolized if needed. Hence, in case bioaccumulation occurs, bioaccumulation in animal tissue is nonhazardous due to the metabolic fate of the Fatty Acid Glycerides (use as energy source) (ECHA).

6 ENVIRONMENTAL EFFECTS SUMMARY

A. Summary

Based on read-across to fatty acid glyceride group members, glycerides, C14-18 mono- and di-, ethoxylated is of low toxicity concern to aquatic and terrestrial organisms.

B. Aquatic Toxicity

Acute Studies

Table 3 lists the results of acute aquatic toxicity studies on read-across substance glycerides, C16-18 mono- and di-. No effects were seen in group members up to the limit of water solubility (ECHA).

Table 3 Acute Aquatic Toxicity Studies on Glycerides, C16-18 mono- and di-

Test Species	Endpoint	Results (mg/L)	Klimisch Score	Reference
Danio rerio	96-hour LC_{50}	>10,000*	-	OECD, 2014
Daphnia magna	48-hour EL_{50}	>100	2	ECHA
Desmodesmus subspicatus	72-hr EC_{50}	>100	2	ECHA

*Diglyceride group member: decanoic acid, ester with 1,2,3-propanetriol octanoate (CAS RN 65381-09-1)

Chronic Studies

Regarding the long-term toxicity to invertebrates, no effects were seen in group members up to the limit of water solubility (ECHA). In addition:

- There were no chronic reproductive effects of CAS 65381-09-1 (diglyceride) or 67701-30-8 (triglyceride) on Daphnia magna (OECD 202), with NOEL (for reproduction) values > 100 mg/L; a concentration which exceeds the water solubility of the substances. Similar results are expected for the Glyceride Category members that have not been tested (OECD, 2014).
- A QSAR model (ECOSAR) was used were used to estimate chronic values (ChV) of glycerides, C14-18 mono- and di-, ethoxylated for the endpoint long-term toxicity to fish, invertebrates and algae. Estimated values were greater than 1 mg/L, ranging between 1.94 mg/L and 20.39 mg/L (USEPA, 2026).

C. Terrestrial Toxicity

No tests with soil organisms are available for the category members Fatty Acid Glycerides (mono-, di-, and tri-esters of fatty acids with glycerol), but due to their properties a hazard to soil organisms is assumed to be low: Fatty Acid Glycerides are readily biodegradable and thus not expected to persist in soil. Furthermore, acute and chronic study results show that Fatty Acid Glycerides have only a low toxicity for mammals and aquatic organisms (ECHA).

7 CATEGORISATION AND OTHER CHARACTERISTICS OF CONCERN

A. PBT Categorisation

The methodology for the Persistent, Bioaccumulative and Toxic (PBT) substances assessment is based on the Australian and EU REACH Criteria methodology (IChEMS, 2022; ECHA, 2023).

Based on read-across to fatty acid glyceride group members, glycerides, C14-18 mono- and di-, ethoxylated is readily biodegradable and thus does not meet the screening criteria for persistence.

No bioconcentration studies are available for fatty acid glyceride group members. Bioaccumulation in animal tissue is nonhazardous due to the metabolic fate of the Fatty Acid Glycerides; thus glycerides, C14-18 mono- and di-, ethoxylated does not meet the screening criteria for bioaccumulation.

QSAR models show the long-term chronic values above 0.1 mg/L. The acute E(L)C_{50} values for fatty acid glyceride group members are >1 mg/L. Thus, glycerides, C14-18 mono- and di-, ethoxylated does not meet the screening criteria for toxicity.

The overall conclusion is that glycerides, C14-18 mono- and di-, ethoxylated is not a PBT substance.

B. Other Characteristics of Concern

No other characteristics of concern were identified for glycerides, C14-18 mono- and di-, ethoxylated.

8 SCREENING ASSESSMENT

Chemical Name	CAS No.	Overall PBT Assessment [1]	Chemical Databases of Concern Assessment Step		Persistence Assessment Step		Bioaccumulative Assessment Step	Toxicity Assessment Step			Risk Assessment Actions Required[3]
			Listed as a COC on relevant databases?	Identified as Polymer of Low Concern	P criteria fulfilled?	Other P Concerns	B criteria fulfilled?	T criteria fulfilled?	Acute Toxicity [2]	Chronic Toxicity[2]	
Glycerides, C14-18 mono- and di-, ethoxylated	68153-76-4	Not a PBT	No	No	No	No	No	No	1	1	1

Footnotes:

1 - PBT Assessment based on PBT Framework.

2 - Acute and chronic aquatic toxicity evaluated consistent with assessment criteria (see Framework).

3 – Tier 1 – Hazard Assessment only.

Notes:

NA = not applicable

PBT = Persistent, Bioaccumulative and Toxic

B = bioaccumulative

P = persistent

T = toxic

9 REFERENCES, ABBREVIATIONS AND ACRONYMS

A. References

Department of the Environment and Energy [DoEE]. (2017). *Chemical Risk Assessment Guidance Manual: for chemicals associated with coal seam gas extraction*. Guidance manual prepared by Hydrobiology and ToxConsult Pty Ltd for the Department of the Environment and Energy, Commonwealth of Australia, Canberra. https://www.dcceew.gov.au/water/coal-and-coal-seam-gas/national-assessment-chemicals/consultation-risk-assessment-guidance-manual

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Organisation for Economic Co-operation and Development [OECD]. (2014). SIDS Initial Assessment Report (SIAR) on Glycerides Category, UNEP Publications. https://hpvchemicals.oecd.org/UI/handler.axd?id=aaf10514-94e2-48b9-9264-360bbda9ec1d

United States Environmental Protection Agency [USEPA]. (2019). Estimation Programs Interface Suite™ for Microsoft® Windows, v 4.11. https://www.epa.gov/tsca-screening-tools/epi-suitetm-estimation-program-interface#what

USEPA. (2026). Comptox Chemicals Dashboard. https://comptox.epa.gov/dashboard/chemical/details/DTXSID7097224 (accessed September 02, 2026) Glycerides, C14-18 mono- and di-, ethoxylated

B. Abbreviations and Acronyms

°C	degrees Celsius
AICS	Australian Inventory of Chemical Substances
CAS RN	Chemical Abstract Services Registry Number
COC	constituent of concern
DoEE	Department of the Environment and Energy
EC	effective concentration
ECHA	European Chemicals Agency

EU	European Union
g/L	grams per litre
IChEMS	Industrial Chemicals Environmental Management Standard
IUPAC	International Union of Pure and Applied Chemistry
kg/m^3	kilograms per cubic metre
KI	Klimisch scoring system
KOCWIN™	USEPA organic carbon partition coefficient estimation model
kPa	kilopascal
L/kg	litres per kilogram
LC	lethal concentration
MCI	molecular connectivity index
mm	millimetre
NICNAS	National Industrial Chemicals Notification and Assessment Scheme
OECD	Organisation for Economic Co-operation and Development
Pa s	pascal second
PBT	Persistent, Bioaccumulative and Toxic
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
SGG	Synthetic Greenhouse Gases
SIDS	Screening Information Data Set
USEPA	United States Environmental Protection Agency

PROPYLENE GLYCOL

This dossier on propylene glycol presents the most critical studies pertinent to the risk assessment of propylene glycol in its use in coal seam gas extraction activities. This dossier does not represent an exhaustive or critical review of all available data. The majority of information presented in this dossier was obtained from the ECHA database that provides information on chemicals that have been registered under the EU REACH (ECHA). Where possible, study quality was evaluated using the Klimisch scoring system (Klimisch *et al.*, 1997).

Screening Assessment Conclusion – propylene glycol is classified as a **tier 1** chemical and requires a hazard assessment only.

1 BACKGROUND

Propylene glycol is readily biodegradable. It is not expected to bioaccumulate. Propylene glycol has a low tendency to bind to soil or sediment. It is of low toxicity concern to aquatic and terrestrial organisms.

2 CHEMICAL NAME AND IDENTIFICATION

Chemical Name (IUPAC): propane-1,2-diol

CAS RN: 57-55-6

Molecular formula: $C_3H_8O_2$

Molecular weight: 76.09 g/mol

Synonyms: propylene glycol, 1,2-propanediol, sirlene

3 PHYSICO-CHEMICAL PROPERTIES

Key physical and chemical properties for the substance are shown in Table 1.

Table 1: Overview of the Physico-chemical Properties of propylene glycol

Property	Value	Klimisch score	Reference
Physical state at 20°C and 101.3 kPa	Colourless, strongly hygroscopic liquid	1	ECHA
Melting Point	-20°C @ 101.3 kPa	1	ECHA
Boiling Point	184°C @ 101.3 kPa	1	ECHA
Density	1,030 kg/m^3@ 20 °C	2	ECHA
Vapor Pressure	20 Pa @ 25°C	1	ECHA
Partition Coefficient (log K_{ow})	-1.07 @ 20°C	1	ECHA
Water Solubility	1,000 g/L @ 20°C	1	ECHA

Property	Value	Klimisch score	Reference
Dissociation constant (pKa)	Not relevant, substance has not ionic structure	-	ECHA
Viscosity	43.4 mPa s @ 25°C	1	ECHA

4 DOMESTIC AND INTERNATIONAL REGULATORY INFORMATION

A review of international and national environmental regulatory information was undertaken (Table 2). This chemical is listed on the Australian Inventory of Chemical Substances – AICS (Inventory). No conditions for its use were identified. No specific environmental regulatory controls or concerns were identified within Australia and internationally for propylene glycol.

NICNAS has assessed propylene glycol in an IMAP Tier 1 assessment and concluded that it poses no unreasonable risk to the environment[1] .

Table 2 Existing International Controls

Convention, Protocol or other international control	Listed Yes or No?
Montreal Protocol	No
Synthetic Greenhouse Gases (SGG)	No
Rotterdam Convention	No
Stockholm Convention	No
REACH (Substances of Very High Concern)	No
United States Endocrine Disrupter Screening Program	No
European Commission Endocrine Disruptors Strategy	No

5 ENVIRONMENTAL FATE SUMMARY

A. Summary

Propylene glycol is readily biodegradable. The substance is not expected to adsorb to soil or sediment. It has a low potential for bioaccumulation.

B. Biodegradation

Propylene glycol is readily biodegradable. In an activated sludge test under aerobic conditions, degradation after 28 days was approximately 106.8% as measured by oxygen consumption, 81.7% based on carbon dioxide evolution, and 98.3% based on dissolved organic carbon (DOC) removal (ECHA) [KI. Score = 1]. In another activated sludge test under aerobic conditions in saltwater, degradation after 64 days was approximately 90.6% as measured by carbon dioxide evolution and 95.8% based on DOC removal (ECHA) [KI. Score = 1].

[1] https://services.industrialchemicals.gov.au/assessment-detail/?id=c34e433e-f36b-1410-8de4-00e8f2afc108

If a chemical is found to be readily biodegradable, it is categorised as Not Persistent since its half-life is substantially less than 60 days (DoEE, 2017).

C. Environmental Distribution

No experimental data on environmental distribution are available for propylene glycol. Using KOCWIN in EPISuite™ (USEPA, 2019), the estimated soil organic carbon partition coefficient (K_{oc}) value from log K_{ow} is 0.392 L/kg. The estimated K_{oc} value from the molecular connectivity index (MCI) is 1 L/kg.

Based upon these K_{oc} values, if released to soil, propylene glycol is expected to have low potential for adsorption and a high potential for mobility. If released to water, based on its K_{oc} and high water solubility values, propylene glycol is likely to remain in water and not adsorb to sediment or suspended solids.

D. Bioaccumulation

There are no bioaccumulation studies on propylene glycol. Propylene glycol is not expected to bioaccumulate based on a log K_{ow} of -1.07 (ECHA).

6 ENVIRONMENTAL EFFECTS SUMMARY

A. Summary

Propylene glycol has low acute and chronic toxicity to aquatic and terrestrial organisms.

B. Aquatic Toxicity

<u>Acute Studies</u>

Table 3 lists the results of acute aquatic toxicity studies conducted on propylene glycol.

Table 3: Acute Aquatic Toxicity Studies on Propylene Glycol

Test Species	Endpoint	Results (mg/L)	Klimisch score	Reference
Oncorhynchus mykiss (Rainbow trout)	96-hr LC_{50}	40,613	2	ECHA
Ceriodaphnia dubia (Water flea)	48-hr EC_{50}	18,340	2	ECHA
Raphidocelis subcapitata (Green alga)	96-hr EC_{50}	19,000	1	ECHA

<u>Chronic Studies</u>

Fish: No experimental studies have been identified for propylene glycol. A QSAR evaluation estimated a 30-day NOEC of 1,768 mg/L to freshwater fish (ECHA). [Kl. Score = 2]

Invertebrates: A 7-day NOEC of 13,020 mg/L was identified for *Ceriodaphnia dubia* (water flea) based on reproduction or growth (ECHA). [KI. Score = 2]

Algae: A 14-day NOEC of 15,000 mg/L was identified for *Raphidocelis subcapitata* (green alga) based on growth rate (ECHA). [KI. Score = 1]

C. Sediment Toxicity

No studies available. The substance has a low potential for adsorption based on log K_{ow} of -1.07 (ECHA).

D. Terrestrial Toxicity

No studies available. The substance is readily biodegradable with low adsorption potential in soil and no hazard to aquatic organisms is demonstrated (ECHA).

7 CATEGORISATION AND OTHER CHARACTERISTICS OF CONCERN

A. PBT Categorisation

The methodology for the Persistent, Bioaccumulative and Toxic (PBT) substances assessment is based on the Australian and EU REAC Criteria methodology (IChEMS, 2022; ECHA, 2023).

Propylene glycol is readily biodegradable; thus, it does not meet the screening criteria for persistence.

Based on a log K_{ow} of -1.07, propylene glycol does not meet the screening criteria for bioaccumulation.

The lowest chronic NOEC for propylene glycol is >0.1 mg/L. The acute E(L)C_{50} values are >1 mg/L. Thus, propylene glycol does not meet the screening criteria for toxicity.

The overall conclusion is that propylene glycol is not a PBT substance.

B. Other Characteristics of Concern

No other characteristics of concern were identified for propylene glycol.

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8 SCREENING ASSESSMENT

Chemical Name	CAS No.	Overall PBT Assessment [1]	Chemical Databases of Concern Assessment Step		Persistence Assessment Step		Bioaccumulative Assessment Step	Toxicity Assessment Step			Risk Assessment Actions Required[3]
			Listed as a COC on relevant databases?	Identified as Polymer of Low Concern	P criteria fulfilled?	Other P Concerns	B criteria fulfilled?	T criteria fulfilled?	Acute Toxicity[2]	Chronic Toxicity[2]	
Propylene glycol	57-55-6	Not a PBT	No	No	No	No	No	No	1	1	1

Footnotes:

1 - PBT Assessment based on PBT Framework.

2 - Acute and chronic aquatic toxicity evaluated consistent with assessment criteria (see Framework).

3 - Tier 1 – Hazard Assessment only.

Notes:

NA = not applicable

PBT = Persistent, Bioaccumulative and Toxic

B = bioaccumulative

P = persistent

T = toxic

9 REFERENCES, ABBREVIATIONS AND ACRONYMS

A. References

Department of the Environment and Energy [DoEE]. (2017). Chemical Risk Assessment Guidance Manual: for chemicals associated with coal seam gas extraction, Guidance manual prepared by Hydrobiology and ToxConsult Pty Ltd for the Department of the Environment and Energy, Commonwealth of Australia, Canberra. Available: https://www.dcceew.gov.au/water/coal-and-coal-seam-gas/national-assessment-chemicals/consultation-risk-assessment-guidance-manual

ECHA. ECHA REACH database: http://echa.euroa.eu/information-on-chemicals/registered-substances.

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U.S. Environmental Protection Agency [EPA] (2019). EPISuite™ v. 4.11, United States Environmental Protection Agency, Office of Pollution Prevention and Toxics and Syracuse Research Corporation. Available at: https://www.epa.gov/tsca-screening-tools/epi-suitetm-estimation-program-interface.

B. Abbreviations and Acronyms

°C	degrees Celsius
AICIS	Australian Industrial Chemicals Introduction Scheme
AICS	Australian Inventory of Chemical Substances
COC	constituent of concern
DOC	dissolved organic carbon
EC	effective concentration
ECHA	European Chemicals Agency
EU	European Union
g/L	grams per litre
IChEMS	Industrial Chemicals Environmental Management Standard
IUPAC	International Union of Pure and Applied Chemistry

kg	kilograms
Kl	Klimisch scoring system
KOCWIN™	USEPA organic carbon partition coefficient estimation model
kPa	kilopascal
L	litre
L/kg	litres per kilogram
LC	lethal concentration
LD	lethal dose
m^3	cubic metre
MCI	molecular connectivity index
mg/kg	milligrams per kilogram
mg/L	milligrammes per litre
mg/m^3	milligrams per cubic metre
mL	millilitre
mPa s	millipascal second
NICNAS	The National Industrial Chemicals Notification and Assessment Scheme
Pa	pascal
PBT	Persistent, Bioaccumulative and Toxic
ppm	parts per million
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
SGG	Synthetic Greenhouse Gases
USEPA	United States Environmental Protection Agency

Attachment B Safety Data Sheets

HALLIBURTON

SAFETY DATA SHEET

HALAD® 344L CEMENT ADDITIVE

Revision date: 09-Oct-2025 **Revision Number:** 15

Section 1: Identification: Product identifier and chemical identity

Product identifier

Product Name HALAD® 344L CEMENT ADDITIVE

Product Code(s) HM000818

Other means of identification

Pure substance/mixture Mixture

Recommended use of the chemical and restrictions on use

Recommended use Fluid Loss Additive
Uses advised against No information available.

Details of manufacturer or importer

Halliburton Australia Pty. Ltd.
15 Marriott Road, Jandakot, WA 6164
Australia
ACN Number: 009 000 775
Telephone Number: + 61 (08) 6424 4800

For further information, please contact

fdunexchem@halliburton.com

Emergency telephone number

Australia Emergency Telephone 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

Section 2: Hazard(s) identification

Statement of Hazardous Nature: Non-Hazardous according to the criteria of the 7th Revised Edition of the Globally Harmonised System of Classification and Labelling of Chemicals (GHS), Non-Dangerous Goods according to the criteria of ADG.

GHS Classification

Not a hazardous substance or mixture according to the Globally Harmonised System (GHS). Not classified.

Label elements

Hazard statements

Not a hazardous substance or mixture according to the Globally Harmonised System (GHS). Not classified.

Other hazards which do not result in classification

May cause long lasting harmful effects to aquatic life.

Section 3: Composition/information on ingredients

Chemical name	CAS No.	Weight-%
Paraffin based petroleum oil	8012-95-1	60 - 100%
Non-hazardous ingredients	Proprietary	Balance

If CAS number is "proprietary", the specific chemical identity and percentage of composition has been withheld as a trade secret

Section 4: First aid measures

Description of first aid measures

Inhalation Remove to fresh air.

Eye contact Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a doctor.

Skin contact Wash skin with soap and water.

Ingestion Rinse mouth.

Most important symptoms and effects, both acute and delayed

Symptoms No information available.

Effects of Exposure No information available.

Indication of any immediate medical attention and special treatment needed

Note to doctors Treat symptomatically.

Section 5: Firefighting measures

Suitable Extinguishing Media

Suitable extinguishing media Water fog, carbon dioxide, foam, dry chemical.

Large Fire CAUTION: Use of water spray when fighting fire may be inefficient.

Unsuitable extinguishing media Do not scatter spilled material with high pressure water streams.

Specific hazards arising from the chemical

Specific hazards arising from the chemical No information available.

Oxides of sulfur. Carbon monoxide and carbon dioxide.

Special protective actions for fire-fighters

Special protective equipment and precautions for fire-fighters Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

Section 6: Accidental release measures

Personal precautions, protective equipment and emergency procedures

Personal precautions Ensure adequate ventilation.

For emergency responders Use personal protection recommended in Section 8.

Environmental precautions

Environmental precautions See Section 12 for additional Ecological Information.

Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so.

Precautions to prevent secondary hazards

Prevention of secondary hazards Clean contaminated objects and areas thoroughly observing environmental regulations.

Section 7: Handling and storage, including how the chemical may be safely used

Precautions for safe handling

Advice on safe handling Handle in accordance with good industrial hygiene and safety practice.

Conditions for safe storage, including any incompatibilities

Storage Conditions Store away from oxidizers. Store in a cool well ventilated area. Keep container closed when not in use. Product has a shelf life of 6 months.

Incompatible materials Strong oxidizers.

Section 8: Exposure controls and personal protection

Working area parameters, subject to mandatory control (MAC or TSEL)

Exposure Limits

Chemical name	Australia	New Zealand	ACGIH TLV
Paraffin based petroleum oil 8012-95-1	TWA: 5 mg/m^3	TWA: 5 mg/m^3 STEL: 10 mg/m^3	TWA: 5 mg/m^3 inhalable particulate matter excluding metal working fluids, highly & severely refined

Chemical name	OSHA PEL	NIOSH
Paraffin based petroleum oil 8012-95-1	TWA: 5 mg/m^3 (vacated) TWA: 5 mg/m^3	IDLH: 2500 mg/m^3 TWA: 5 mg/m^3 STEL: 10 mg/m^3

Biological occupational exposure limits This product, as supplied, does not contain any hazardous materials with biological limits established by the region specific regulatory bodies

Appropriate engineering controls

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

Individual protection measures, such as personal protective equipment

Eye/face protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Skin and body protection	Normal work coveralls.
Hand protection	Impervious rubber gloves.
Respiratory protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Organic vapor respirator.
Environmental exposure controls	No information available.
Other protective equipment	None known.
Thermal hazards	No information available.

Section 9: Physical and chemical properties

Information on basic physical and chemical properties

Physical state	Liquid
Appearance	No information available
Colour	White
Odour	Mild kerosene.
Odour threshold	No information available

Property	**Values**	**Remarks • Method**
pH	No data available	
Melting point / freezing point	No data available	
Initial boiling point and boiling range	253.9 °C / 489 °F	
Flash point	122.8 °C / 253 °F	(PMCC)
Evaporation rate	No data available	
Flammability	No data available	
Flammability Limit in Air		
Upper flammability or explosive limits	6	
Lower flammability or explosive limits	0.9	
Vapour pressure	0.9	
Relative vapour density	> 8	
Relative density	1.06	
Water solubility	Soluble in water	
Solubility(ies)	No data available	
Partition coefficient	No data available	
Autoignition temperature	No data available	
Decomposition temperature		
Kinematic viscosity	No data available	
Dynamic viscosity	120 mPa.s / Cps	
Other information		
Pour Point	No data available	
VOC content	No information available	
Particle characteristics	No information available	

Section 10: Stability and reactivity

Reactivity

Reactivity	No information available.

Chemical stability

Stability Stable under normal conditions.

Explosion data
Sensitivity to mechanical impact None.
Sensitivity to static discharge None.

Possibility of hazardous reactions

Possibility of hazardous reactions None under normal processing.

Conditions to avoid

Conditions to avoid None known based on information supplied.

Incompatible materials

Incompatible materials Strong oxidizers.

Hazardous decomposition products

Hazardous decomposition products Oxides of sulfur. Carbon monoxide and carbon dioxide.

Section 11: Toxicological information

Information on likely routes of exposure

Principle Routes of Exposure Eye or skin contact, inhalation, Ingestion, Skin contact, Eye contact, Inhalation

Product Information

Inhalation Specific test data for the substance or mixture is not available.

Eye contact Specific test data for the substance or mixture is not available.

Skin contact Specific test data for the substance or mixture is not available.

Ingestion Due to viscosity, this product does not present an aspiration hazard. May cause abdominal pain, vomiting, nausea, and diarrhea.

Symptoms No information available.

Acute toxicity .

Numerical measures of toxicity - Product Information

The following values are calculated based on chapter 3.1 of the GHS document

ATEmix (oral)	99,999.00	mg/kg
ATEmix (dermal)	99,999.00	mg/kg
ATEmix (inhalation-gas)	99,999.00	ppm
ATEmix (inhalation-vapour)	99,999.00	mg/l
ATEmix (inhalation-dust/mist)	99,999.00	mg/l

Component Information

Chemical name	Oral LD50	Dermal LD50	Inhalation LC50
Paraffin based petroleum oil	> 2000 mg/kg (Rat) >5000 mg/kg (Rat) (similar substance)	> 15000 mg/kg (Rodent) > 2000 mg/kg (Rabbit) (similar substance)	> 0.210 mg/L (Rat) (similar substance)

See section 16 for terms and abbreviations

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation Based on available data, the classification criteria are not met.

Chemical name	Skin corrosion/irritation
Paraffin based petroleum oil 8012-95-1	Non-irritating to the skin (similar substances)

Serious eye damage/eye irritation Based on available data, the classification criteria are not met.

Chemical name	Serious eye damage/eye irritation
Paraffin based petroleum oil 8012-95-1	Non-irritating to the eye (similar substances)

Respiratory or skin sensitisation Based on available data, the classification criteria are not met.

Chemical name	Respiratory sensitisation
Paraffin based petroleum oil 8012-95-1	No information available
Chemical name	Skin sensitisation
Paraffin based petroleum oil 8012-95-1	Not confirmed to cause skin or respiratory sensitization. (similar substances)

Germ cell mutagenicity Based on available data, the classification criteria are not met.

Chemical name	Germ cell mutagenicity
Paraffin based petroleum oil 8012-95-1	In vitro tests did not show mutagenic effects. (similar substances)

Carcinogenicity

Chemical name	Carcinogenicity
Paraffin based petroleum oil 8012-95-1	Did not show carcinogenic effects in animal experiments (similar substances)

The table below indicates whether each agency has listed any ingredient as a carcinogen.

Chemical name	Australia	European Union	IARC
Paraffin based petroleum oil - 8012-95-1	-	-	Group 1 Group 3

Legend

IARC (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans
Group 3 - Not Classifiable as to Carcinogenicity in Humans

Reproductive toxicity Based on available data, the classification criteria are not met.

Chemical name	Reproductive toxicity
Paraffin based petroleum oil 8012-95-1	No information available

STOT - single exposure Based on available data, the classification criteria are not met.

Chemical name	STOT - single exposure
Paraffin based petroleum oil 8012-95-1	No significant toxicity observed in animal studies at concentration requiring classification. (similar substances)

STOT - repeated exposure Based on available data, the classification criteria are not met.

Chemical name	STOT - repeated exposure
Paraffin based petroleum oil	No significant toxicity observed in animal studies at concentration requiring classification.

8012-95-1	(similar substances)

Aspiration hazard Due to viscosity, this product does not present an aspiration hazard. Based on available data, the classification criteria are not met.

Chemical name	Aspiration hazard
Paraffin based petroleum oil 8012-95-1	Aspiration into the lungs may cause chemical pneumonitis including coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal.

Section 12: Ecological information

Ecotoxicity Based on available data, the classification criteria are not met

Aquatic ecotoxicity May cause long lasting harmful effects to aquatic life.

Chemical name	Algae/aquatic plants	Fish	Toxicity to microorganisms	Crustacea
Paraffin based petroleum oil	-	LC50 (96h) >1000 mg/L (Oncorhynchus mykiss) LC50 (96h) > 100 mg/L (Lepomis macrochirus)	-	-

Terrestrial ecotoxicity There is no data for this product.

Persistence and degradability Based on available data, the classification criteria are not met

Chemical name	Persistence and degradability
Paraffin based petroleum oil 8012-95-1	(15 - 35% @ 28d)

Bioaccumulation There is no data for this product.

Mobility Based on available data, the classification criteria are not met

Chemical name	Mobility
Paraffin based petroleum oil 8012-95-1	KOC > 3

Other adverse effects No data available

Section 13: Disposal considerations

Disposal methods

Waste from residues/unused products Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Contaminated packaging Do not reuse empty containers.

See section 8 for more information

Section 14: Transport information

ADG Not regulated

IATA Not regulated

IMDG Not regulated

Transport in bulk according to Annex II of MARPOL and the IBC Code
No information available

Section 15: Regulatory information

Safety, health and environmental regulations/legislation specific for the substance or mixture

National regulations

Australia

See section 8 for national exposure control parameters

Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP)
Classified as a scheduled poison according to the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP)
Poison Schedule Number 5

Australian Industrial Chemicals Introduction Scheme (AICIS)

Chemical name	Australian Industrial Chemicals Introduction Scheme (AICIS)	Additional information
Paraffin based petroleum oil - 8012-95-1	Present	-

Illicit Drug Precursors/Reagents
This product does not contain any substance(s) on the Illicit Drug Precursors/Reagents list.

International Inventories

TSCA	All components listed on inventory or are exempt
AIIC	All components listed on inventory or are exempt
NZIoC	All components listed on inventory or are exempt

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
AIIC - Australian Inventory of Industrial Chemicals
NZIoC - New Zealand Inventory of Chemicals

International Regulations

The Montreal Protocol on Substances that Deplete the Ozone Layer Not applicable

The Stockholm Convention on Persistent Organic Pollutants Not applicable

The Rotterdam Convention Not applicable

Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal Not applicable

Section 16: Any other relevant information

Revision date	09-Oct-2025
Reason for revision	Update to Format

Key or legend to abbreviations and acronyms used in the safety data sheet

ADR - The European Agreement concerning the International Carriage of Dangerous Goods by Road
bw – body weight
CAS – Chemical Abstracts Service
CLP – REGULATION (EC) No 1272/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on Classification, Labelling and Packaging of substances and mixtures
EN 149 - European standard on filtering halfmasks to protect against particles
FFP - Filtering Facepieces
h - hour
IBC Code – International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk
LL50 – Lethal Loading 50%
d - day
Derived No Effect Level (DNEL)
EC – European Commission
EC10 – Effective Concentration 10%
EC50 – Effective Concentration 50%
EEC – European Economic Community
IATA/ICAO - International Air Transport Association / International Civil Aviation Organization
IMDG/IMO - International Maritime Dangerous Goods / International Maritime Organization
LC50 – Lethal Concentration 50%
LD50 – Lethal Dose 50%
NTP – National Toxicology Program
OEL – Occupational Exposure Limit
PEL – Permissible Exposure Limit
ppm – parts per million
REACH – REGULATION (EC) No 1907/2006 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals
VOC – Volatile Organic Carbon
UN – United Nations
VLA-EC - short-time excursion limits [Spain valores límite ambientales para la exposición de corta duración]
vPvB – very Persistent and very Bioaccumulative
w/w - weight/weight
Water hazard class (WGK)
UN – United Nations
VOC – Volatile Organic Carbon
TWA - Time-Weighted Average
STEL – Short Term Exposure Limit

Legend Section 8: Exposure controls/personal protection

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	Sk*	Skin designation
+	Sensitisers		

Key literature references and sources for data used to compile the SDS

Acute Exposure Guideline Level(s) (AEGL(s))
European Chemicals Agency (ECHA) (ECHA_API)
European Chemicals Agency (ECHA) Committee for Risk Assessment (ECHA_RAC)
Hazardous Substance Database
International Uniform Chemical Information Database (IUCLID)
NIOSH (National Institute for Occupational Safety and Health)

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End of Safety Data Sheet