Klohn Crippen Berger

Senex Energy Ltd

Chemical Risk Assessment

InFlow Chemical Risk Assessment

Final Report

ISO 9001 14001 45001

DX10171A18

July 2024

Klohn Crippen Berger

24 July 2024

Senex Energy Ltd
Level 30, 180 Ann Street
Brisbane
QLD 4001

Ms Annabelle Cummings
Environment and Approvals Intern

Dear Annabelle:

Chemical Risk Assessment
CRA for InFlow Chemicals
Final

1 INTRODUCTION

Senex Energy Ltd requested KCB to conduct a Chemical Risk Assessment for the use of the drilling chemical "InFlow" in workover operations across the original Atlas field. The Project Atlas coal seam gas (CSG) field was assigned a non-controlled action, however the Senex-Atlas Environmental Management Plan committed to undertaking risk assessments for new chemicals.

In March 2024, as part of the EPBC referral for the Atlas Stage 3 Project, KCB conducted an update for Chemical Classification and Risk Assessment for 59 chemicals in 47 drilling fluids using a newly developed Chemical Risk Assessment Framework (CRAF) (KCB2024). However, InFlow did not form part of the assessment at the time.

The objective of this assessment is to assess the potential impact to water resources and water dependent assets from chemicals which constitute the liquid "InFlow" using the revised CRAF process.

2 CHEMICAL RISK ASSESSMENT: INFLOW LIQUID

A Safety Data Sheet (SDS) was provided by the supplier (COHO Resource) for InFlow and specifies the composition of two chemicals that make up InFlow:

- 2-Propanol (CAS no. 67-63-0).
- Alcohols, C12-15, Ethoxylated (CAS no. 68131-39-5).

2.1 Methodology

The risk assessment was conducted as per the Atlas Stage 3 CRAF, and in accordance with the recently received Atlas Stage 3 EPBC conditions to allow for relevance for the Atlas Stage 3 project area (PL 209/445 and PL 1127), as well as the original Atlas area (PL 1037).

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The assessment process is designed to assess the full lifecycle of chemicals that are stored, handled, used and/or disposed of during or following drilling activities.

The CRAF for review of chemicals to be used in CSG operations follows a two-step process:

- Step 1: Classification
- Step 2: Assessment

Classification involved identifying products and chemicals to be used during the drilling process. It details how the products will be used and assesses the hazardous nature of the products and the chemicals within them.

Each chemical was placed into a tier through the screening assessment (persistence, bioaccumulative and toxic (PBT) assessment). The appropriate chemical tier level for each chemical assessed was determined according to the tiers as described in Section 3 of the CRAF. The overall tier level is determined by the highest tier value assigned for each criteria (for example, a chemical which is determined to be Tier 1 for toxicity but Tier 2 for persistence is assigned as a Tier 2 chemical).

2.2 Results

A summary of the review for the two InFlow chemicals is provided in Table 2.1.

Table 2.1 Summary of Assessment Results for InFlow

Chemical	Classification	Assessment	Comment
2-Propanol	Tier 1	▪ Screening and Toxicological Assessment ▪ No Qualitative Assessment required	No further action required
Alcohols, C12-15, Ethoxylated	Tier 2	▪ Screening and Toxicological Assessment ▪ Qualitative Assessment Completed	No further action required

A peer review has not been undertaken for this chemical and this should form part of the next peer review. According to the CRAF (KCB 2024) a peer review for Tier 1 and Tier 2 low-risk chemicals needs to be conducted every 5 years and the most recent review was conducted in December 2023.

3 CONCLUSIONS AND RECOMMENDATIONS

Two chemicals contained in InFlow liquid were assessed, and the following deliverables are appended to this letter:

1. Updated Chemical Register Table (Appendix I).
2. Toxicological profile sheets completed for each of the chemicals (Appendix II).
3. Qualitative Risk Assessment completed for Tier 2 chemical (Alcohols, C12015, Ethoxylated) (Appendix III).

Senex has existing management documents and protocols in place for the mitigation, management, and monitoring of the use of chemicals in drilling fluids. It is recommended that these be applied to the two additional chemicals to prevent risks to the MNES.

Overall, the risk assessment of the chemicals Senex proposes to use is low after mitigation measures have been implemented.

Both chemicals assessed do not meet the requirements for persistence or bioaccumulation, and therefore the potential for cumulative impacts is considered low.

Following the outcomes of this assessment it is recommended that InFlow can now be used across PL 1037.

4 CLOSING

This report is an instrument of service of Klohn Crippen Berger (KCB). The report has been prepared for the exclusive use of Senex Energy Ltd (Client) for the specific application to the InFlow Chemical Risk Assessment, and it may not be relied upon by any other party without KCB's written consent.

KCB has prepared this report in a manner consistent with the level of care, skill and diligence ordinarily provided by members of the same profession for projects of a similar nature at the time and place the services were rendered. KCB makes no warranty, express or implied.

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1. The report is to be read in full, with sections or parts of the report relied upon in the context of the whole report.
2. The observations, findings and conclusions in this report are based on observed factual data and conditions that existed at the time of the work and should not be relied upon to precisely represent conditions at any other time.
3. The report is based on information provided to KCB by the Client or by other parties on behalf of the client (Client-supplied information). KCB has not verified the correctness or accuracy of such information and makes no representations regarding its correctness or accuracy. KCB shall not be responsible to the Client for the consequences of any error or omission contained in Client-supplied information.
4. KCB should be consulted regarding the interpretation or application of the findings and recommendations in the report.
5. This report is electronically signed and sealed, and its electronic form is considered the original. A printed version of the original can be relied upon as a true copy when supplied by the author or when printed from its original electronic file.

Yours truly,

KCB AUSTRALIA PTY LTD.

Marlese Nel
Senior Hydrogeologist

Carly Waterhouse, RPGeo
Senior Hydrogeologist, Associate, Team Lead

MN/CW/JJ

REFERENCES

KCB.2024. “Atlas Stage 3 DCCEEW PD response. Chemical Risk Assessment Framework.”

APPENDIX I

Register of Assessed Chemicals

			Document Control			Stage 1: Initial Check	Stage 2: Screening Assessment							Risk Assessment			Assessed Drilling Activity					
Chemical Name	CAS No.	Contained in the following drilling fluids:	Initial Chemical Assessment Date	Independent Peer Review	Chemical Re-evaluation Date	Previously Assessed as low hazard by NICNAS? Y/N	Listed as a COC on relevant databases?	Persistence Tier	Bioaccumulation Tier	Acute toxicity Tier	Chronic toxicity tier	Overall Tier	Concern/Risk Level	Toxicological profile?	Qualitative risk assessment?	Quantitative risk assessment?	Drilling additive - CSG production well	Drilling additive - completion and workover	Drilling additive - exploration and core holes	Drilling additive for abandonment	Production Operations	Monitoring Wells
Boric Acid	10043-35-3	FOAM-X-ACX-145	25/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A	X	X	X			X
Calcium chloride	10043-52-4	CM600	23/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A				X		
Calcium Sulfate Dihydrate	10101-41-4	Blended cement	26/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A				X		
2,2-dibromo-3-nitrilopropionamide	10222-01-2	DNBPA 20%	15/11/2023			N	No	1	1	3	3	2	POTENTIAL	YES	YES	N/A					X	
Triethanolamine	102-71-6	FOAM-X-ACX-143, CM601	25/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A	X	X	X	X		X
2-Ethyl-1-hexanol	104-76-7	COHO Defoam, Foam-X ACB 143	25/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A	X	X	X			X
Ethylene Glycol	107-21-1	CM500	25/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A				X		
Glyoxal	107-22-2	Duo-Vis	26/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A	X	X	X			X
N,N'-methylenediacrylamide	110-26-9	FOAM-X- ACS-141	15/11/2023			N	No	1	1	2	-	2	POTENTIAL	YES	YES	N/A		X				
Gluteraldehyde	111-30-8	Glutaraldehyde 25%, ALDACIDE G, COHO Glute 9	16/11/2023			N	No	1	1	2	1	2	POTENTIAL	YES	YES	N/A	X	X	X	X	X	X
Diethanolamine,	111-42-2	CM601, FOAM-X ACB-143	26/10/2023			N	No	1				1	LOW	YES	N/A	N/A	X	X	X	X		X
2-Butoxyethanol	111-76-2	FOAM-X ACF-147	26/10/2023			N	No	1				1	LOW	YES	N/A	N/A		X				
1-Octanol	111-87-5	CM401	15/11/2023			N	No	1	1	1	-	1	LOW	YES	N/A	N/A				X		
1-Decanol	112-30-1	CM401	15/11/2023			N	No	1	2	2	2	2	POTENTIAL	YES	YES	N/A				X		
Ammonium Sulfate 2-(2-butoxyethoxy)ethanol	112-34-5	Foam-X ACF-144	20/11/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A	X	X	X			X
Xanthan gum	11138-66-2	Duo-Vis	23/10/2023			Y (NICNAS 2017)	N/A	N/A	N/A	N/A	N/A	N/A	LOW	N/A	N/A	N/A	X	X	X			X
triethylamine	121-44-8	THPS 5-%	15/11/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A					X	
Bentonite	1302-78-9	CM300	23/10/2023			Y (NICNAS 2017)	N/A	N/A	N/A	N/A	N/A	N/A	LOW	N/A	N/A	N/A				X		
Calcium Oxide	1305-78-8	Blended cement	26/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A				X		
Potassium hydroxide	1310-58-3	Foam-X ACX-145, Foam-X ACB-143	26/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A	X	X	X			X
Sodium Hydroxide	1310-73-2	Caustic Soda	26/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A				X		
Limestone	1317-65-3	Blended cement	23/10/2023			Y (NICNAS 2017)	N/A	N/A	N/A	N/A	N/A	N/A	LOW	N/A	N/A	N/A				X		
Kaolin	1332-58-7	Contingency Program	15/11/2023			N	No	1	N/A	1	1	1	LOW	YES	N/A	N/A	X		X			X
Sodium Silicate solution	1344-09-8	CM301	26/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A				X		

			Document Control			Stage 1: Initial Check	Stage 2: Screening Assessment							Risk Assessment			Assessed Drilling Activity					
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Wollastonite (Ca(Sio3))	13983-17-0	FORM-A-BLOK	15/11/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A	X		X			X
Monoethanolamine	141-43-5	Nuosept 78	26/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A	X		X			X
Ethylenediaminetetra (methylenephosphonic acid)	1429-50-1	CM102	17/11/2023			N	No	2	1	1	-	2	LOW	YES	N/A	N/A				X		
Crystalline silica (impurity)	14808-60-7	BARACARB 1200, STOPPIT, Blended Cement, Safe-Carb 250, Fiber (F/M/C)	27/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A	X		X	X		X
2-Acrylamido-2-methyl-1-propanesulfonic acid	15214-89-8	CM502	15/11/2023			N	No	2	-	1	-	2	POTENTIAL	YES	YES	N/A				X		
Chromium (6+)	18540-29-9	Blended cement	16/11/2023			N	No	2	2	3	-	2	POTENTIAL	YES	YES	N/A				X		
Dipropylene glycol	25265-71-8	DNBPA 20%	15/11/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A					X	
Polypropylene Glycol	25322-69-4	CM401	15/11/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A				X		
Polyethylene glycol diacrylate	26570-48-9	Foam-X ACS-141	15/11/2023			N	No	1	-	1	-	1	LOW	YES	N/A	N/A	X	X	X			X
Hexanedioic acid, compd. with 1,6-hexanediamine (1:1) Molecular Formula	3323-53-3	COHO F2V N12, COHO Floc C	14/11/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A	X		X			X
Calcium Carbonate	471-34-1	Safe-Carb 250	27/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A	X		X			X
s-Triazine-1,3,5-triethanol	4719-04-4	Nuosept 78	15/11/2023			N	No	1	1	1	-	1	LOW	YES	N/A	N/A	X		X			X
Sodium Carbonate	497-19-8	Soda Ash	27/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A	X		X			X
Tetrakis (Hydroxymethyl)Phosphonium Sulfate	55566-30-8	THPS 50%, IDCIDE-20	27/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A		X			X	
Nitrogen containing Polysaccharide	56780-58-6	COHO F2V CS	17/11/2023			N	No	-	-	-	-	2	POTENTIAL	YES	YES	N/A	X		X			X
Stearic Acid	57-11-4	CM401	17/11/2023			N	No	1	2	1	1	2	POTENTIAL	YES	YES	N/A				X		
Potassium Carbonate	584-08-7	Foam-X ACX-145	15/11/2023			N	No	1	-	1	1	1	LOW	YES	N/A	N/A	X	X	X			X
Cocoamidopropyl betaine	61789-40-0	Foam-X ACF-147	27/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A		X				
Polyethylene Glycol Monotallate	61791-00-2	CM401	20/11/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A				X		
Polycarboxylic acid, sodium salt	62601-60-9	CM200	14/11/2023			N	No	-	-	-	-	2	POTENTIAL	YES	YES	N/A				X		
Petroleum Gas Oil	64741-44-2	CM401	16/11/2023			N	No	2	-	2	3	2	POTENTIAL	YES	YES	N/A				X		
Hydrotreated Light Distillate	64742-47-8	CM401, FOAM-X ACG-1412	27/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A				X		

			Document Control			Stage 1: Initial Check	Stage 2: Screening Assessment							Risk Assessment			Assessed Drilling Activity					
Chemical Name	CAS No.	Contained in the following drilling fluids:	Initial Chemical Assessment Date	Independent Peer Review	Chemical Re-evaluation Date	Previously Assessed as low hazard by NICNAS? Y/N	Listed as a COC on relevant databases?	Persistence Tier	Bioaccumulation Tier	Acute toxicity Tier	Chronic toxicity tier	Overall Tier	Concern/Risk Level	Toxicological profile?	Qualitative risk assessment?	Quantitative risk assessment?	Drilling additive - CSG production well	Drilling additive - completion and workover	Drilling additive - exploration and core holes	Drilling additive for abandonment	Production Operations	Monitoring Wells
Granulated Blast Furnace Slag	65996-69-2	Blended cement	17/11/2023			N	No	2	1	1	1	2	POTENTIAL	YES	YES	N/A				X		
Hydraulic Silicate Cement	65997-15-1	Blended cement	31/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A				X		
Methanol	67-56-1	ALDACIDE G	31/10/2023			N	No	1	1	1	1	1	LOW	YES	N/A	N/A		X		X		
Ethoxylated C6-C10 Alcohol	68037-05-8	Foam-X ACF-144	14/11/2023			N	No	-	1	-	-	2	POTENTIAL	YES	YES	N/A	X	X	X			X
Coal Fly Ash	68131-74-8	Blended cement	17/11/2023			N	No	2	1	1	1	2	POTENTIAL	YES	YES	N/A				X		
Potassium Chloride	7447-40-7	Potassium Chloride	23/10/2023			Y (NICNAS 2017)	N/A	N/A	N/A	N/A	N/A	N/A	LOW	N/A	N/A	N/A	X	X	X			X
Ammonium Persulfate	7727-54-0	FOAM-X ACB-144	31/10/2023			N	No	1				1	LOW	YES	N/A	N/A	X	X	X			X
Water Ultrapur	7732-18-5	IDCIDE-20	23/10/2023			Y (NICNAS 2017)	N/A	N/A	N/A	N/A	N/A	N/A	LOW	N/A	N/A	N/A		X			X	
Sodium Acid Pyrophospate	7758-16-9	COHO SAPP	20/11/2023			N	No	1				1	LOW	YES	N/A	N/A		X		X		
Paraffin (hard)	8002-74-2	CM401	15/11/2023			N	No	2	2	1	1	2	POTENTIAL	YES	YES	N/A				X		
Polyacrylamide	9003-5-8	COHO Floc C	23/10/2023			Y (NICNAS 2017)	N/A	N/A	N/A	N/A	N/A	N/A	LOW	N/A	N/A	N/A	X					
Cellulose	9004-34-6	FORM-A-BLOK	15/11/2023			N	No	2	1	1	1	2	POTENTIAL	YES	YES	N/A	X		X			X
Corn Starch	9005-25-8	COHO AUS DEX	2/11/2023			N	No	1	1	1	1	1	LOW	Yes	N/A	N/A	X		X			X
2-Propanol	67-63-0	InFlow	08/07/2024			N	No	1	1	1	1	1	Low	Yes	N/A	N/A	X	X	X	X		
Alcohols, C12-15, Ethoxylated	68131-39-5	InFlow	08/07/2024			N	No	1	1	2	2	2	POTENTIAL	Yes	Yes	N/A	X	X	X	X		

Notes:
COC = chemical of concern

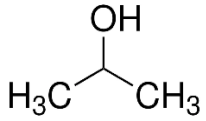
APPENDIX II

Toxicological Profile Sheets

TOXICOLOGICAL PROFILE

II-1 2-PROPANOL

II-1.1 Chemical Synonyms and Structure

	Chemical
CAS Name	2-Propanol
CAS No.	67-63-0
AICS name(s)	2-Propanol
Synonyms	Isopropanol, Isopropyl alcohol, Propan-2-ol
Structural formula	
Molecular formula	C_3H_8O
Molecular weight	60.10
Physical form, appearance and odour at 20 degrees C and 1.013 hPa	Colorless liquid
SMILES notation	CC(O)C

II-1.2 Physico-chemical Properties

Properties	
Physical form	It is a colorless liquid with a strong odour.
Melting point	-89 °C
Boiling point	82 °C
Density (relative to water)	0.786 g/cm^3 at 20 °C
Water solubility	Miscible with water
pKa	16.5
Log K_{ow}	0.05
Vapour pressure	4.4 kPa at 20°C

II-1.3 Domestic and International Regulator Information

A review of international and national environmental regulatory information was undertaken. No specific environmental regulatory controls or concerns were identified within Australia and internationally.

Convention, Protocol or other International Control	Listed yes or no?
Australian Inventory of Chemical Substances (AICS)	Yes
Montreal Protocol	No
Synthetic Greenhouse Gases (SGG)	No
Rotterdam Convention	No
Stockholm Convention	No
Reach (Substances of Very High Concerns)	No
United States Endocrine Disrupter Screening Program	No
European Commission Endocrine Disruptors Strategy	No

II-1.4 Environmental Fate Summary

	Comment
Dissolution, speciation and partitioning	Isopropanol is miscible in water. Volatilisation from water surfaces or moist soil surfaces is expected to be an important fate process based upon this compound's estimated Henry's Law constant of 0.821 Pa m^3 /mole. It is also expected to volatilise from dry soil surfaces based upon its vapour pressure. Based on calculated results from a lever 1 fugacity model, isopropanol (IPA) is expected to partition primarily to the aquatic compartment (77.7%) with the remainder to the air (22.3%).
Degradation	Biological degradation. Additional biodegradation data developed using standardised test methods show that isopropanol is readily biodegradable in both freshwater and saltwater media.
Persistence	Readily biodegradable, considered as non-persistent since its half-life is substantially less than 60 days.
Bioaccumulation	Is readily biodegradable, no bioaccumulation expected. Bioconcentration of isopropanol in aquatic organisms is not expected to occur based on a measured log K_{ow} of 0.05 (ECHA). Based on this estimated value, the substance is expected to have very high mobility in soil. If released to water, based on this value and its water solubility, it is also not expected to adsorb to suspended solids and sediment.
Transport	Volatilisation from water surfaces is expected with half-lives for a model river and model lake of 86 hours and 29 days, respectively. Highly volatile and will rapidly evaporate to the air if released into the water.

II-1.5 Environmental Effects

Overall, 2-Propanol presents a low potential hazard to aquatic or terrestrial biota.

II-1.5.1 Acute Aquatic Toxicity

From study results 2-Propanol has been shown to have a low order of acute aquatic toxicity. Results from 24- to 96-hour LC50 studies range from 1,400 to more than 10,000 mg/L for freshwater and saltwater fish and invertebrates. Two studies on acute toxicity of 2-Propanol confirmed a low toxicity to aquatic organisms, with Klimisch scores of 2.

II-1.5.2 Chronic Aquatic Toxicity

Three studies on the chronic toxicity of 2-Propanol on *Daphnia magna* (a small planktonic crustacean) and *Scenedesmus quadricauda* (a green freshwater alga) have been conducted. Only the study on the alga is considered reliable with a Klimisch score of 2. Chronic aquatic toxicity has also been shown to be of low concern, based on 16- to 21-day NOEC values of 141 to 30 mg/L, respectively, for a freshwater invertebrate.

Long-term toxicity study in fish is not provided.

II-1.5.3 Toxicity to Sediment Organisms

No available data.

II-1.5.4 Terrestrial Toxicity

An EC50 value of 2,100 mg/L was determined from a lettuce seed germination test (Reynold, 1977) with a Klimisch score of 2.

II-1.6 Categorisation and other Characteristics of Concern

	Comment
Persistent, Bioaccumulative and Toxic (PBT) Categorisation	Not a PBT.
Other characteristics of concern	No other characteristics of concern.

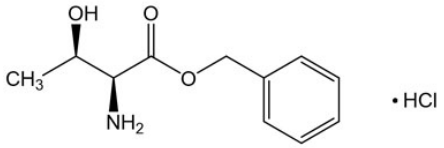
REFERENCES

Reynold, T. (1977). An anomalous effect of isopropanol on lettuce germination. Plant Sci. Lett. 15: 25-28

TOXICOLOGICAL PROFILE

II-1 ALCOHOLS, C12-15, ETHOXYLATED, LIQUIDS

II-1.1 Chemical Synonyms and Structure

	Chemical
CAS Name	Alcohols, C12-15, ethoxylated
CAS No.	68131-39-5
AICS name(s)	Alcohols, C12-15, ethoxylated
Synonyms	C12-15 Pareth-11, C12-15 Alcohol ethoxylate, Ethoxylated fatty alcohol, Polyethylene glycol, Teric 12A3
Structural formula	
Molecular formula	(C2H4O)1-3(CH2)10-13C2H6O
Molecular weight	Not available
Physical form, appearance and odour at 20 degrees C and 1.013 hPa	Hazy liquid
SMILES notation	[H]OCCOCCC

II-1.2 Physico-chemical Properties

Properties	
Physical form	Hazy liquid with a mild odour
Melting point	7.22 °C (no pressure provided)
Boiling point	ca. 287 °C at 101.3 kPa
Density (relative to water)	926 kg/cm^3 at 15.56 °C.
Water solubility	21 mg/L @ 20 °C
pKa	No dissociation
Log K_{ow}	5.79 @25 °C and pH 5.1
Vapour pressure	0.005-0.113 Pa @25°C

II-1.3 Domestic and International Regulator Information

A review of international and national environmental regulatory information was undertaken. No specific environmental regulatory controls or concerns were identified within Australia and internationally.

Convention, Protocol or other International Control	Listed yes or no?
Australian Inventory of Chemical Substances (AICS)	No
Montreal Protocol	No
Synthetic Greenhouse Gases (SGG)	No
Rotterdam Convention	No
Stockholm Convention	No
Reach (Substances of Very High Concerns)	No
United States Endocrine Disrupter Screening Program	No

Convention, Protocol or other International Control	Listed yes or no?
European Commission Endocrine Disruptors Strategy	No

II-1.4 Environmental Fate Summary

	Comment
Dissolution, speciation and partitioning	Experimental studies on adsorption/desorption of Alcohols, C12-15, branched and linear, ethoxylated are not available. Partition coefficient (K_{ow}) of 5.79.
Degradation	Biological degradation, readily biodegradable, are not likely to sorb to sediments or soil, have low potential to bioaccumulate or bioconcentrate and are of low toxicity to environmental receptors. An alcohol, C12-15, ethoxylated (7 EO) degraded 80 to 88% in 28 days when tested using a shakeflask CO_2-evolution test method (ECHA).
Persistence	Readily biodegradable, not persistent.
Bioaccumulation	Low potential.
Transport	No experimental data available. Based on surrogate data for alcohols, this substance has a moderate potential for adsorption to soil or sediments and a low potential for mobility.

II-1.5 Environmental Effects

II-1.5.1 Acute Aquatic Toxicity

In general, ethoxylated alcohols are rapidly taken up across the gills in fish (Bishop and Maki 1980; Wakabayashi et al. 1987) and are rapidly metabolised and eliminated from fish (Bishop and Maki 1980; Wakabayashi et al. 1987). Based on the high elimination rates, Tolls et al. (2000) concluded that rapid biotransformation was taking place in fathead minnows (Pimephales promelas), and that AEs were not stored in the fish.

II-1.5.2 Chronic Aquatic Toxicity

While acute toxicity is low, chronic toxicity effects of ethoxylated alcohols can vary.

II-1.5.3 Toxicity to Sediment Organisms

No available data.

II-1.5.4 Terrestrial Toxicity

No available data.

II-1.6 Categorisation and other Characteristics of Concern

	Comment
Persistent, Bioaccumulative and Toxic (PBT) Categorisation	Not a PBT.
Other characteristics of concern	No other characteristics of concern.

REFERENCES

Bishop, W.E. and A.W. Maki. 1980. A critical comparison of two bioconcentration test methods. Pages 61-77 in J. G. Eaton, P.R. Parrish, and A.C. Hendricks, eds. Aquatic Toxicology, ASTM STP 707. American Society for Testing and Materials.

Newsome, C. S., D. Howes, S. J. Marshall, and R. A. van Egmond. 1995. Fate of some anionic and alcohol ethoxylate surfactants in Crassius auratus. Tenside Surf. Det. 32: 498-503.

Wakabayashi, M., M. Kikuchi, A. Sato, and T. Yoshida. 1987. Bioconcentration of alcohol ethoxylates in Carp (Cyprinus carpio). Ecotox. Environ. Safe. 13: 148-163.

Tolls, J., M. Haller, E. Labee, M. Verweij, and D.T.H.M. Sijm. 2000. Experimental determination of bioconcentration of the nonionic surfactant alcohol ethoxylate. Environ. Toxicol. Chem. 19: 646-653.

APPENDIX III

Qualitative Risk Assessment

QUALITATIVE RISK ASSESSMENT

Alcohols, C12-15, ethoxylated

CAS Name	Alcohols, C12-15, ethoxylated
CAS No.	68131-39-5
AICS name(s)	Alcohols, C12-15, ethoxylated
Synonyms	C12-15 Pareth-11, C12-15 Alcohol ethoxylate, Ethoxylated fatty alcohol, Polyethylene glycol, Teric 12A3
Assigned Tier Level	Tier 2
Relevant Drilling fluid	InFlow

Proposed Chemical Use

Application	Hole Section	Drilling Fluid	Quantity Per Well (kg)	System Volume (litres)	Concentration (kg/m^3)	General Purpose and Function
Mud and additives	All (open and cased)	InFlow	420	103,350	4.06	Surfactant and emulsifier, stimulation fluid

Drilling Fluid Surface State and Pathway Assessment

The nature and state of the chemicals at surface and their solubility was assessed to determine the potential for the chemical to enter the environment. Where a chemical is a solid at surface and is insoluble in water, it is assumed that the chemical is unlikely to be mobilised away from the drill pad, and if present down a well is unlikely to mobilise through an aquifer. It is assumed that there is little to no risk that the chemical will migrate off-site, and these chemicals are not considered to present a risk to MNES.

Chemical Name	Physical State at surface (as manufactured and pre-mixing)	Solubility	Comment
Alcohols, C12-15, ethoxylated	Liquid	Miscible in water	The soluble nature of this drilling chemical presents some risk that it could move off-site and will be considered further in this risk assessment.

Chemical Fate and Transport

The behaviour of the chemical in the surface and subsurface was considered further to determine how the chemicals would behave should they be released to the surface water or groundwater environment. The chemical fate and transport informed the potential consequence of a release of the chemical into the environment.

Chemical Name	CAS Registry Number - From SDS	Persistence / Degradation	Potential for Bioaccumulation	Mobility
Alcohols, C12-15, ethoxylated	CAS 68131-39-5; 7 to 13%	Readily biodegradable	Not expected	Low

Environmental Hazard

The proposed chemical concentrations to be used have been evaluated against environmental health hazard criteria. Note that the concentration of additives stated would be diluted upon entering the receiving environment. The predicted environmental concentrations (PEC) have not been calculated, making this assessment overly conservative.

Drilling fluid	Chemical name	Maximum Chemical Concentration of Active Substance mg/L	Toxicity to fish*	Toxicity to invertebrates**	Toxicity to algae***	Comment
InFlow	Alcohols, C12-15, ethoxylated	528	LC50 (Pimephales promelas) – 1.4 mg/L (96 h)	EC50 (Ceriodaphnia dubia) – 0.39 mg/L (48 h)	EC50 (Selenastrum capricornutum) – 0.7 mg/L (96 h)	There is low potential for environmental harm.

*Wong, D.C.L., P.B. Dorn, and E.Y. Chai (1997) Acute Toxicity and Structure-Activity Relationships of Nine Alcohol Ethoxylate Surfactants to Fathead Minnow and Daphnia magna. Environ.Toxicol.Chem. 16(9):1970-1976

**Warne, M.S.T., and A.D. Schifko (1999) Toxicity of Laundry Detergent Components to a Freshwater Cladoceran and Their Contribution to Detergent Toxicity. Ecotoxicol.Environ.Saf. 44(2):196-206

***Dorn, P.B., J.P. Salanitro, S.H. Evans, and L. Kravetz (1993) Assessing the Aquatic Hazard of Some Branched and Linear Nonionic Surfactants by Biodegradation and Toxicity Reference. Environ.Toxicol.Chem. 12(10):1751-1762. [ECOTOX]

Risk Assessment – Predicted Significance of Impact

The significance of impact on a Matters of National Environmental Significance (MNES) has been assessed based on:

- The likelihood of an impact reaching an MNES receptor; and
- The environmental consequence on the MNES receptor.

Environmental Consequence

Drilling Fluid	Magnitude Assigned	Description	Reasoning
InFlow	Moderate	Can result in impact on the integrity of attribute or loss of part of attribute at a local to regional scale	Some potential for adverse effects on aquatic ecosystems and human health.

Significance of Impacts

The significance of an impact is assessed prior to and following the application of management and mitigation measures.

The full assessment is provided in the tables below.

Final Impact Assessment Before and Following Application of Management and Mitigation Measures: Above Ground Chemical Spills and Leaks

	MNES	Mitigating Factors	Inherent Risk Rating			Management Controls	Residual Risk Rating		
			Likelihood[1]	Consequence[2]	Risk Rating[3]		Likelihood[1]	Consequence[2]	Risk Rating[3]
Wetlands	RAMSAR wetlands (Great Sandy Strait)	This is located over 300 km from the project. This distance, together with the dilution effect, indicate that the wetlands will not be impacted.	1	Mod	I	**Well Siting** The Atlas Stage 3 Environmental Protocol for Planning and Field Development prevents the siting of any CSG wells in locations which may result in the degradation of an environmental value. The Constraints Protocol aims to avoid, minimise and mitigate disturbance to biodiversity values. Brigalow and Poplar Box Grassy Woodland will be avoided by project footprint. **Chemical and fuel storage** ▪ All fuel, oil and chemicals are to be stored, transported and handled in accordance with appropriate standards including AS 3780:2008 – The storage and handling of corrosive substances, AS 3833:2007 – Storage and handling of mixed classes of dangerous goods in packaged and intermediate bulk containers. ▪ Storage areas must be sealed, bunded, and adequately ventilated. ▪ Storage and refuelling areas will be preferentially located away from watercourses, sensitive areas and any source of ignition as determined by the Senex Site Supervisor. ▪ Containment bunds and/or sumps will be drained periodically of accumulated rainwater to prevent overflow and subsequent pollution of the surrounding land and watercourses. All chemical, oil and fuel storage areas are to be inspected at least weekly for temporary storage, and monthly for permanent storage areas during the operating phase by the Contractor Site Supervisor and/or the Senex Site Supervisor. **Emergency and Incident Support** ▪ In the event of a chemical, oil or fuel spill, the spill will be contained and cleaned up as outlined in the Senex Spill Response Plan. ▪ Contractors must have in place procedures for spill response which are in accordance with the Senex Spill Response Plan and will include details requirements for: ♦ Minimising release; ♦ Containing spilled material; ♦ Raising the alarm and response; ♦ Locations of spill kits; and ♦ Management of contaminated material if necessary. ▪ Any spills will be assessed by the Senex Site Supervisor supported by the Senex Environment Manager as required to determine appropriate remediation options such as the removal of contaminated material. ▪ Incident reports will contain information required by the Senex Environment Manager and any Incident Reporting and Investigation Procedures. ▪ Emergency Response drills will be performed to ensure readiness and identify opportunities for improvement. ▪ Senex will ensure that all incidents including spills are reported and fully investigated in accordance with their specific level of potential risk. ▪ Emergency events will be managed in accordance with the contingency procedures in the Project Atlas Emergency Response Plan. ♦ Personnel who observe an environmental incident including a spill must immediately notify the Contractor Site Supervisor who will then notify the Senex Site Supervisor.	1	Mod	I
Ecological Communities	Brigalow (*Acacia harpophylla* dominant and codominant)	Analogous RE type descriptions do not suggest this community is reliant on groundwater or associated with wetlands.	2	Mod	Low		1	Mod	I
	Poplar Box Grassy Woodland on Alluvial Plains	Potential dependence on groundwater at 12 – 22m rooting depth.	2	Low	Low			Low	I
Flora	*Cadellia pentastylis* (Ooline)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low		1	Mod	I
	Homopholis belsonii (Belson's panic)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Vincetoxicum forsteri (syn. Tylophora linearis) (Slender Tylophora)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
Fauna	*Phascolarctos cinereus* (Koala)	Habitat and resources unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low		1	Mod	I
	Petauroides volans (Greater Glider)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Geophaps scripta (Squatter Pigeon)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Petaurus australis (Yellow-bellied Glider)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Rostratula australis (Australian painted-snipe)	Habitat possibly affected where wetlands associated with GDEs. Only occasion transient presence anticipated.	3	Mod	Mod			Mod	I
	Adclarkia dulacca (Dulacca Woodland Snail)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Calyptorhynchus lathami (Glossy Black Cockatoo)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Nyctophilus corbeni (Long-eared Bat)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Delma torquata (Collared Delma)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Egernia rugosa (Yakka Skink)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Furina dunmalli (Dunmall's Snake)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Climacteris picumnus victoriae (Brown Treecreeper (south-eastern))	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Stagonopleura guttata (Diamond Firetail)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Aphelocephala leucopsis (Southern whiteface)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Hemiaspis damelii (Grey Snake)	Habitat possibly affected where wetlands associated with GDEs.	3	Mod	Mod			Mod	I
	Anomalopus mackayi (Five-clawed worm-skink)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Grantiella picta (Painted Honeyeater)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Dasyurus hallucatus (Northern Quoll)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I

	MNES	Mitigating Factors	Inherent Risk Rating			Management Controls	Residual Risk Rating		
			Likelihood[1]	Consequence[2]	Risk Rating[3]		Likelihood[1]	Consequence[2]	Risk Rating[3]
Migratory species	*Hirundapus caudacutus* (White-throated Needletail) (both threatened and migratory)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low	Follow procedures stipulated in SDS Section 6 for Containment and Cleanings Up in case of accidental release.	1	Mod	I
	Various migratory species (potential occurrence but no evidence)	Habitat and resources, especially for aerial species, unlikely to be affected; may be impacted by direct uptake of contaminated water.	1	Mod	I		1	Mod	I
Surface Water	Woleebee Creek	All surface water sub-catchments present are vulnerable to above ground chemical spills should drilling activities be occurring within close proximity. Note, these systems are ephemeral systems which are not utilised for abstraction and no freshwater MNES have been verified. Any impacts could be regional.	4	High	High		2	Mod	Low
	Wandoan Creek		4	High	High			Mod	Low
Groundwater	Walloon Coal Measures	Productive coal measure at depth. Unlikely that a surface spill will reach this formation. Aquifer at depth.	2	High	Low		1	High	I
								Mod	I
	Gubberamunda Sandstone	Present at surface in some part of the Project. High groundwater abstraction Supports spring complexes and watercourse springs regionally. Impacts could be at a regional scale.	3	High	Mod		2	High	Low
	Superficial deposits	Present at surface in some parts of the Project area. Does not support groundwater abstraction. Any impacts would be localised.	3	High	Mod		2	High	Low

1 Based on Table 3.2 Likelihood levels in the Chemical Risk Assessment Framework (KCB, 2023)
2 Based on Table 3.3 Consequence levels in the Chemical Risk Assessment Framework (KCB, 2023)
3 Based on Table 3.4 Significance of impact; I represents an 'insignificant impact' in the Chemical Risk Assessment Framework (KCB, 2023)

Final Impact Assessment Before and Following Application of Management and Mitigation Measures: CSG Production Well Construction / Design / Drilling / Integrity Results in Contamination of Aquifers

	MNES	Mitigating Factors	Inherent Risk Rating			Management Controls	Residual Risk Rating		
			Likelihood[1]	Consequence[2]	Risk Rating[3]		Likelihood[1]	Consequence[2]	Risk Rating[3]
Wetlands	RAMSAR wetlands (Great Sandy Strait)	This is located over 300 km from the project. This distance, together with the dilution effect, indicate that the wetlands will not be impacted.	1	Mod	I	**Well Siting** Sites for CSG production wells will be selected based on a good understanding of the local conditions and geology to prevent any potentials for connections of target coal seam gas reservoirs and aquifers (i.e. avoiding the presence of known faults). The Constraints Protocol aims to avoid, minimise and mitigate disturbance to biodiversity values. Brigalow and Poplar Box Grassy Woodland will be avoided by project footprint. **Well Construction** CSG production wells will be designed, constructed and decommissioned in accordance with the "Code of Practice for the construction and abandonment of coal seam gas and petroleum wells and associated bores in Queensland (DNRME 2019)". This code outlines mandatory requirements and good practice to reduce the risk of environmental harm. CSG production wells will be designed to: ▪ Prevent any interconnection between target hydrocarbon bearing formations and aquifers; ▪ Ensure that gas is contained within the well and associated pipework and equipment without leakage; ▪ Ensure zonal isolation between different aquifers is achieved; and	1	Mod	I
Ecological Communities	Brigalow (Acacia harpophylla dominant and codominant)	Analogous RE type descriptions do not suggest this community is reliant on groundwater or associated with wetlands.	2	Mod	Low		1	Mod	I
	Poplar Box Grassy Woodland on Alluvial Plains	Potential dependence on groundwater at 12 – 22m rooting depth.	2	Low	Low			Low	I
	Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Analogous RE type descriptions suggest that this community is not reliant on groundwater or associated with wetlands.	1	Mod	I		1	Mod	I
Flora	*Cadellia pentastylis* (Ooline)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low		1	Mod	I
	Homopholis belsonii (Belson's panic)		2	Mod	Low			Mod	I
	Vincetoxicum forsteri (syn. Tylophora linearis) (Slender Tylophora)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
Fauna	*Phascolarctos cinereus* (Koala)	Habitat and resources unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low		1	Mod	I
	Petauroides volans (Greater Glider)	Habitat possibly affected where wetlands associated with GDEs.	3	Mod	Mod			Mod	I
	Geophaps scripta (Squatter Pigeon)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I

	MNES	Mitigating Factors	Inherent Risk Rating			Management Controls	Residual Risk Rating		
			Likelihood[1]	Consequence[2]	Risk Rating[3]		Likelihood[1]	Consequence[2]	Risk Rating[3]
	Petaurus australis (Yellow-bellied Glider)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low	▪ Not introduce substances that may cause unlawful environmental harm. **Prevention of drilling fluid losses** Selecting the correct drilling additives based on the drilling conditions and formation to prevent excessive fluid losses in the well. Prior to drilling, reference to the geological conditions and fluid losses encountered during the drilling of other nearby bores to assist with selection of the most appropriate fluids. CSG production wells will be flushed with water until all traces of drilling additives are removed.		Mod	I
	Rostratula australis (Australian painted-snipe)	Habitat possibly affected where wetlands associated with GDEs. Only occasion transient presence anticipated.	3	Mod	Mod			Mod	I
	Adclarkia dulacca (Dulacca Woodland Snail)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Calyptorhynchus lathami (Glossy Black Cockatoo)	Habitat possibly affected where wetlands associated with GDEs.	3	Mod	Mod			Mod	I
	Nyctophilus corbeni (Long-eared Bat)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Delma torquata (Collared Delma)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Egernia rugosa (Yakka Skink)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Furina dunmalli (Dunmall's Snake)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Climacteris picumnus victoriae (Brown Treecreeper (south-eastern))	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Stagonopleura guttata (Diamond Firetail)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Aphelocephala leucopsis (Southern whiteface)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Hemiaspis damelii (Grey Snake)	Habitat possibly affected where wetlands associated with GDEs.	3	Mod	Mod			Mod	I
	Anomalopus mackayi (Five-clawed worm-skink)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Grantiella picta (Painted Honeyeater)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Dasyurus hallucatus (Northern Quoll)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
Migratory species	Various migratory species (potential occurrence but no evidence)	Habitat and resources, especially for aerial species, unlikely to be affected; may be impacted by direct uptake of contaminated water.	1	Mod	I		1	Mod	I
Migratory species	*Hirundapus caudacutus* (White-throated Needletail) (both threatened and migratory)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low		1	Mod	I
Surface Water	Woleebee Creek	All surface water sub-catchments present are vulnerable to above ground chemical spills should drilling activities be occurring within close proximity. Note, these systems are ephemeral systems which are not utilised for abstraction and no freshwater MNES have been identified. Any impacts could be regional.	3	High	Mod		1	High	I
Surface Water	Wandoan Creek		3	High	Mod			High	I
Groundwater	Walloon Coal Measures	Productive coal measure at depth. Supports some groundwater abstraction outside of the Project Area. Impacts could be at a regional scale.	3	High	Mod		1	High	I
Groundwater	Gubberamunda Sandstone	High groundwater abstraction. Supports spring complexes and watercourse springs regionally. Impacts could be at a regional scale.	3	High	Mod		1	High	I
Groundwater	Superficial deposits	Supports some groundwater abstraction. Any impacts would be localised.	3	High	Mod		1	High	I

1 Based on Table 3.2 Likelihood levels in the Chemical Risk Assessment Framework (KCB, 2023)
2 Based on Table 3.3 Consequence levels in the Chemical Risk Assessment Framework (KCB, 2023)
3 Based on Table 3.4 Significance of impact; I represents an 'insignificant impact' in the Chemical Risk Assessment Framework (KCB, 2023)

Final Impact Assessment Before and Following Application of Management and Mitigation Measures: Inappropriate Reuse / Disposal of Drill Cuttings and Additives

	MNES	Mitigating Factors	Inherent Risk Rating			Management Controls	Residual Risk Rating		
			Likelihood[1]	Consequence[2]	Risk Rating[3]		Likelihood[1]	Consequence[2]	Risk Rating[3]
Wetlands	RAMSAR wetlands (Great Sandy Strait)	The is located over 300 km from the project. This distance, together with the dilution effect, indicate that the wetlands will not be impacted.	1	Mod	I	**Appropriate disposal of drilling additives** Waste solids will be disposed of to an appropriately licenced facility. Drilling additives to be recycled where possible. Disposed of on site by mix-bury-cover method if the residual drilling material meets the approved quality criteria as per the EA (EA0001207).	1	Mod	I
Ecological Communities	Brigalow (*Acacia harpophylla* dominant and codominant)	Analogous RE type descriptions do not suggest this community is reliant on groundwater or associated with wetlands.	2	Mod	Low		1	Mod	I
	Poplar Box Grassy Woodland on Alluvial Plains	Potential dependence on groundwater at 12 – 22m rooting depth.	3	Mod	Mod			Mod	I
Flora	*Cadellia pentastylis* (Ooline)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low		1	Mod	I
	Homopholis belsonii (Belson's panic)		2	Mod	Low			Mod	I
	Vincetoxicum forsteri *(syn. Tylophora linearis)* (Slender Tylophora)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
Fauna	*Phascolarctos cinereus* (Koala)	Habitat and resources unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low		1	Mod	I
	Petauroides volans (Greater Glider)	Habitat possibly affected where wetlands associated with GDEs.	3	Mod	Mod			Mod	I
	Geophaps scripta scripta (Squatter Pigeon)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Petaurus australis (Yellow-bellied Glider)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Rostratula australis (Australian painted-snipe)	Habitat possibly affected where wetlands associated with GDEs. Only occasion transient presence anticipated	3	Mod	Mod			Mod	I
	Adclarkia dulacca (Dulacca Woodland Snail)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Calyptorhynchus lathami (Glossy Black Cockatoo)	Habitat possibly affected where wetlands associated with GDEs.	3	Mod	Mod			Mod	I
	Nyctophilus corbeni (Long-eared Bat)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Delma torquata (Collared Delma)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Egernia rugosa (Yakka Skink)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Furina dunmalli (Dunmall's Snake)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Climacteris picumnus victoriae (Brown Treecreeper (south-eastern))	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Stagonopleura guttata (Diamond Firetail)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Aphelocephala leucopsis (Southern whiteface)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Hemiaspis damelii (Grey Snake)	Habitat possibly affected where wetlands associated with GDEs.	3	Mod	Mod			Mod	I
	Climacteris picumnus victoriae (Brown Treecreeper (south-eastern))	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Stagonopleura guttata (Diamond Firetail)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
	Aphelocephala leucopsis (Southern whiteface)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low			Mod	I
Migratory species	Hirundapus caudacutus (White-throated Needletail) (both threatened and migratory)	Habitat unlikely to be affected, may be impacted by direct uptake of contaminated water.	2	Mod	Low		1	Mod	I
	Various migratory species (potential occurrence but no evidence)	Habitat and resources, especially for aerial species, unlikely to be affected; may be impacted by direct uptake of contaminated water.	1	Mod	I		1	Mod	I
Surface Water	Woleebee Creek	All surface water sub-catchments present are vulnerable to above ground chemical spills should drilling activities be occurring within close proximity. Note, these systems	4	High	High		1	High	I
	Wandoan Creek		4	High	High			High	I

	MNES	Mitigating Factors	Inherent Risk Rating			Management Controls	Residual Risk Rating		
			Likelihood[1]	Consequence[2]	Risk Rating[3]		Likelihood[1]	Consequence[2]	Risk Rating[3]
		are ephemeral systems which are not utilised for abstraction and no freshwater MNES have been identified. Any impacts could be regional.							
Groundwater	Walloon Coal Measures	Productive coal measure at depth.	2	High	Low		1	High	I
	Gubberamunda Sandstone	Present at surface in some part of the Project. High groundwater abstraction Supports spring complexes and watercourse springs regionally. Impacts could be at a regional scale.	3	High	Mod		1	High	I
	Superficial deposits	Present at surface in some parts of the Project area. Does not support groundwater abstraction. Any impacts would be localised.	3	High	Mod			Mod	I

1 Based on Table 3.2 Likelihood levels in the Chemical Risk Assessment Framework (KCB, 2023)
2 Based on Table 3.3 Consequence levels in the Chemical Risk Assessment Framework (KCB, 2023)
3 Based on Table 3.4 Significance of impact; I represents an 'insignificant impact' in the Chemical Risk Assessment Framework (KCB, 2023)