Chemical Risk Assessment

Comet Ridge Mahalo North Pty Ltd
Mahalo North Coal Seam Gas Project
BAA220014.07
21 November 2024

EXECUTIVE SUMMARY

Epic Environmental Pty Ltd (Epic) were engaged to undertake a chemical risk assessment for chemicals to be used in the coal seam gas (CSG) operations as part of the Mahalo North CSG project (the project). The project is located in the Central Highlands Regional Council area, approximately 45 kilometres (km) north of Rolleston, Queensland. CSG operations refers to initial drilling, operations, maintenance and decommissioning of the CSG production wells.

The aim of the chemical risk assessment was to evaluate the potential risk and effects of chemicals used during CSG operations to Matters of National Environmental Significance (MNES) listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This assessment examined the risks associated with use of drilling fluids and water treatment products and their associated chemicals.

The risk assessment has been undertaken in accordance with national standard and guidelines, including AS/NZS 4360:2004: *Risk Management*, AS/NZS ISO 31000:2009 *Risk Management – Principals and Guidelines* (AS/NZS 2009, 2004) and the *Exposure draft: Chemical risk assessment guidance manual: for chemicals associated with coal seam gas extraction* (Australian Government, 2017).

The first stage of the risk assessment involved identifying the hazardous nature of the products to be used during the drilling and water treatment processes. A product was deemed hazardous if it triggers environmental health hazard criteria or has been identified as a pollutant, contaminant or hazardous material. Where a chemical of a product was considered to be potentially hazardous, further hazard characterisation was undertaken. An exposure assessment was then undertaken to identify the potential chemical sources and risk events which could result in the release of the chemicals to the environment. The final stage of the risk assessment considered the potential for, and magnitude of, the risk to MNES from the identified hazardous chemicals.

17 chemicals were identified for potential use during CSG extraction. Of these 17 chemicals, 12 were deemed to contain chemical of a potentially 'hazardous' nature to the environment. These were then characterised further to understand the consequence of the release of those chemicals into the environment. These chemicals are identified as being potentially harmful to fish, algae and crustacea.

This risk assessment determined that the risk to MNES from hazardous chemicals could be as a result of above ground chemical spills, loss of chemicals to aquifers below ground and incorrect disposal of products and fluids.

The management and mitigation measures that will apply to reduce the risk to MNES include undertaking works in accordance with the following:

- Code of Practice for Constructing and Abandoning CSG Wells and Associated Bores in Queensland (DNRME, 2019)
- Site specific environmental management practices such as, erosion and sediment control plan, environmental management plan, spill response plan, standard operating procedures and environmental contingency plan

The outcome of the risk assessment on the impact to MNES from drilling fluid and water treatment products determined that their likelihood to adversely impact a MNES is highly unlikely to unlikely due to the controls in place during drilling and the site specific protocols in place if a spill did occur. The overall risk to MNES has been assessed as minor significance to insignificant.

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1 INTRODUCTION

Epic Environmental Pty Ltd (Epic) has been engaged by Comet Ridge Mahalo North Pty Ltd (the Proponent) to undertake a chemical risk assessment for chemicals anticipated to be used during coal seam gas (CSG) extraction, as part of the Mahalo North CSG project (the project). CSG operations refers to initial drilling, operations, maintenance and decommissioning of the CSG production wells.

The overarching objective of this risk assessment is to assess potential impacts to Matters of National Environmental Significance (MNES) protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) from the use of chemicals during the project's CSG operations.

This assessment has been carried out in accordance with the following guidelines:

- Department of Climate Change, Energy, the Environment and Water (DCCEEW) (formerly the Department of Environment (DoE)): Significant Impact Criteria provided in '*Significant Impact Guidelines 1.3: Coal seam gas and large coal mining developments— impacts on water resources* (DCCEEW 2022)
- DoE (2013) *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance*
- The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (the IESC): *Information guidelines for proponents preparing coal seam gas and large coal mining development proposals* (IESC 2018)

1.1 Project Overview

The Proponent is proposing to develop a greenfield CSG field within Authority to Prospect (ATP) 2048, encompassing an area of approximately 141 square kilometres (km^2). The project is located approximately 45 km north of Rolleston, in the Central Highlands Regional Council Local Government Area of central Queensland (the site) (**Figure 1**). Infrastructure and activities pertaining to the project include the following:

- Drilling, construction, and operation (including workovers) of vertically and laterally oriented CSG wells from permeable coals in the Denison Trough within the southern Bowen Basin
- Installation, operation and maintenance of water and gas gathering flow lines, including vents and drains
- Construction, operation and maintenance of a gas compression facility (GCF) and necessary associated infrastructure
- Construction, operation and maintenance of a water treatment plant, including above ground lined ring tanks to store produced water from the wells, treated produced water and brine as well as necessary associated infrastructure
- Installation, operation and maintenance of necessary temporary and/or permanent associated infrastructure, including but not necessarily limited to well pads, access roads, power and communication systems, laydown and storage areas, and administration facilities
- Decommissioning and rehabilitation of infrastructure and disturbed areas as necessary post-production

Figure 1. Project Location

1.2 Document Structure

1.2.1 Assessment Against Independent Expert Scientific Committee on coal seam gas and large coal mining development checklist

The IESC is a statutory body governed by the EPBC Act. The IESCs key function in regard to this project is to provide scientific advice to the Commonwealth Environment Minister and relevant state ministers in regard to CSG development proposals that have the potential to have a significant impact on water resources.

To allow the IESC to provide robust scientific advice to government regulators on water-related impacts of CSG, a guideline (IESC 2018) was developed outlining the information considered necessary for the IESC to undertake their assessment. The information checklist related to this chemical risk assessment and the relevant sections of this report is provided in **Table 1.**

Fracturing using hydraulic stimulation is not proposed as part of the project's operations, and therefore checklist items related to this activity are not applicable or addressed further in this report.

Table 1. Assessment Against IESC Checklist

Checklist Title	Checklist Item	Section Addressed
CSG well construction and operation	Describe the scale of fracturing (number of wells, number of fracturing events per well), types of wells to be stimulated (vertical versus horizontal), and other forms of well stimulation (cavitation, acid flushing)	Not applicable, no fracturing is proposed for the project
	Describe proposed measuring and monitoring of fracture propagation	Not applicable, no fracturing is proposed for the project
	Identify water source for drilling and hydraulic stimulation and outline the volume of fluid and mass balance (quantities/volumes)	No hydraulic stimulation will occur. Refer to Section 4 and Section 5.3 of the CSG Water Management Plan (RDMHydro 2023)
	Describe the rules (e.g. water sharing plans) covering access to each water source used for drilling and hydraulic stimulation and how the project proposes to comply with them	No hydraulic stimulation will occur. Refer to Section 1.1 of the CSG Water Management Plan (RDMHydro 2023)
	Quantify and describe the quality and toxicity of flowback and produced water and how it will be treated and managed	Refer to Section 1.2 and Section 1.3 of the CSG Water Management Plan (RDMHydro 2023)
	Assess the potential for inter aquifer leakage or contamination	**Section 6:** Exposure Assessment
	The use of drilling and hydraulic fracturing chemicals should be informed by appropriately tiered deterministic and/or probabilistic hazard and risk assessments, based on ecotoxicological testing consistent with Australian Government testing guidelines (NRMMC-EPHC-NHMRC 2009; Commonwealth of Australia 2012)	**Section 2.2:** Risk Assessment Method **Section 7:** Risk Characterisation
	Propose waste management measures (including salt and brine) during both operation and legacy after closure	Refer to Section 5.2 of the CSG Water Management Plan (RDMHydro 2023)

Checklist Title	Checklist Item	Section Addressed
	List the chemicals proposed for use in drilling and hydraulic stimulation including: • Names of the companies producing fracturing fluids and associated products • Proprietary names (trade names) of compounds (fracturing fluid additives) being produced • Chemical names of each additive used in each of the fluids • Chemical Abstract Service (CAS) numbers of each of the chemical components used in each of the fluids • General purpose and function of each of the chemicals used • Mass or volume proposed for use • Maximum concentration (mg/L or g/kg) of the chemicals used • Chemical half-life data, partitioning data, and volatilisation data • Ecotoxicology • Any material safety data sheets for the chemicals or chemical products used	**Sections 2.2.2** and **2.2.3**: Hazard Identification and Characterisation
	Chemicals for use in drilling and hydraulic fracturing must be identified as being approved for import, manufacture or use in Australia (that is, confirmed by NICNAS as being listed in the Australian Inventory of Chemical Substances (refer Commonwealth of Australia 2017)	**Sections 2.2.2** and **2.2.3**: Hazard Identification and Characterisation

2 RISK ASSESSMENT OVERVIEW

This report has been prepared with the consideration of key policies and legislation enacted by the Commonwealth of Australia. The following sections provide an overview of key legislation and policies that are relevant to this assessment.

2.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act provides the legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, water resources, parks, and heritage places, collectively known as matters of national environmental significance (MNES). Activities likely to have a significant impact on MNES are subject to assessment and the approval process under the Act. Water resources in relation to CSG and large coal mining development projects are a MNES.

2.1.1 Significant Impact Guideline 1.3: Coal Seam Gas and Large Coal Mining Developments

Section 1.1 of the *Significant Impact Guideline 1.3: Coal Seam Gas and Large Coal Mining Development – impacts on water resources* (DCCEEW 2022) (Significant Impact Guideline), states that under the EPBC Act, an action that involves a CSG development or a large coal mining development requires the approval from the Australian Government's Environment Minister (the Minister) if the action has, will have, or is likely to have a significant impact on a water resource. A 'significant impact' is further outlined in section 4.1.1 of the Significant Impact Guideline and stipulates it is an impact "*which is important, notable, or of consequence, having regard to its context or intensity*".

Further, Section 4.2 of the Significant Impact Guideline indicates that an action is likely to have a significant impact on a water resource if there is a real or not remote chance, or possibility of directly or indirectly resulting in a change to the hydrological characteristics or the water quality of a water resource. This in turn may impact third party users, the environment and other public benefit outcomes.

The following aspects have been identified in Section 4.3 of the Significant Impact Guideline, which should be considered when assessing changes to hydrological characteristics:

- Flow regimes (volume, timing, duration, and frequency of surface water flows)
- Recharge rates to groundwater
- Aquifer pressure or pressure relationships between aquifers
- Groundwater table and potentiometric surface levels
- Groundwater surface water interactions
- River floodplain connectivity
- Inter aquifer connectivity
- Coastal processes including changes to sediment movement or accretion, water circulation patters, permanent alterations in tidal patterns, or substantial changes to water flows or water quality in estuaries.

Section 4.4 of the Significant Impact Guideline outlines aspects relating to changes to water quality in which a significant impact may occur as a result of the following:

- Ability to achieve relevant local or regional water quality objectives would be materially compromised due to the action:
  - Creates a risk to human or animal health or to the condition of the natural environment as a result of the change in water quality
  - Substantially reduces the amount of water available for human consumption or other uses, including environmental uses, which are dependent on water quality of an appropriate nature
  - Causes persistent organic chemicals, heavy metals, salt or other potentially harmful substances accumulating in the environment
  - Seriously effects the habitat or lifecycle of native species dependent on water resources
  - Causes the establishment of an invasive species (or the spread of an invasive species) that is harmful to the ecosystem
- There is a significant worsening of local water quality

- High quality water is released into an ecosystem which is adapted to lower quality of water

Potential changes to water quality due to the use of drilling fluids have been evaluated as part of this assessment in order to identify potential impacts.

2.2 Risk Assessment Method

2.2.1 Method Overview

A four-stage risk assessment has been adopted for this investigation, generally in accordance with the guidelines provided in the Organisation for Economic Co-Operation and Development (OECD) *Risk Assessment Toolkit* (OECD 2014). The four stages of the chemical risk assessment framework have been shown in **Figure 2** and explained in **Sections 2.2.2** to **2.2.5**.

In addition to the above the risk assessment method was developed with reference to the:

- *AS/NZS 4360:2004: Risk Management* and *AS/NZS ISO 31000:2009 Risk Management – Principals and Guidelines*
- *Risk Assessment Guidance Manual: for chemicals associated with coal seam gas extraction* (DoE 2017a)
- *Environmental Risk Assessment of Chemicals used in WA Petroleum Activities Guideline* (Department of Mines and Petroleum 2013)
- *National Assessment of Chemicals Associated with Coal Seam Extraction in Australia,* Commonwealth of Australia, Canberra, Technical Reports (DoE 2017b, 2017c; NICNAS 2017)

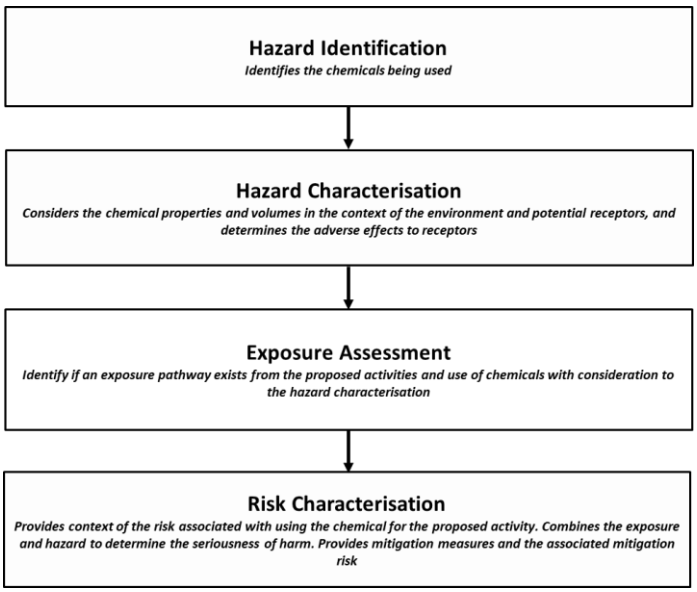

Figure 2. Chemical Risk Assessment Framework

Source: Based on OECD Toolbox; OECD 2014 and the Chemical Assessment Guidance Manual Department of the Environment and Energy (DoEE) 2017a

To appropriately assess the environmental impacts due to the use of chemicals, the following stages of the chemical lifecycle were considered:

- Transport and storage to and on the site
- Processing on site at the CSG production well head prior to use
- During use down-hole at the CSG production well
- Processing on site at the water treatment plant
- Disposal of the waste fluid

2.2.2 Hazard Identification

The identification of products and chemicals used in the drilling process and water treatment is an important process of hazard identification. It details how products will be used and assesses their hazardous nature and the chemicals within them.

An initial review has been carried out to clarify whether products proposed to be used could be determined a 'hazard'. A product or chemical is deemed hazardous (Department of Mines and Petroleum 2013) if it:

- Meets health hazard criteria
- Meets environmental health hazard criteria
- Identifies as a pollutant, contaminant or hazardous good on its Safety Data Sheet (SDS)

Products or the chemicals within the products that were identified as hazardous were then assessed further under this method. It is important to note that the scope of the risk assessment only applies to potential harm to MNES, and the risk of harm to human health is beyond the scope of this risk assessment.

2.2.2.1 Products and Chemicals not Requiring a Detailed Risk Assessment

Products or chemicals not considered to require a detailed risk assessment as part of this assessment included:

- Inert, man-made products
- Products not meeting the criteria of being harmful, toxic, or very toxic to human health and / or the environment

2.2.3 Hazard Characterisation

Where a product or chemical is considered to be potentially hazardous in accordance with the criteria described in **Section 2.2.2**, further hazard characterisation was undertaken. This characterisation further assessed the chemical constituents to consider (as per DoE 2017a):

- The nature and state of the chemicals at surface and their solubility, to determine the potential for chemicals to enter the environment
- The fate and transport of the chemical in the environment including an assessment of the mobility, potential for bioaccumulation and degradation
- An assessment of chemical volumes proposed to be used in the context of the environment, with a comparison against relevant environmental hazard criteria

The fate of a chemical depends on its chemical and physical properties including its persistence, solubility, binding ability, volatility and how it reacts in the environment that it is released into. Relevant information of the chemicals was obtained from the SDS provided by the drilling fluid supplier for the products proposed to be used in the drilling activities (**Appendix A**)

2.2.4 Exposure Assessment

An exposure assessment identified the potential chemical sources and 'risk events' where a release to the environment had the potential to occur. The consideration of the likely fate and transport of the chemical, the likely exposure pathways and resulting potential impacts on MNES were assessed.

2.2.4.1 Exposure Pathways

Exposure pathways can include:

- Overland flow into nearby surface water systems
- Infiltration / leaching through soil into shallow groundwater systems
- Groundwater flow as a result of a loss of chemicals in the well
- Direct contact between chemical and receptor

2.2.5 Risk Characterisation

A tiered approach is recommended by DCCEEW (formerly DoEE) (DoEE 2017); based on this guidance chemicals are classified into three tiers. This approach entails increasing level of complexity, commensurate refinement of assumptions, and the inclusion of additional, more site specific data. Based on the classification category of the chemical (and its potential toxicity, persistence and bioaccumulation potential) different levels of assessment will be undertaken. The following are reviewed within the screening assessment to determine the appropriate chemical tier level:

- **Persistence:** Persistence refers to whether, and how fast, a chemical degrades in the environment over time. Chemicals that are persistent in the environment may cause chronic health problems, particularly in humans and animals that are high in the food chain. The Stockholm Convention provides scientifically based criteria for identifying persistent organic pollutants and is used in this assessment to define a chemical's persistence in water, soil and air and has been adopted in the Environmental Risk Assessment Guidance Manual: for industrial chemicals (EPHC 2009b)
- **Bioaccumlation:** Bioaccumulation is the general term describing a process by which chemicals are taken up by a plant or animal either directly through exposure to a contaminated medium (soil, sediment, water) or by eating food containing the chemical (DoEE 2017). The criteria for bioaccumulation used in this assessment has been taken from the Exposure draft: Chemical risk assessment guidance manual: for chemicals associated with coal seam gas dextraction (DoEE 2017), which adopts the criteria from the Environmental Risk Assessment Guidance Manuals (EPHC 2009b; 2009a).
- **Toxicity:** Ecotoxicity data are used to determine the toxic hazards posed by a chemical to terrestrial and aquatic organisms. The assessment process involves collecting all available acute and chronic data and considering how this data can inform the assessment (DoEE 2017). The minimum data set for quantitative CSG chemical risk assessments comprises acute toxicity tests for fish and invertebrates, and a chronic test for algae, however chronic data for fish and invertebrates are preferable if they are available. Acute and chronic toxicity are assessed against criteria from the Exposure draft: Chemical risk assessment guidance manual: for chemicals associated with coal seam gas extraction (DoEE 2017)

The overall tier level is determined by the highest tier value assigned for each criterion (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). A general description of the chemical tiers, category and the assessment required is summarised in **Table 2**.

Table 2. Description of Chemical Tiers

Tier	General Description	Category	Risk Assessment Required	Management Measures
1	• Not persistent • No potential concerns with bioaccumulation on flora and fauna, and • No/low Toxicity	Chemicals of low concern	No further assessment required	Standard management measures suitable
2	• Persistent • Low / no bioaccumulate, and • Acute toxicity, toxic with long lasting effects	Chemicals of potential concern	Toxicological profile Qualitative Risk Assessment	Site specific management Measures
3	• Persistent • Does bioaccumulate, and • Very acutely toxic, long term toxicity – very toxic with long lasting effects	Chemicals of potentially High concern	Toxicological Profile Qualitative and quantitative risk assessment	Site specific management Measures

2.2.5.1 Tier 1: Chemical of low concern

Tier 1 are chemicals that are categorised as of low concern which requires basic toxicological assessment and screening that will have no impacts on flora and fauna. Tier 1 chemicals are also chemicals not listed as a chemical of concern on relevant databases.

2.2.5.2 Tier 2: Chemicals of potential concern

Tier 2 chemicals are chemicals that will undergo a qualitative assessment in addition to a basic toxicological assessment and screening. The qualitative risk assessment includes:

- Further hazard characterisation
- Determination of pathways to identified receptors
- A risk assessment which examines the likelihood, consequence, and subsequent magnitude to MNES from the chemical. This is undertaken both with and without management and mitigation measures in place

2.2.5.3 Tier 3: Chemical of potentially high concern

Tier 3 chemicals will have to undergo a quantitative risk assessment in addition to the qualitative risk assessment as outlined above. The assessment will be more site-specific and is tailored towards specific locations including distance to a watercourse. Tier 3 chemical will also require additional mitigation and management controls to ensure the potential risk to MNES has been reduced as much as is reasonably practicable.

2.2.6 Risk Assessment

The risk assessment is a qualitive evaluation of **Tier 2** and **Tier 3** chemicals (refer **Section 2.2.5**), which takes into consideration the likelihood of exposure and allocated a rating of the consequence of the exposure. The likelihood of exposure was assessed by examining the likelihood that a chemical used in CSG extraction could reach a MNES receptor, based on known pathways and following the application of the management and mitigation measures. The likelihood of exposure ranking is provided in **Table 3.**

Table 3. Likelihood of Exposure

Rank	Description	Example
1	Highly unlikely	No known connection between the source and receptor – there is no pathway i.e. source is solid and not soluble – highly unlikely pathway to surface water and groundwater systems
2	Unlikely	Unlikely connection between the source and the receiving environment. Unlikely for a surface spill and underground use to reach a receptor
3	Possible	Possible connection between the source and the receptor (i.e. connection of coal seams with an aquifer being used for extraction). Possible that surface and groundwater spills could reach the receiving environment
4	Likely	Likely connection between the source and the receiving environment. Likely that surface and groundwater spills could reach receiving environment, or direct contact occurs
5	Very likely	Confirmed connection between the source and the receiving environment, with the receiving environment (aquifer) being used for drinking water or discharging to an ecosystem. Very likely that a surface and groundwater spills will reach receiving environment

The consequence of Tier 2 and Tier 3 chemical used was then assessed using the consequence levels outlined in **Table 4**. The consequence level of a chemical to MNES is based on the hazard characterisation identified for each chemical.

Table 4. Consequence Levels

Magnitude	Description	Example
Negligible	Negligible potential for adverse effects	• Low severity and short-term, impacts restricted to the immediate area of an activity or footprint • Very minor chemical incident (<20 litres [L]) • Minimal environmental impacts • Insignificant departure from Commonwealth or State policy or guidance
Low	Results in some measurable changes in attributes quality of vulnerability	• Chemical incident (20 L to 100 L) • Impacts likely to persist for short duration only, with rapid recovery when the activity is completed • Impact is restricted to the Bandanna Formation/Bandanna Coal Measures only and other aquifers or users are not affected • Impact causes minor departure from Commonwealth or State policy or guidance
Moderate	Results in impact on the integrity of attribute at a localised scale	• Significant chemical event (100 L to 1,000 L) • Minor, but manageable, environmental impacts • Rapid recovery upon activity completion • Potential health impacts • Impact may occur across aquifers and groundwater features, or users may be affected • Moderate potential for adverse effects on aquatic ecosystems
High	Results in impact on the integrity of attribute or loss of part of attribute at a regional scale	• Chemical pollution or contamination is likely (1,000 L to 10,000 L) • Significant environmental impacts • Significant health impacts • High potential for adverse effects on the aquatic ecosystems
Severe	Results in loss of attribute	• Irreversible or persistent high-severity impact likely (>10,000 L) • No recovery within the foreseeable future • Impacts are at a regional, national or international scale • Impacts to groundwater may include impacts across aquifers regionally • Groundwater discharge features and users are affected

A final risk rating was determined for each particular risk by combining the consequence level with the likelihood level (refer **Table 5**). The risk to MNES from chemical use was considered using the Significant Impact Guidelines (DCCEEW 2022), where a 'significant impact' is described as an impact which is important, notable or of consequence, having regard to its context or intensity. The following risk rating was determined:

- **Significant**: Significant impact with high likelihood of impact to MNES. Level of impacts are considered as unacceptable. Impacts may be irreversible or have a persistently high severity impact on the quality or availability to surface water or groundwater
- **Medium**: Moderate severity with MNES impacts persisting over time. Level of impacts are considered as unacceptable. Impacts may be tolerable, but risk treatment and mitigation should apply where possible
- **Minor**: Impacts to MNES will be impacted at a low severity. Level of impacts are considered as acceptable with risk treatments applied. Impacts will be of a short duration and the receptor will have a rapid recovery when the activity is complete
- **Insignificant**: An insignificant impact exists to MNES. Level of impacts are considered to be acceptable with no risk treatment necessary. The impact is of low severity and restricted to a localised area of activity. There are no medium or long-term impacts and recovery is rapid

Table 5. Risk Rating Assessment

		Likelihood				
		Highly Unlikely (1)	**Unlikely (2)**	**Possible (3)**	**Likely (4)**	**Highly Likely (5)**
Consequence	**Severe (E)**	Minor	Medium	Significant	Significant	Significant
	High (D)	Insignificant	Minor	Medium	Significant	Significant
	Moderate (C)	Insignificant	Minor	Medium	Medium	Medium
	Low (B)	Insignificant	Minor	Minor	Minor	Minor
	Negligible (A)	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant

2.2.7 Predicted Impact on MNES

The consequence of a chemical impacting on a MNES is based on the hazard characterisation of each chemical. The significance of impact on a MNES has been assessed and is typically based on the following:

- The likelihood of an impact reaching a MNES receptor
- The environmental consequence on the MNES receptor

The significance of the inherent risk is assessed prior to the consideration of mitigating factors. With the significance of the residual risk assessed following consideration of mitigating factors.

The full risk assessment is provided in **Table 19** to **Table 22.** This is based on the criteria provided in **Section 2.4.4** which outlines the risk assessment method utilised by the project and provides the Likelihood (**Table 2**), Consequence Levels (**Table 3**) and Risk Rating (**Table 4**).

2.3 Management and Mitigation Measures

All current plans and procedures developed and implemented by the Proponent in order to manage and mitigate the risk to the environment from chemical use, are described in **Section 9**. These plans and procedures are developed to reduce the likelihood and subsequent risk to MNES, as identified in the exposure assessment.

3 PROJECT DESCRIPTION

The project involves the construction and operation of a greenfield CSG plant, pipeline and well infrastructure contained within ATP2048, comprising approximately 141 km^2, refer to **Figure 3.**

3.1 Project Status

A summary of the project's approval status includes the following:

- Authorisation to carry out petroleum exploration activities within ATP2048 in accordance with Environmental Authority (EA) EA0002076, under the *Environmental Protection Act 1994* (EP Act)
- The Proponent is currently in the process of applying for a Petroleum Lease (PL) under the *Petroleum and Gas (Production and Safety) Act 2004* (P&G Act)
- The Proponent is currently in the process of applying for an EA to authorise production activities within the PL
- The project has been referred to the DCCEEW for consideration under the EPBC Act
- The project received a controlled action decision and will be assessed via preliminary documentation
- This Chemic

3.2 Project Components

The project will include the drilling and completion of up to 68 CSG wells (including a mix of vertical and lateral wells) over an estimated 30-year project life, which is planned to commence in 2025. The project will include the following activities:

- Drilling, construction, and operation (including workovers) of vertically and laterally oriented CSG wells from permeable coals in the Denison Trough within the southern Bowen Basin (refer to **Section 3.3** for further details)
- Installation, operation and maintenance of water and gas gathering flow lines, including vents and drains
- Construction, operation and maintenance of a GCF and necessary associated infrastructure
- Construction, operation and maintenance of a water treatment plant, including above ground lined ring tanks to store produced water from the wells, treated produced water and brine as well as necessary associated infrastructure (refer to **Section 3.4** for further details)
- Installation, operation and maintenance of necessary temporary and/or permanent associated infrastructure, including but not necessarily limited to well pads, access roads, power and communication systems, laydown and storage areas, and administration facilities
- Decommissioning and rehabilitation of infrastructure and disturbed areas as necessary post-production

3.3 Drilling Activities

The *Code of Practice for Construction and Abandonment of Petroleum Wells and Associated Bores in Queensland Version 2* (Department of Natural Resources, Mines and Energy (DNRME) 2019) (the Code) outlines mandatory requirements to ensure all petroleum wells and associated bores are constructed, maintained, and abandoned to a minimum acceptable standard to reduce the risk of environmental harm.

The Code has been designed to complement the operator's internal risk assessment processes, operating standards, and procedures by outlining a recommended process to ensure that:

- Environment and groundwater resources are protected
- Risk to the public and workers is managed to a level as low as reasonably practicable
- Regulatory and applicable Australian and international standards/requirements, as well as the Operator's standards, are understood and implemented where appropriate
- The life of a petroleum well or associated bore is managed effectively through appropriate design
- Construction techniques and ongoing well integrity monitoring

All CSG production wells will be designed, constructed, and decommissioned in accordance with the Code.

3.3.1 Activity Description

A description of the activities associated with the drilling activities is outlined in **Table 6.**

Table 6. Description of Drilling Activities

Construction	**Activity**	• Drilling of wells using rotary mud or air drilling • Completion of well using the completion rig • Equipment includes fuel and chemical storage, diesel generator(s), mud tanks, flare tank, temporary site buildings and storage unit(s) • Drilling fluids are ordered as needed
	Area	• Drilling and completions rig, and associated equipment contained within the drill pad. Initial disturbance area of 1 hectare (ha) required • Following construction of the well, sites will be partially rehabilitated, leaving an area of up to approximately 0.04 ha allowing for well maintenance
	Timeframes	• Drill rig work undertaken 24-hour, 7 days per week • Completions working undertaken 24-hour, 7 days per week
Operations (including workovers)	**Activity**	• Well workover: workover operations to clean-out wells of solids, replace pump and down-hole components, installation on new completions
	Area	• Workover rig will work within a flat pad area • Areas outside the required pad will be rehabilitated in the interim to final abandonment and rehabilitation
	Timeframes	• The production well will remain operational for the life of the well, expected to be 12-15 years • Workovers of wells will be completed as required, not expected to be a frequent occurrence
Decommissioning	**Activity**	• Includes decommissioning, plugging, rehabilitation and monitoring • Vertical wells will be fully cemented back to surface from the bottom • Lateral wells will be cemented from the bottom of the 7 inch casing back to the surface • Fluid displaced from the well will be put in onsite brine tank(s)
	Area	• Well sites and GCF
	Timeframes	• Decommissioning is completed progressively as wells are depleted, plugged and abandoned over the life of the project

Once depleted, CSG production wells will be decommissioned, plugged, abandoned, and rehabilitated, with new CSG production wells drilled to maintain production needs, if required.

3.3.2 Use of Drilling Fluids

While drilling, fluid will be circulated down the drill string and up the annulus (space) between the drill string and well wall. Drilling fluids serve to lubricate the drilling assembly, remove the formation cuttings, maintain control of the well and stabilise the hole being drilled.

Drilling fluid, or muds, generally consist of a mixture of water, clays, fluid loss control additives, density control additives, and viscosifiers. Oil-based and synthetic oil-based drilling muds will not be used.

To avoid well formation damage and to limit corrosion, a drilling fluid specific for each CSG production well will be selected that is appropriate to the well design, and local experience and anticipated geological conditions. The standard drilling fluid to be used is water-based.

Potassium chloride will be used as a weighting agent to help control swelling clays. Organic polymers and clays may be added to the base fluid to raise the viscosity and assist in removing drill cuttings. Compounds that include benzene, toluene, ethylbenzene, or xylenes, (known as BTEX) will not be used. Biocides will be used during drilling and workover of production wells to prevent microbial growth and contamination and prevent the build-up of biofilms.

Cement will be used in the drilling and plug and abandonment (P&A) phase of the project. Cement will be used during the drilling phase to cement in the steel casing in the anulus between the outside of the steel casing and the wall of the well bore.

Vertical and lateral wells will be filled with cement during P&A using the following methods:

- Vertical wells will be fully cemented back to surface from their base, and
- Lateral wells will be cemented from bottom of the seven inch casing back to the surface, with the lateral wells themselves will not be cemented up

Drilling fluids are selected and managed to ensure all products are used in accordance with the manufacturer's recommendations and relevant SDS (refer to **Appendix A**). The name, type and quantity of each drilling fluid additive used on each well is recorded. Information on drilling fluids is also required to be included in the 'well completion report' for each well. This is required to be submitted to the Queensland Department of Resources (DoR) under the P&G Act.

3.3.3 Drilling Locations

To support CSG field layout for infrastructure, including wells and gathering pipelines, the Proponent will implement the Proponent's *Environmental Protocol for Constraints Analysis and Field Development* (the Protocol) for cases where construction involves significant disturbance to land. The Protocol aims to avoid or limit (where avoidance is not possible) impacts such that infrastructure siting:

- Considers biodiversity values and environmental constraints
- Is compliant with State (including EA conditions) and Commonwealth regulatory requirements
- Identifies any external environmental approvals required

With respect to environmental values, the protocol addresses avoiding or minimising and managing potential impacts to:

- Biodiversity values contributing to MNES
- Habitat for wildlife, including MNES threatened ecological communities, flora, and fauna
- Wetlands, watercourses, springs, and groundwater dependent ecosystems

The Protocol also recognises that, in addition to environmental constraints, landholder, engineering and cultural heritage constraints must be considered during infrastructure siting.

3.3.4 Drilling Waste Materials

The Queensland Department of Environment, Science and Innovation (DESI) regulates management and disposal of wastes under provisions of the EP Act, *Waste Reduction and Recycling Act 2011* (WRR Act) and subordinate legislation.

Waste materials created from the drilling process and their subsequent disposal for the project is outlined in **Table 7.** Drilling fluids will be recycled wherever possible and at the end of their lifecycle will be disposed of at an appropriately licensed facility.

Table 7. Waste Materials from Drilling and Disposal

Waste material	Well type	Approximate quantities	Disposal options
Drill cutting and residual muds combined	Vertical	22 cubic meter (m^3) per well	Disposed to an appropriately licensed facility or manage in accordance with the DES End of waste code Coal Seam Gas Drilling Mud (ENEW07543018)
	Lateral	157 m^3 per well	

3.4 Water Treatment

A water treatment facility will be constructed to treat produced water to facilitate the beneficial use of water at a nominal treatment rate of up to approximately 1.0 megalitre (ML)/day.

The water treatment facility will include the following infrastructure:

- A package water treatment plant
- Above ground lined ring tanks to store:
  - Produced water from the wells
  - Treated produced water
  - Brine
- Aboveground pipes to connect water treatment plant and the ring tanks
- Pumping equipment to facilitate the transfer of treated produced water for beneficial re-use

Treated produced water generated from the project will be beneficially used to support irrigation and industrial activities and, development and operational activities (including drilling the wells and dust suppression). Treated produced water used for off-site purposes will be undertaken in accordance with the *End of Waste Code Associated Water (including coal seam gas water)* (ENEW07547018) and *End of Waste Code Associated water for irrigation (including coal seam gas water)* (ENEW07546918).

3.4.1 Activity Description

A description of the water treatment activities during CSG operations are outlined in **Table 8.**

Table 8. Description of Water Treatment Activities

Operations	**Activity**	• Operation of a reverse osmosis plant to treat water • Treated produced water from any treatment process will be stored in up to 100 ML of above-ground storages (e.g. lined ring tanks) • Constructed and operated in accordance with the manufacturers' specifications
	Area	• The water treatment plant is proposed to be located within the GCF
	Timeframes	• The water treatment plant will remain operational for the life of the project (30 years)

3.4.2 Brine and Salt Management

The DESI (formally Department of Environment and Heritage Management (DEHP)) hierarchy with the CSG Water Management Policy (DEHP 2012) provides a prioritisation hierarchy for managing saline waste as follows:

- Priority 1 – Wherever feasible, brine or salt residues are treated to create usable products
- Priority 2 – Once the feasibility of treating the brine or salt residues to create usable and saleable products has been assessed, disposal of the brine and salt residues is done in accordance with strict standard that protects the environment.

Brine from any treatment process will be stored in up to 100 ML of above-ground storages (e.g. lined ring tanks), constructed and operated in accordance with the manufacturers' specifications, from where it may be further concentrated via solar and mechanical evaporation to a concentrated slurry or solid salt. The concentrated waste product will be disposed of at a licensed Waste Facility.

<insert figure here>

Figure 3. Project Infrastructure Layout

4 ENVIRONMENTALLY SENSITIVE RECEPTORS

An updated MNES Ecological Assessment Report (EAR) has been prepared by Epic in November 2024 to support the legislated environmental approvals process for the project, building on an earlier EAR report completed in March 2024 (Epic 2024). The purpose of the assessment was to document the baseline terrestrial ecological values of the project area and provide avoidance, mitigation and management measures to adequately address impacts associated with the project. The study area for the EAR is the PL boundary. Refer to Section 5 and Section 6 of the EAR for baseline findings and Section 7 for potential impacts and mitigation measures. A summary of the findings from the EAR is provided in **Sections 4.1** to **Section 4.3** below.

4.1 Matters of National Environmental Significance

The DCCEEW Protected Matters Report (PMR) identified species of MNES protected under the EPBC Act considered to be potentially impacted by the project. The PMR identified three categories of MNES potentially present in the project area or surrounds, refer to **Table 9.**

Table 9. PMR Summary

MNES	PMR Search Result of Relevance to Project
World heritage properties	Not applicable
National heritage places	Not applicable
Wetlands of International Importance	Not applicable
Great Barrier Reef Marine Park	Not applicable
Commonwealth Marine Area	Not applicable
Listed Threatened Ecological Communities (TEC)	Five TECs predicted to be present
Listed threatened species	Thirty species listed as threatened predicted to be present including eight flora species and 22 fauna species
Listed migratory species	Nine species listed as migratory predicted to be present

4.2 Matters of State Environmental Significance

The Queensland Government Environmental Reports Online portal identified a number of MSES as present within the project area, as summarised in **Table 10.**

Table 10. Applicable MSES Matters

Matters of State Environmental Significance	Relevance to Project
Wetlands in a wetland protection area or wetlands of high ecological significance as listed under the Environmental Protection Regulation 2019	There is a large area mapped as a Wetland Protection Area in the north of the project area.
Protected wildlife habitat for species listed as threatened or special least concern (*Nature Conservation Act 1994*, NC Act) fauna or flora as listed under the *Nature Conservation (Animals) Regulation 2020* (NC Animals Regulation) or the *Nature Conservation (Plants) Regulation 2020* (NC Flora Regulation)	There are patches of protected wildlife habitat located throughout the study area. These are considered to provide core habitat for Ornamental Snake (*Denisonia maculata*).
Regulated vegetation under the *Vegetation Management Act 1999* (VM Act):	
Category B (remnant) areas on the regulated vegetation management map, that are 'endangered' and 'of concern' regional ecosystems	There are a number of polygons mapped as present comprising vegetation listed as endangered under the VM Act. These largely occur on Togara property. Meroo comprises polygons on the southern boundary of the study area comprising vegetation listed as endangered and of concern.
Essential habitat on the essential habitat map for wildlife prescribed as critically endangered, endangered or vulnerable under the NC Act	There are patches of essential habitat located throughout the study area. These are considered to provide habitat for Ornamental Snake.

Matters of State Environmental Significance	Relevance to Project
Regulated vegetation located within a defined distance from the defining banks of a relevant watercourse identified on the VM Act watercourse and drainage feature map	Watercourse mapping intersects very little regulated vegetation within the study area. This largely occurs in two vegetation polygons in the north of the project area.
Regulated vegetation management located within a wetland or within 100 metres from the defining bank of a wetland identified on the VM Act wetlands map	Two mapped wetland areas occur in the north of the project area.

4.3 Nationally Threatened Species and Ecological Communities

4.3.1 Threatened Ecological Communities (TEC)

The PMR identifies the following five TECs as possibly present:

- Brigalow (*Acacia harpophylla* dominant and co-dominant) (Brigalow TEC)
- Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin
- Poplar Box Grassy Woodland on Alluvial Plains
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (SEVT TEC)
- Weeping Myall Woodlands

Following the baseline flora and fauna field assessments undertaken in April 2022, September 2023, and July 2024 by two suitably qualified Epic Ecologists, it was determined that there are six regional ecosystems (RE) comprising Brigalow communities listed as Endangered under the EP Act present. The majority of vegetation is listed as No Concern under the EP Act. There are substantial differences with the current State Government RE mapping which overstates the potential extent of Brigalow communities present within the project. The EPBC Act listed Brigalow TEC is considered present as scattered patches throughout the project area. The ground-truthed area for Brigalow TEC within the project area is estimated at 259.44 ha (Epic 2024). A single small patch of SEVT TEC occurs in the south-east corner of the project area (Epic 2024). The patch is approximately 1 ha and surrounded by Mountain Coolibah woodland and is located approximately 300 m from the nearest project infrastructure (Epic 2024).

4.3.2 Conservation Significant Flora Species

The likelihood of occurrence assessment for conservation significant flora species identified in database searches determined that a single threatened species, *Solanum elachophyllum*, is known to occur within the project area (based on records associated with works carried out by EMM 2022).

A single threatened flora species is likely to occur within the project area (Epic 2024):

- Annual wiregrass (*Aristida annua*)

One further flora species is considered a possible occurrence within the project area (Epic 2024):

- Ooline (*Cadelia pentastylis*)

The remaining threatened flora species are considered unlikely to occur within the project area (Epic 2024).

4.3.3 Threatened Fauna Species

- The PMR predicted the potential presence of 22 fauna species listed as Vulnerable or Endangered.

No conservation significant fauna listed as threatened were recorded during the 2022 or 2023 field surveys (Epic 2024). There was one species identified, the Short Beaked Echidna (*Tachyglossus aculeatus*) which is listed as special least concern (SLC) under the NC Act. White-throated Snapping Turtle listed as Critically Endangered under the EPBC act was recorded to the immediate west of the project area at a waterhole on the Comet River.

A detailed assessment of the likelihood of occurrence within the project area of conservation significant fauna species identified during the desktop review is provided within the EAR (Epic 2024)**.** The EAR has identified one conservation significant species known to occur, the White-throated Snapping Turtle. Two species as likely to occur, the Ornamental Snake and Koala and an additional six conservation significant species as potentially occurring, the Australian Painted Snipe, Latham's Snipe, Sharp-tailed Sandpiper, Squatter Pigeon, Painted Honeyeater, and Grey Snake. (Epic 2024).

4.3.4 Migratory Species

No conservation significant migratory species were recorded during the 2022 or 2023 field surveys (Epic 2024). The likelihood of occurrence assessment undertaken as part of the EAR identified four migratory species listed under the EPBC Act which may possibly occur based on the habitat values within the project area.

- Glossy Ibis (*Plegadis falcinellus*)
- Gull-billed Tern (*Gelochelidon nilotica*)
- Caspian Tern (*Hydroprogne caspia*)
- Fork-tailed Swift (*Apus pacificus*)

4.4 Water Resources

4.4.1 Surface Water

The waterways of the project area range from small first order tributaries to the sixth order Humboldt Creek. Other named waterways in the project area include the third order Rockland Creek. These waterways drain into the seventh order Comet River approximately 800 m downstream to the west of the project area.

Waterways in the project area are highly ephemeral and were observed to be largely dry at the time of the 2022 and 2023 aquatic ecology surveys (DPM EnviroSciences 2023). The only waterways of any substantive size that could be impacted by the project are Humboldt Creek and the Comet River.

4.4.1.1 Aquatic Ecosystem

An aquatic ecological assessment report has been prepared for the project (DPM EnviroSciences, 2023). The study area for the aquatic assessment is the PL boundary. A summary of the report findings is provided below. Overall aquatic values within the project area range from Low to High. The sites on Humboldt Creek and Rockland Creek were rated as having Moderate aquatic value, due to their importance as conduits for fish passage. The smaller, unnamed tributaries were rated as having Low aquatic value. The State-mapped high ecological significance (HES) wetlands were rated High aquatic value due to their mapped status. The lacustrine wetland waterbodies (mostly farm dams) were rated Low aquatic value, although still provide important watering and foraging resources for terrestrial fauna and some dry season refuge for Least Concern fish and turtle species. The sites on the adjoining Comet River in the broader study area were rated as having High aquatic value as they provide both likely and known habitat for the Critically Endangered (EBPC Act and NC Act) White-throated Snapping Turtle (*Elseya albagula).*

4.4.1.2 Third-party Water Users

The Water Entitlement Viewer (Queensland Government 2023a) was used to identify existing water licences in the vicinity of the project area, refer to **Table 11**. There are 17 surface water and three groundwater water licences within 25 km radius of the project area**.** A range of privately owned dams are located within the project area. Based on the surrounding land uses and environmental values, dam water may be used for stock watering, irrigation, and farm supply.

Table 11. Water Licences – Surface Water

Authorisation number	Authorisation Type	Expiry Lapse Date	Water Plan Area	Authorised Purpose	Location Lot/Plan	Unique Water Code	Name of Water Entity/ water type	Nominal Entitlement per Water Year (ML)	Approximate distance from project area (km)
Water Licence – Watercourse									
04830F	Licence to interfere by impounding embankment or wall	30/06/2111	Fitzroy Basin	Impound water	5/WNA106	130.01.31.12	Humboldt Creek, Water course	Unknown	Within project area (Lot 5/WNA106)
603641	Licence to take water	30/06/2111	Fitzroy Basin	Stock; Water harvesting	1/SP203781	130.01.31.12.02	Shotover Creek, Water course	Unknown	4 km south
48430F	Licence to interfere by impounding embankment or wall	30/06/2111	Fitzroy Basin	Impound water	9/DSN706	130.01.31.00+Z	Comet River (Anabranch), Watercourse	Unknown	800 m west
48431F	Licence to take water	30/06/2111	Fitzroy Basin	Agriculture	9/DSN706	130.01.31.00+Z	Comet River (Anabranch), Watercourse	1200.00	800 m west
57741WF	Licence to take water	30/06/2111	Fitzroy Basin	Irrigation	9/RP620356	130.01.31.00+Z	Comet River (Anabranch), Watercourse	Unknown	800 m west
57775F	Licence to interfere by impounding embankment or wall	30/06/2111	Fitzroy Basin	Impound water	9/RP620356	130.01.31.00+Z	Comet River (Anabranch), Watercourse	Unknown	1 km west
52650F	Licence to interfere by impounding embankment or wall	30/06/2111	Fitzroy Basin	Impound water	13/WNA75	130.01.31.12.02	Shotover Creek, Watercourse	Unknown	1.5 km east

Authorisation number	Authorisation Type	Expiry Lapse Date	Water Plan Area	Authorised Purpose	Location Lot/Plan	Unique Water Code	Name of Water Entity/ water type	Nominal Entitlement per Water Year (ML)	Approximate distance from project area (km)
52648F	Licence to take water	30/06/2111	Fitzroy Basin	Stock; Water harvesting	13/WNA75	130.01.31.12.02	Shotover Creek, Watercourse	Unknown	1.5 km east
52649F	Licence to take water	30/06/2111	Fitzroy Basin	Stock; Water harvesting	13/WNA75	130.01.31.12.02	Shotover Creek, Watercourse	Unknown	1.5 km east
57711WF	Divert the course of flow	30/06/2111	Fitzroy Basin	Licence to interfere by diversion-Other	12/SP185512; 13/WNA75	130.01.31.12.01	Rockland Creek	Unknown	8.5 km east
52652F	Divert the Course of Flow	30/06/2111	Fitzroy Basin	Licence to interfere by diversion-Channel	12/SP185512	130.01.31.09	Sirius Creek	Unknown	12 km north-east
W35689F	Licence to interfere by impounding-Embankment or Wall	30/06/2111	Fitzroy Basin	Impound Water	11/HT526	130.01.29	Blackwater Creek	Unknown	13.3 km east
W34609F	Licence to interfere by impounding-Embankment or Wall	30/06/2111	Fitzroy Basin	Impound Water	1/CP897249	130.01.29	Blackwater Creek	Unknown	24.5 km north-east
57763F	Licence to interfere by impounding-Embankment or Wall	30/06/2111	Fitzroy Basin	Impound Water	11/RP867919	130.01.31	Comet River	Unknown	23 km north

Authorisation number	Authorisation Type	Expiry Lapse Date	Water Plan Area	Authorised Purpose	Location Lot/Plan	Unique Water Code	Name of Water Entity/ water type	Nominal Entitlement per Water Year (ML)	Approximate distance from project area (km)
Water License - Underground water									
625417	Licence to take water	31/7/2027	Fitzroy Basin	Petroleum and Gas – Non Associated Water	ATP684	1300.QUAT	Quaternary-Undefined, Underground	5.00	Adjoins northern project boundary
625419	Licence to take water	31/7/2027	Burdekin Basin	Petroleum and Gas – Non Associated Water	ATP684	1203.BETTS	Betts Creek Beds, Underground	5.00	Adjoins northern project boundary
625418	Licence to take water	31/7/2027	Fitzroy Basin	Petroleum and Gas – Non Associated Water	ATP684	1304.REWAN	Rewan Formation, Underground	5.00	Adjoins northern project boundary

4.4.2 Groundwater

4.4.2.1 Geology and Hydrogeology

A CSG water management assessment has been undertaken by RDMHydro and includes a summary on groundwater aspects related to the project (RDMHydro 2023), as summarised below.

The regional geology of the project area comprises sediments from the Early Permian to Middle Triassic age Bowen Basin. The Bowen Basin is an elongated, north to south trending basin extending over 160,000 km^2 from Central Queensland, south beneath the Surat Basin, and into New South Wales, where it connects with the Gunnedah and Sydney basins. The project is located on the southern end of the Comet Ridge outcrop and is flanked by the Taroom Trough to the east and the Denison Trough to the west. CSG production at the project will target the Bandanna Formation of the Bowen Basin. The Bandanna Formation is also known as the Baralaba or Rangal Coal Measures (refer **Table 12**).

Quaternary and Tertiary (Cainozoic) deposits overlay the Bowen Basin units. The Tertiary deposits comprise basalts with interbedded tuff and volcanolithic fragments. The Quaternary deposits predominantly comprise alluvial sediments associated with the major drainage features, as illustrated in **Table 12.** The regional water table is assumed to be hosted within the Tertiary Strata and lies at ~180 m Australian Height Datum (mAHD) (RDM Hydro 2023). The water table depth is estimated to be around 55 mAHD in the vicinity of the planned location of the project's treatment facilities.

Table 12. Stratigraphy and Hydrostratigraphy

Age		Formation		Hydrostratigraphic Description (after Office of Groundwater Impact Assessment (OGIA) 2021)	Location in Project Area
Quaternary		Alluvium		Partial aquifer	Associated with the Comet River and Humboldt Creek. Distribution within the project area limited to the southeastern and southwestern corners.
		Colluvium		Aquitard*	Extensively present to the west of the Comet River, associated with the lower slopes of Tertiary Basalt outcrop.
Tertiary		Tertiary Sediments		Aquitard*	Surficial deposits across the majority of the project area and to the north and east.
		Tertiary Basalt		Partial aquifer*	Small areas of outcrop throughout the project area, predominantly in the west.
Triassic	Middle	Moolayember Formation		Tight aquitard	Does not outcrop or subcrop within 25 km of the project area
		Showground Sandstone	Clematis Group	Regional aquifer	Outcrops as the Expedition Ranges to the east of the project area, with a small inlier of outcrop to the south of the project area adjacent to the Inderi Fault.
	Early	Rewan Group		Tight aquitard	Outcrops to the northeast of the project area and subcrops beneath the Tertiary strata within the proposed PL, forming the primary aquitard.
Permian	Late	Bandanna Formation/Rangal Coal Measures		Interbedded aquitard	Target formation. Subcrops beneath the Tertiary Strata within the project area and outcrops to the northeast within the Blackwater mine tenements.
		Back Creek Group	Black Alley Shale	Tight Aquitard*	Outcrop and subcrop within the Comet Anticline to the north of the project area. Also subcrops with a small amount of outcrop to the southwest of the project area.
			Peawaddy Formation		
			Burngrove Formation		
			Fair Hill Formation		
			MacMillan Formation		
			Crocker Formation		
			Maria Formation		
			Catherine Sandstone Ingelara Formation Freitag Formation		
			Upper Aldebaran Sandstone		
	Early		Lower Aldebaran Sandstone	Interbedded aquitard*	Does not outcrop or subcrop within the project area.
			Cattle Creek Formation	Tight Aquitard*	
			Reids Dome Beds	Tight Aquitard*	

* No hydrostratigraphic designation by OGIA (2021)

4.4.2.2 Groundwater Dependent Ecosystems

Ecological field surveys were undertaken by Epic (Epic 2024) in 2023 and 2024, DPM EnviroSciences (DPM 2023) in 2023 and Water Mark Ecohydrological in 2024. During this surveys targeted assessments were undertaken to ground truth the presence of terrestrial and surface water expression groundwater dependent ecosystems (GDEs) within the project area. The results shows that no potential terrestrial and surface expression GDE communities have the attributes required to be classified as GDEs.

4.4.2.3 Groundwater Bores

A search of the Queensland Groundwater bore database (GWBD) identified 18 registered groundwater bores within the project area and an additional 96 bores within a 20 km buffer from the centre of the project area. Of the 114 bores, 40 were not allocated and 17 were not drilled for water supply purposes, which included 12 mine monitoring bores and five petroleum exploration wells.

Eight active water supply bores have been identified within the project area, likely used for stock watering purposes. The GWBD indicated eight bores to be artesian, with only one which has been abandoned or destroyed. 21 bores in total have been abandoned and destroyed within the 20 km buffer of the project area.

4.5 Soils

With reference to Atlas of Australian Soils (Queensland Government 2023b), the soils across project area can be divided into three main areas:

- **Central** swathe, running southeast to northwest – Grey self-mulching cracking clays
- **North** – Red massive earths
- **Southwestern corner** – Red massive earths

There is no acid sulphate soil mapped within the project area.

5 HAZARD IDENTIFICATION AND CHARACTERISATION

5.1 Chemical List

This section provides detail on the chemicals likely to be used throughout the drilling and water treatment process of the project to identify potential hazards. The hazards are further characterised based upon their chemical composition in **Section 5.2.**

Throughout the various aspects of the project lifecycle, drilling fluids will be required to facilitate the drilling of the production bores. Each phase of drilling incorporates different drilling fluids, and hence produce different risk profiles. The phases of drilling include:

- Phase 1 – Drilling CSG production wells
- Phase 2 – Completion and workover of CSG production wells
- Phase 3 – Production
- Phase 4 – Decommissioning

The proposed drillings fluids are listed in **Table 13** and the proposed water treatment chemicals are listed in **Table 14.** The tables provide the following information:

- Chemical name
- CAS registry number
- Approximate quantities and/or concentrations
- Chemical's general purpose and function

All chemicals have been identified to be approved for import, manufacture or use in Australia. The volumes are based on the amounts being stored on site at any one time.

Table 13. Proposed Drilling Fluids

Chemical Name	CAS Registry Number[1]	Type of Container	Volume of each Container	Number of Containers [2]					Concentration (%)	Purpose and Function
				Drilling Phase		Completion/ workover Phase	Production Phase	Decommissioning Phase		
				Vertical	Lateral					
Quickseal Medium	N/A	Sack	40 lb	7	39	0	0	0	>60	Reduces loss of drilling fluid into the formation
Defoamer S	NA	Cube	20 L	1	1	0	0	0	<=100	Anti-foamer for water-based drilling fluids
Citric Acid	77-92-9	Sack	25 kg	10	10	0	0	0	<=100	pH control
Biocide G	55566-30-8	Cube	20 L	2	5	0.5	0.0015[3]	0.5	9	Reduce and prevent bacterial and fungal activity
Aus Dex	9005-25-8	Sack	25 kg	17	40	0	0	0	100	Provides filtration control
Potassium chloride (KCl)	7447-40-7	Sack	25 kg	120	266	17	0	0	95	Clay control and weight agent
Soda Ash	497-19-8	Sack	25 kg	1	2	0	0	0	80	pH control
Xan Bore	11138-66-2	Sack	25 kg	12	25	0.5	0	0.5	100	Provide maximum solids suspension and hole cleaning

[1] Where CAS registry number is not given, or the drilling fluid is not deemed hazardous in the CAS registry number column, this information has been taken directly from the SDS

[2] Quantity of chemicals to be stored on site at any one time

[3] For Production, one biocide treatment per well annually

Table 14. Proposed Water Treatment Chemicals

Chemical Name	CAS Registry Number	Type of Container	Volume of each Container (L)	Number of Containers (Operations only) (#)	Total Volume Stored / Month (L)	Purpose and Function
Betzdearborn DCL30	7681-57-4	Pail	15	1.3	19	Dechlorination agent
Biomate MBC2881	10222-01-2; 3252-43-5; 7647-15-6	Pail	15	4.8	71	Biocide
Caustic soda	1310-73-2; 7732-18-5	Pail	13	0.5	7	Cleaner, unblocker, disinfectant
Gengard GN7004	NA	Pail	13	4	53	Dispersant
Hypersperse MDC776	38820-59-6	Pail	12	9.3	108	Membrane deposit control agent
Klaraid IC1172	12042-91-0	Pail	15	4.5	67	Waste treatment additive
Kleen MCT103	79-14-1; 139-89-9; 2836-32-0	Pail	15	1.5	22	Reverse osmosis membrane cleaner
KLEEN MCT515	139-89-9; 584-08-7; 497-19-8; 119435-04-9; 1310-58-3; 1310-73-2	Pail	20	3.5	70	Membrane cleaner
Hydrochloric ACID 32% Aquapac	7647-01-0	Pail	15	0.5	7	Removal of scale, lime, calcium, oxides, efflorescence, bore stains, concrete dust and hard water deposits

5.2 Hazardous Chemical Database

An initial review of each chemical and its contents was carried out to determine the hazardous nature of each chemical (refer **Table 15**). As detailed in **Section 2.2**, a product or chemical is considered hazardous based on its environmental hazard criteria and if it is identified as a pollutant, contaminant or a hazardous good under Australian legislation or regulations.

Table 15. Hazardous Chemical Database

Chemical Name	Mixture	Hazardous Chemical [4]	Aquatic toxicity (environment)	Persistence	Bioaccumulative	Mobility in soil	Comments
Drilling Fluids							
Biocide G	Tetrakis (hydroxymethyl) phosphonium Sulfate, CAS 55566-30-8	Yes	Yes	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients	The product is classified as environmentally hazardous and spills can have a harmful or damaging effect on the environment [5]. Very toxic to fish, crustacea, algae or other aquatic plants.
Soda Ash	Sodium carbonate, CAS 497-19-8	Yes	Yes	Low in water/soil and air	Low (LogKOW = -0.4605)	High (KOC = 1)	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that spills can have a harmful or damaging effect on the environment [5]. The hazard of sodium carbonate for the environment is mainly caused by the pH effect of the carbonate ion. For this reason, the effect of sodium carbonate on the organisms depends on the buffer capacity of the aquatic or terrestrial ecosystem. Toxic to fish, crustacea, algae or other aquatic plants.
Potassium Chloride (KCl)	>95% Potassium chloride	No	Yes	High in water/soil and air	Low (LogKOW = -0.4608)	Low (KOC = 14.3)	Toxic to crustacea, fish and algea and other aquatic plants.
Xanbore	100% gum xanthan, CAS 1138-66-2	No	Yes	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients	Toxic to fish. Acute (rainbow trout) LC50: 320-560 ppm/96hr [Australian Mud].

[4] Based on the definition of 'hazard' identified in **Section 2.2.2**

[5] Effect on the environment measured based on the predicted no-effect concentration (PNEC) values for individual aquatic values listed in the SDS

Chemical Name	Mixture	Hazardous Chemical [4]	Aquatic toxicity (environment)	Persistence	Bioaccumulative	Mobility in soil	Comments
Citric Acid	Citric Acid (C6H8O7), CAS 77-92-9	Yes	No observed effects	Low in water/soil and air	Low (LogKOW = -1.64)	Low (KOC = 10)	Due to its physio-chemical characteristics citric acid is highly mobile in the environment and will partition to the aquatic compartment. Citric acid is rapidly degraded in both sewage works and surface waters and in soil.
Ausdex	>60% Starch	No	Not available	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients	No data available to assess toxicity to the environment. Comply with SDS disposal considerations to mitigate potential environmental impact.
Defoamer S	3-5% Silicone based emulsion neutralised polyacrylic based stabiliser	No	Not available	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients	No data available to assess toxicity to the environment. Comply with SDS disposal considerations to mitigate potential environmental impact.
Quickseal medium	100% of ingredients determined not to be hazardous	No	Not available	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients	No data available to assess toxicity to the environment. Comply with SDS disposal considerations to mitigate potential environmental impact.
Water Treatment Chemicals							
Betzdearborn DCL30	20-40% Sodium bisulphite (CAS 7681-57-4)	Yes	Yes	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that spills can have a harmful or damaging effect on the environment[5]. Toxic to fish and crustacea.
Biomate MBC2881	20-40% DBNPA (CAS 10222-01-2), 2.5-10% Sodium Bromide (CAS 7647-15-6), 0.1-1% Dibromoacetonitrile (CAS 3252-43-5)	Yes	Yes	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that spills can have a harmful or damaging effect on the environment [5]. Toxic to fish, algae, crustacea.
Caustic soda	Sodium hydroxide	Yes	Yes	Water/soil: low	Low	High - may leach to groundwater	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that spills can have a harmful or damaging effect on the environment [5]. Toxic to fish.

Chemical Name	Mixture	Hazardous Chemical [4]	Aquatic toxicity (environment)	Persistence	Bioaccumulative	Mobility in soil	Comments
Gengard GN7004	N/A	No	Yes	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that spills can have a harmful or damaging effect on the environment [5]. Toxic to crustacea and fish.
Hypersperse MDC776	30-60% [Hexane-1, 6-diylbis[nitrilobis(methylene)]] tetrakisphosphonic acid, potassium salt (CAS 38820-59-6)	Yes	Yes	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that spills can have a harmful or damaging effect on the environment [5]. Toxic to crustacea and fish.
Klaraid IC1172	30-60% Aluminium Chlorhydroxide (CAS 12042-91-0)	Yes	Yes	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that spills can have a harmful or damaging effect on the environment[5]. Toxic to crustacea and fish
Kleen MCT103	10-20% Glycolic acid (hydroxyacetic acid) (CAS 79-14-1), 10-20% N-Hydroxyethylenediamine triacetic acid trisodium salt (CAS 139-89-9), 1-2.5% Sodium glycolate (CAS 2836-32-0)	Yes	Yes	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that spills can have a harmful or damaging effect on the environment [5]. Toxic to crustacea.

Chemical Name	Mixture	Hazardous Chemical [4]	Aquatic toxicity (environment)	Persistence	Bioaccumulative	Mobility in soil	Comments
Kleen MCT515	2.5-10% N-hydroxyethylenediamine triacetic acid trisodium salt (CAS 139-89-9), 2.5-10& Potassium carbonate (CAS 584-08-7), 2.5-10% Sodium carbonate (CAS 497-19-8), 1-25% Benzene, 1,1'-oxybis-, Tetrapropylene Derivs., Sulfonated, 0-1%Potassium hydroxide (CAS1310-58-3), 0-1% Sodium hydroxide (CAS 1310-73-2)	Yes	Yes	Not biodegradable	Not bioaccumulating	No data available for all ingredients	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that spills can have a harmful or damaging effect on the environment [5]. Toxic to crustacea and fish.
Hydrochloric ACID 32% Aquapac	Hydrochloric acid (CAS 7647-01-0)	Yes	No	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients	Comply with SDS disposal considerations to mitigate potential environmental impact.

5.3 Hazard Characterisation

Drilling fluids and water treatment chemicals that are proposed to be used for the project that have been identified as potentially harmful to the environment in **Table 15** are further characterised in the below sections.

5.3.1 Nature of Chemicals

The potential for chemicals to enter the environment have been assessed based on their nature and state at the surface as well as their solubility in water, as summarised in **Table 16**. If a chemical is a solid at the surface and is insoluble in water, it is assumed the chemical is unlikely to be mobilised. In addition, if a solid, insoluble chemical is present down a well it is assumed it is unlikely to be mobilised through the aquifer. It is also assumed there is little to no risk the chemical will migrate offsite and therefore these chemicals are not deemed to pose a risk to MNES.

Table 16. Chemical Surface State and Pathway

Chemical Name	Physical State at Surface (as manufactured and pre-mixing)	Water Solubility	Comment
Biocide G	Liquid	Miscible	Poses some risk where it has the potential to move offsite
Soda Ash	Divided Solid	Miscible	Poses some risk where it has the potential to move offsite
Potassium Chloride (KCl)	Divided Solid	Miscible	Poses some risk where it has the potential to move offsite
Xanbore	Divided Solid	Partly miscible	Poses some risk where it has the potential to move offsite
Betzdearborn DCL30	Liquid	Soluble	Poses some risk where it has the potential to move offsite
Biomate MBC2881	Liquid	Soluble	Poses some risk where it has the potential to move offsite
Caustic soda	Liquid	Miscible	Poses some risk where it has the potential to move offsite
Gengard GN7004	Liquid	Soluble	Poses some risk where it has the potential to move offsite
Hypersperse MDC776	Liquid	Soluble	Poses some risk where it has the potential to move offsite
Klaraid IC1172	Liquid	Soluble	Poses some risk where it has the potential to move offsite
Kleen MCT103	Liquid	Soluble	Poses some risk where it has the potential to move offsite
Kleen MCT515	Liquid	Soluble	Poses some risk where it has the potential to move offsite

5.3.2 Chemical Fate and Transport

The behaviour of chemicals at the surface and subsurface has been assessed to understand how chemicals may behave if released to the environment. The chemical fate and transport informed the potential consequence of a release of the chemicals to surface water or groundwater. The mobility, potential for bioaccumulation and degradation of chemicals were assessed with findings outlined in **Table 17.**

Table 17. Chemical Fate and Transport Summary

Chemical Name	Persistence / Degradation	Potential for Bioaccumulation	Mobility in Soil
Biocide G	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients
Soda Ash	Low in water/soil and air	Low (LogKOW = -0.4605)	High (KOC = 1)
Potassium Chloride (KCl)	High in water/soil and air	Low (LogKOW = -0.4608)	Low (KOC = 14.3)

Chemical Name	Persistence / Degradation	Potential for Bioaccumulation	Mobility in Soil
Xanbore	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients
Betzdearborn DCL30	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients
Biomate MBC2881	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients
Caustic soda	Water/soil: low	Low	High - may leach to groundwater
Gengard GN7004	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients
Hypersperse MDC776	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients
Klaraid IC1172	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients
Kleen MCT103	No data available for all ingredients	No data available for all ingredients	No data available for all ingredients
Kleen MCT515	Not biodegradable	Not bioaccumulating	No data available for all ingredients

5.3.3 Environmental Hazards

Proposed chemicals have been identified as being toxic to fish, crustacea and algae (**Table 15**). However, it is important to note that this hazard assessment has considered the chemicals in their concentrated and undiluted forms. If a spill or release occurs, chemicals will be diluted upon entering the receiving environment such as a watercourse, drainage line or aquifer. The predicted environmental concentrations (PEC) have not been calculated, making this assessment conservative in nature and a worst-case scenario.

6 EXPOSURE ASSESSMENT

An exposure assessment has been carried out to examine the potential risk of using chemicals. The assessment has identified potential risk events (sources), pathways, and the MNES receptors that may occur as a result of project activities. This is summarised in **Table 18**.

The primary pathways for contaminants include:

- **Overland flow** – chemicals spilt at the surface, if not contained, have the potential to travel via overland flow into nearby receiving environments. This has the potential to impact on surface water quality in the surrounding creek systems and have potential health impacts on dependent threatened or migratory species if the water is consumed. As the receiving environment is typically ephemeral in nature, the risk of contaminants reaching the system will be higher during periods of rainfall. Contaminant concentrations at the receptor may be significantly lower than at the source due to dilution within the flowing receiving environment
- **Ground infiltration** – chemicals spilt at surface have the potential to infiltrate into the ground. This has the potential to impact water quality within the shallow groundwater system (and subsequently the surface water system if there is a connection)
- **Groundwater flow** – chemicals used at improper concentrations entering the water-bearing coal measure (WCM) through a poorly constructed well has the potential to reduce the local quality of groundwater within the formation. Contaminated groundwater then has the potential to flow through the coal measures and subsequently be extracted and discharged to surface at a GDE or watercourse spring (if present) via irrigation, dust suppression or construction use. If a connection between the WCM and other aquifers exist, there is the potential for contaminant migration and subsequent pollution of these aquifers to occur
- **Leaching in soils** – chemicals spilt as surface have the potential to leach into soils.

Table 18. Exposure Assessment and Source Pathway Receptor

Risk Type	Source/Risk Event	Pathway	Direct MNES Impact	Indirect MNES Impact
Above-ground chemical spills and leaks	Onsite storage of chemicals in containers or tanks. Transfer of chemicals during use or mixing. Transportation of chemicals (e.g. trucks, pipelines).	Overland flow to receiving environment	Surface water contamination	Potential reduction in water quality within receiving environment. Potential health impacts to ecological species accessing contaminated receiving environments
		Leaching in soils	Soil contamination	Potential health impacts to ecological species
		Groundwater infiltration	Groundwater contamination/soil contamination	Potential reduction in water quality in shallow aquifer system.
Below-ground chemical spills and leaks	Inadequate well closure and plugging. Loss of well integrity	Directly to an aquifer during drilling. Connection between aquifers (due to a loss in well integrity)	Groundwater contamination	Potential reduction to water quality in aquifers; WCM; Impacts on water users.
Other	Inappropriate reuse / disposal of drill cuttings and fluids	Leaching in soil. Groundwater infiltration	Potential soil/water contamination	Potential reduction in water quality in shallow aquifer system.

7 RISK CHARACTERISATION

A risk characterisation was undertaken with consideration to the persistence, bioaccumulation and toxicity of the chemicals being used. The risk characterisation was undertaken to determine where the chemical should be categorised as a Tier 1, Tier 2 or Tier 3 chemical. Tier 2 and Tier 3 chemicals will be assessed within the qualitative and quantitative risk assessment.

Table 19. Risk Characterisation

Chemical	Persistence[1]	Bioaccumulation[1]	Aquatic Toxicity[1]	Tier / Risk Category
Biocide G	No data available for all ingredients	No data available for all ingredients	Acute toxicity	2 - Chemicals of potential concern
Soda Ash	Low in water/soil and air	Low (Log KOW = -0.4605)	Acute toxicity	2 - Chemicals of potential concern
Potassium Chloride (KCl)	High in water/soil and air	Low (LogKOW = -0.4608)	Short term toxicity	2 - Chemicals of potential concern
Xanbore	No data available for all ingredients	No data available for all ingredients	Acute toxicity	2 - Chemicals of potential concern
Citric Acid	Low in water/soil and air	Low (LogKOW = -1.64)	No observed effects	1 - Chemicals of low concern
Ausdex	Not persistent	Does not bioaccumulate	No observed effects	1 - Chemicals of low concern
Defoamer S	Not persistent	Does not bioaccumulate	No observed effects	1 - Chemicals of low concern
Quickseal medium	No data available for all ingredients	No data available for all ingredients	Toxic to aquatic life	2 - Chemicals of potential concern
Betzdearborn DCL30	No data available for all ingredients	Product contains only inorganics that are not subject to typical biological degradation.	Acute toxicity	2 - Chemicals of potential concern
Biomate MBC2881	Persistent	Low	Acute toxicity	2 - Chemicals of potential concern
Caustic soda	Water/soil: low	Low	Acute toxicity	2 - Chemicals of potential concern
Gengard GN7004	Low persistence	None	Low observed effect	1 - Chemicals of low concern
Hypersperse MDC776	No data available for all ingredients	No data available for all ingredients	Low observed effect	2 - Chemicals of potential concern
Klaraid IC1172	No data available for all ingredients	No data available for all ingredients	Acute toxicity	2 - Chemicals of potential concern
Kleen MCT103	No data available for all ingredients	No data available for all ingredients	Acute toxicity	2 - Chemicals of potential concern
Kleen MCT515	Not biodegradable	Not bioaccumulating	Acute toxicity	2 - Chemicals of potential concern
Hydrochloric ACID 32% Aquapac	No data available for all ingredients	No data available for all ingredients	Low observed effect	2 - Chemicals of potential concern

[1] Where no data is available, the chemical will automatically be categorised as a Tier 2

8 RISK ASSESSMENT

Chemicals categorised as Tier 2 and Tier 3 may have impacts to environmental values due to the chemical risk. A risk assessment of potential chemical spills and leaks of each environmental value and mitigation factors relevant to the Project has been detailed in **Table 20**, **Table 21** and **Table 22**.

Table 20. Risk Assessment – Above Ground Chemical Spills and Leaks

Environmental Value	MNES	Inherent Risk Rating			Mitigating Factors	Residual Risk Rating		
		Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
Wetlands	There is a large area mapped as a Wetland Protection Area and listed as high ecological significance (HES) under the *Environmental Protection Regulation 2019* located in the northern extent of the project area	2	B	Minor	All infrastructure and any plant or equipment is at least 200 m away from HES wetland, which is consistent with the *Streamlined Model Conditions for Petroleum Activities (ESR/2016/1989, V2 05 May 2016).* This distance indicates any impact would be naturally attenuated and therefore unlikely to impact the wetlands.	1	B	Insignificant
Threatened Ecological Communities (TECs)	Brigalow (*Acacia harpophylla* and co-dominant)	2	B	Minor	All areas of TECs have been avoided by the proposed disturbance footprint. Unlikely to be impacted. Small quantities of product will be utilised and if surface chemical spills occur these are likely to be localised.	1	B	Insignificant
	Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	2	B	Minor		1	B	Insignificant
Threatened Species (fauna)	Ornamental Snake (*Denisonia maculata*)	2	B	Minor	Identified habitat will be avoided where possible in the project layout design. Unlikely to be impacted. Small quantities of product will be utilised and if surface chemical spills occur these are likely to be localised.	1	B	Insignificant
	Koala (*Phascolarctos cinereus*)	2	B	Minor		1	B	Insignificant
Threatened Species (flora)	Annual Wine Grass (*Aristida annua*)	2	B	Minor	Unlikely to be impacted. Small quantities of product will be utilised and if surface chemical spills occur these are likely to be localised. Identified habitat will be avoided where possible in the project layout design.	1	B	Insignificant
Listed Migratory Species	No Listed Migratory species were listed as known or likely to occur within the Project area	1	B	Insignificant	Not applicable	1	B	Insignificant
Surface Water	Comet River	2	C	Minor	Product volumes to be used on site are likely to be small with the majority of products stored as dry ingredients and mixed on site. Creek systems identified within the project site are temporary / ephemeral. Unlikely to be impacted. Small quantities of product will be utilised and if surface chemical spills occur these are likely to be localised.	1	C	Insignificant
	Humboldt Creek	3	C	Medium		2	C	Minor
	Three Mile Creek	3	C	Medium		2	C	Minor
	Rockland Creek	3	C	Medium		2	C	Minor
Groundwater	Quaternary Alluvium	3	C	Medium	Production well intersecting these aquifers is sealed off from these units. Unlikely a surface spill will reach depths of these formations.	2	C	Minor
	Tertiary Sediments	3	C	Medium		2	C	Minor
	Tertiary Basalt	3	C	Medium		2	C	Minor
	Clematis Sandstone	3	C	Medium		2	C	Minor
	Rewan Formation	3	C	Medium		2	C	Minor
	Bandanna Formation	3	C	Medium		2	C	Minor
	Rangal Coal Measure	2	C	Minor	Connectivity of WCM to surface spills is via the production well. Unlikely to have significant impact reach this depth.	1	C	Insignificant

Table 21. Risk Assessment – Below Ground Chemical Spills and Leaks

Environmental Value	MNES	Inherent Risk Rating			Mitigating Factors	Residual Risk Rating		
		Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
Wetlands	There is a large area mapped as a Wetland Protection Area and listed as high ecological significance under the Environmental Protection Regulation 2019 located in the northern extent of the Project area.	2	B	Minor	All infrastructure and any plant or equipment is at least 200 m away from HES wetland, which is consistent with the *Streamlined Model Conditions for Petroleum Activities* (ESR/2016/1989, V2 05 May 2016). This distance indicates any impact would be naturally attenuated and therefore unlikely to impact the wetlands.	1	B	Insignificant
Threatened Ecological Communities	Brigalow (*Acacia harpophylla* and co-dominant)	3	B	Minor	Below ground spills or leaks unlikely to impact TEC.	2	B	Minor
	Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	3	B	Minor		2	B	Minor
Threatened Species (fauna)	Ornamental Snake (*Denisonia maculata*)	3	B	Minor	Below ground spills or leaks unlikely to impact threatened fauna.	2	B	Minor
	Koala (*Phascolarctos cinereus*)	3	B	Minor		2	B	Minor
Threatened Species (flora)	Annual Wine Grass (*Aristida annua*)	3	B	Minor	Below ground spills or leaks unlikely to impact threatened flora.	2	B	Minor
Listed Migratory Species	No Listed Migratory species were listed as known or likely to occur within the Project area	1	B	Insignificant	Below ground spills or leaks unlikely to impact migratory birds.	1	B	Insignificant
Surface Water	Comet River	1	C	Insignificant	Below ground spills or leaks unlikely to impact surface water systems.	1	C	Insignificant
	Humboldt Creek	2	C	Minor		1	C	Insignificant
	Three Mile Creek	2	C	Minor		1	C	Insignificant
	Rockland Creek	2	C	Minor		1	C	Insignificant
Groundwater	Quaternary Alluvium	2	C	Minor	Production wells intersecting these aquifers are sealed.	1	C	Insignificant
	Tertiary Sediments	2	C	Minor		1	C	Insignificant
	Tertiary Basalt	2	C	Minor		1	C	Insignificant
	Clematis Sandstone	2	C	Minor		1	C	Insignificant
	Rewan Formation	2	C	Minor		1	C	Insignificant
	Bandanna Formation	2	C	Minor		1	C	Insignificant
	Rangal Coal Measure	1	C	Insignificant	Connectivity of WCM to surface spills is via the production well. Unlikely to have significant impact reach this depth.	1	C	Insignificant

Table 22. Risk Assessment – Inappropriate Reuse / Disposal of Drill Cutting and Fluids

Environmental Value	MNES	Inherent Risk Rating			Mitigating Factors	Residual Risk Rating		
		Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
Wetlands	There is a large area mapped as a Wetland Protection Area and listed as high ecological significance under the Environmental Protection Regulation 2019 located in the northern extent of the Project area	2	B	Minor	All infrastructure and any plant or equipment is at least 200 m away from HES wetland, which is consistent with the *Streamlined Model Conditions for Petroleum Activities* (ESR/2016/1989, V2 05 May 2016). This distance indicates any impact would be naturally attenuated and therefore unlikely to impact the wetlands.	1	B	Insignificant
Threatened Ecological Communities	Brigalow (*Acacia harpophylla* and co-dominant)	2	B	Minor	All areas of TECs have been avoided by the proposed disturbance footprint. Small quantities of product will be utilised and if surface chemical spills occur these are likely to be localised.	1	B	Insignificant
	Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	2	B	Minor		1	B	Insignificant
Threatened Species (fauna)	Ornamental Snake (*Denisonia maculata*)	2	B	Minor	Areas of the disturbance footprint within threatened fauna habitat have been reduced to the greatest extent possible.	1	B	Insignificant
	Koala (*Phascolarctos cinereus*)	2	B	Minor		1	B	Insignificant
Threatened Species (flora)	Annual Wine Grass (*Aristida annua*)	2	B	Minor	Areas of the disturbance footprint within threatened flora habitat have been reduced to the greatest extent possible.	1	B	Insignificant
Listed Migratory Species	No Listed Migratory species were listed as known or likely to occur within the Project area	1	B	Insignificant	Not applicable, no suitable habitat for migratory species was identified.	1	B	Insignificant
Surface Water	Comet River	2	C	Minor	Well sites are located away from watercourses. Product volumes to be used on site are likely to be small with the majority of products	1	C	Insignificant
	Humboldt Creek	3	C	Medium		2	C	Minor
	Three Mile Creek	3	C	Medium		2	C	Minor

Environmental Value	MNES	Inherent Risk Rating			Mitigating Factors	Residual Risk Rating		
		Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
	Rockland Creek	3	C	Medium	stored as dry ingredients and mixed on site. Creek systems identified within the project site are temporary / ephemeral.	2	C	Minor
Groundwater	Quaternary Alluvium	2	B	Minor	Production well intersecting these aquifers is sealed.	1	B	Insignificant
	Tertiary Sediments	2	B	Minor		1	B	Insignificant
	Tertiary Basalt	2	B	Minor		1	B	Insignificant
	Clematis Sandstone	2	B	Minor		1	B	Insignificant
	Rewan Formation	2	B	Minor		1	B	Insignificant
	Bandanna Formation	2	B	Minor		1	B	Insignificant
	Rangal Coal Measure	1	B	Insignificant	Connectivity of WCM to surface spills is via the production well. Unlikely to have significant impact reach this depth.	1	B	Insignificant

9 MANAGEMENT AND MITIGATION MEASURES

Several management and mitigation measures will be adopted as part of construction and operational activities associated with the project to address the potential chemical risks. These are described in **Table 23** as well as in **Section 9.1.**

Table 23. Management and Mitigation Measures

Risk	Mitigation or Management Measure
Above-ground chemical spills and leaks	**Chemical and Fuel Storage** • All fuel, oil and chemicals are to be stored, transported, and handled in accordance with appropriate standards including *AS1940:2004 - The storage and handling of flammable and combustible liquids*, *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 • Chemical and fuel storage areas must be bunded, and adequately ventilated • Refuelling must only be carried out in dedicated refuelling areas, and in line with the relevant standard operating procedures that will be prepared for the Project • All locations storing hazardous chemicals will be located at a minimum of 200 m away from wetlands or watercourses • Containment bunds will be inspected monthly, and immediately following a rain event; all rainwater will be removed from the bunded area as soon as reasonably practical
	Tank Storage • All tanks will be constructed on hardstand and will be double lined with a leak detection system • CSG water storage structures classified as 'low hazard', such as tanks, will be designed in accordance with accepted engineering standards and will be constructed to an Australian Standard that ensures its integrity • All regulated structures are to be designed, constructed and operated in accordance with the requirements of the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures* (DES 2016) • Tanks have been located in accordance with the Queensland requirements for buffers around watercourses and MNES
	Emergency and Incident Response • All chemical or fuel spills will be managed in accordance with the Project's Spill Response Management Plan that will be developed and implemented prior to the commencement of construction • All contractors undertaking works, including the drilling contractor, must have suitable spill response procedures in place prior to commencing works. As a minimum, spill response procedures must document: - How spills are to be prevented from occurring - Communication plans outlining contact details and order of communication in the event of a spill or chemical release - Details on storage and location of chemicals and fuels - Location of spill kits and details on how they are to be used - Clean-up procedures, including testing and/or disposal of contaminated material • Required remediation and clean-up procedures will be determined by the Project's environmental manager, with works completed under the supervision of them or the site supervisor • All fuel or chemical spills are to be recorded in the Project's internal reporting system and include details on nature of fuel/chemical spilled, what clean-up was undertaken and any incident investigation reports • Emergency drills will be undertaken regularly in line with Comet Ridge's emergency response procedure • Personnel who observe an environmental incident or emergency must immediately notify the Project's environmental management within 24 hrs of incident identification

Risk	Mitigation or Management Measure
	Well Locations Well locations will be determined through the implementation of the Proponent's *Environmental Protocol for Constraints Planning and Field Development* (the protocol) for all cases where construction involves significant disturbance to land. The protocol aims to avoid or limit (where avoidance is not possible) impacts such that infrastructure siting: • Considers biodiversity values and environmental constraints • Is compliant with EA conditions and State and Commonwealth regulatory requirements • Identifies any external environmental approvals required With respect to environmental values, the protocol addresses avoiding or minimising and managing potential impacts to: • Biodiversity values contributing to MNES • Habitat for wildlife, including MNES threatened ecological communities, flora and fauna • Wetlands, watercourses, springs, and groundwater dependent ecosystems The protocol also recognises that, in addition to environmental constraints, landholder, engineering and cultural heritage constraints must be considered during infrastructure siting
Below ground chemical spills and leaks	**Well Construction & Decommissioning** All CSG production wells will be designed, constructed, and decommissioned in accordance with the Code (DNRME 2019).
	Prevention of Drilling Fluid Losses • Drilling fluids are selected and managed to ensure all products are used in accordance with the manufacturer's recommendations and relevant SDS. The name, type and quantity of each drilling fluid additive used on each well is recorded • A suitably licenced, and experienced drilling contractors will be engaged to undertake the drilling program and will adopt currently accepted best industry practice throughout the engagement • A review of available geological information will be undertaken prior to drilling commencing to aid in informing method and materials to be used
	Well Siting Well siting will be determined through adoption of the Proponent's protocol for all cases where activities for the project involves significant disturbance to land. Engineering constraints are addressed within the protocol, and include (but aren't limited to): • Presence of any known or potential faults • Location of coal seam gas reservoirs and / or groundwater aquifers • Interconnectivity of coal seam gas reservoirs and / or groundwater aquifers
Inappropriate reuse / disposal of drill cuttings and fluids and brine	**Appropriate Disposal of Drilling Fluids** • If drilling muds are found to meet the approved quality criteria, they may be disposed of onsite, via land spraying or land spreading. • Initial discussions with landholders expressed interest in the land spraying/spreading methodologies (Leucaena), if the residual drilling material meets the approved quality criteria. Otherwise, the drilling muds will be disposed of offsite to a licensed facility • Do not discharge into sewer or waterways • Do not allow wash water from cleaning or process equipment to enter drains
	Appropriate Disposal of Drill Cuttings • Drill cuttings that meet the approved quality criteria may be disposed of onsite through burial or via land spraying or land spreading activities • Otherwise cuttings will be disposed of at an offsite facility licenced to receive materials • Manage in accordance with the DES *End of waste code Coal Seam Gas Drilling Mud* (ENEW07543018) • Drill cuttings will not be used as backfill for the production well
	Appropriate Disposal of Brine • Concentrated waste product will be disposed of at a licensed Waste Facility.

9.1 Environmental Management Protocols and Procedures

The following documents will be updated and implemented during detailed design in order to provide guidance regarding best environmental practices for the placement of wells as well as responses required in accordance with environmental incidents.

9.1.1 Environmental Protocol for Constraints Planning and Field Development

The Proponent's protocol aims to ensure the placement of infrastructure within the project area takes into consideration biodiversity values and environmental constraints when selecting preferential locations, compliance with EA conditions and both State and Commonwealth regulatory requirements, as well as identifies any additional external environmental approvals that may be required for the project as part of operations.

Pipeline crossings at waterways will be avoided where possible during the final project design phase. Where pipeline crossings are required (such as at Humboldt Creek and the Comet River), they will be located underground through the application of directional drilling. Where required, instream construction impacts such as trenching will be temporary and occur during the dry season to minimise the impact of sediment entrainment during rainfall-associated flow events.

9.1.2 Environmental Management Plan

The project will prepare and implement an environmental management plan (EMP) relevant for the individual phases of the project. The EMP will outline the management and mitigation measures required for the handling and storage of all chemicals on site.

The plan will describe how potential environmental impacts associated with the construction, operations and decommissioning phases of the project will be managed. The plan will also ensure compliance with the EA conditions, industry guidelines and regulatory requirements will be met.

9.1.3 Spill Response Plan

A spill response plan will be prepared and implemented for the project. Procedures for spill response will be prepared and implemented by contractors in accordance with the project spill response plan. Notification of spills must be reported to the environmental manager as soon as the incident is identified by project personnel. All incidents including spills will be reported and investigated in accordance with potential risk to the environment and in regards to the conditions of the EA.

9.1.4 Erosion and Sediment Control

The project will develop and implement an Erosion and Sediment Control Plan (ESCP) to mitigate uncontrolled sediment flows into waterways as a result of project works.

9.1.5 Standard Operating Procedures

Standard Operating Procedures (SOPs) will be prepared and implemented to include (but not be limited to the following):

- Storage of drilling fluids and muds in portable, temporary tanks
- Use of bunds at surface
- Undertake regular site inspections, monitoring and recording of mud returns/volumes in tanks on a daily basis
- Undertake daily drillers instructions

9.1.6 Environmental Contingency Plan

An Environmental Contingency Plan (ECP) will be prepared and implemented to provide a framework for the Proponent to respond to emergency environmental incidents. The ECP will include (but not be limited to the following:

- Identify communication protocols with relevant parties in the event of an emergency environmental incident
- Set instructions for investigating the cause of an emergency environmental incident
- Identify remedial actions to be implemented to reduce the likelihood of reoccurrence of similar emergency environmental incidents
- Develop procedures and plans for the management of emergency environmental incident as required during the project life

10 INSPECTIONS, MONITORING AND AUDITING

10.1 Environmental Monitoring

Monitoring will be undertaken to demonstrate conformance with the project's environmental requirements (e.g. EMP) and compliance with statutory requirements (e.g. Commonwealth or State legislation). This monitoring will be directed by the Environmental Manager and or the Environmental Representative. Environmental reporting and monitoring will include the following as relevant:

- Inspections / monitoring reports
- Photograph records
- Incidents reports
- Remedial actions taken following incident reports
- Records of waste removal including waste tracking certificates

If monitoring indicates a breach of a condition or the contaminant level has caused, or has potential to cause, environmental harm, the Proponent will take the necessary actions to rectify the condition or contaminant level so as to avoid or minimise environmental harm. All required monitoring records and reports will be:

- Kept for a period of at least five (5) years
- Provided to a new holder of the EA on transfer of the EA
- Provided to the administering authority within a timeframe nominated by the administering authority or in annual reports
- Provided to the administering authority in the format requested

10.2 Environmental Auditing

Auditing and reporting of on-site activities provide a direct measure of environmental compliance in accordance with regulations and EA conditions, together with an indication of the effectiveness of the Health Safety and Environment Management System, EMP and supporting procedures and plans.

Environmental auditing will be undertaken by suitably qualified environmental representatives on a periodic basis to assess whether activities are in compliance with the requirements of these systems and documents.

10.2.1 Review Process

Chemicals determined to be low-risk chemicals (Tier 1) will be peer reviewed by an independent chemical risk assessment expert to review the toxicological profile. The review process will include the following assessment:

- Have the physical/chemical properties been documented?
- Was the chemical listed on any databases indicating chemical of concern?
- Has the toxicity been assessed?
- Has the environment fate (persistence, biodegradation, and bioaccumulation) been assessed?
- Is the categorisation correct?

A signed statement detailing the findings of the low-risk assessment, including evidence and findings that the chemical has been correctly categorised and will be reviewed every 5 years if it the low-risk chemical are still in use.

10.3 Review of Listed Chemicals

The Proponent will review the chemical risk assessment when:

- Prior to the use of new drilling fluids and chemicals at the site
- Receipt of advice from drilling contractors or the regulatory authority indicating the toxicology and hazardous nature of the chemicals being used change

10.4 Risk Assessment Reporting

A Risk Assessment Report of chemicals is to be published and maintained on Comet Ridge website.

The Register of each assessed chemical will provide a summary of outcomes of the screening assessment, including risk level categorisation, the activities the chemical has been assessed for (i.e drilling) and the assessed end use/fate of the chemical.

An example of the register is provided in **Appendix A.**

10.5 Adaptive Risk Management

In a scenario where accidental release or spill of chemical an emergency response plans been implemented to provide standard protocols for Comet to respond in an appropriate and timely manner in the event of a spill and/or accident as shown in **Figure 4**.This adaptive management pathway adopts a common procedure in focusing on responding to spill events in which focus on a response support and response hierarchy system which can be adaptively used to preserving life, ensure the safety of people and minimising the impact on environment. The chemical risk assessment and associated SDS will be adaptively used to inform the spill response associated with accidental release of a chemical to prevent adverse impacts to MNES uses information from the CRA and SDS throughout the response process. In addition, the outcome of the chemical risk assessment may inform the need for additional mitigation and management controls which may need to be added to the Project's Environmental Management Plan.

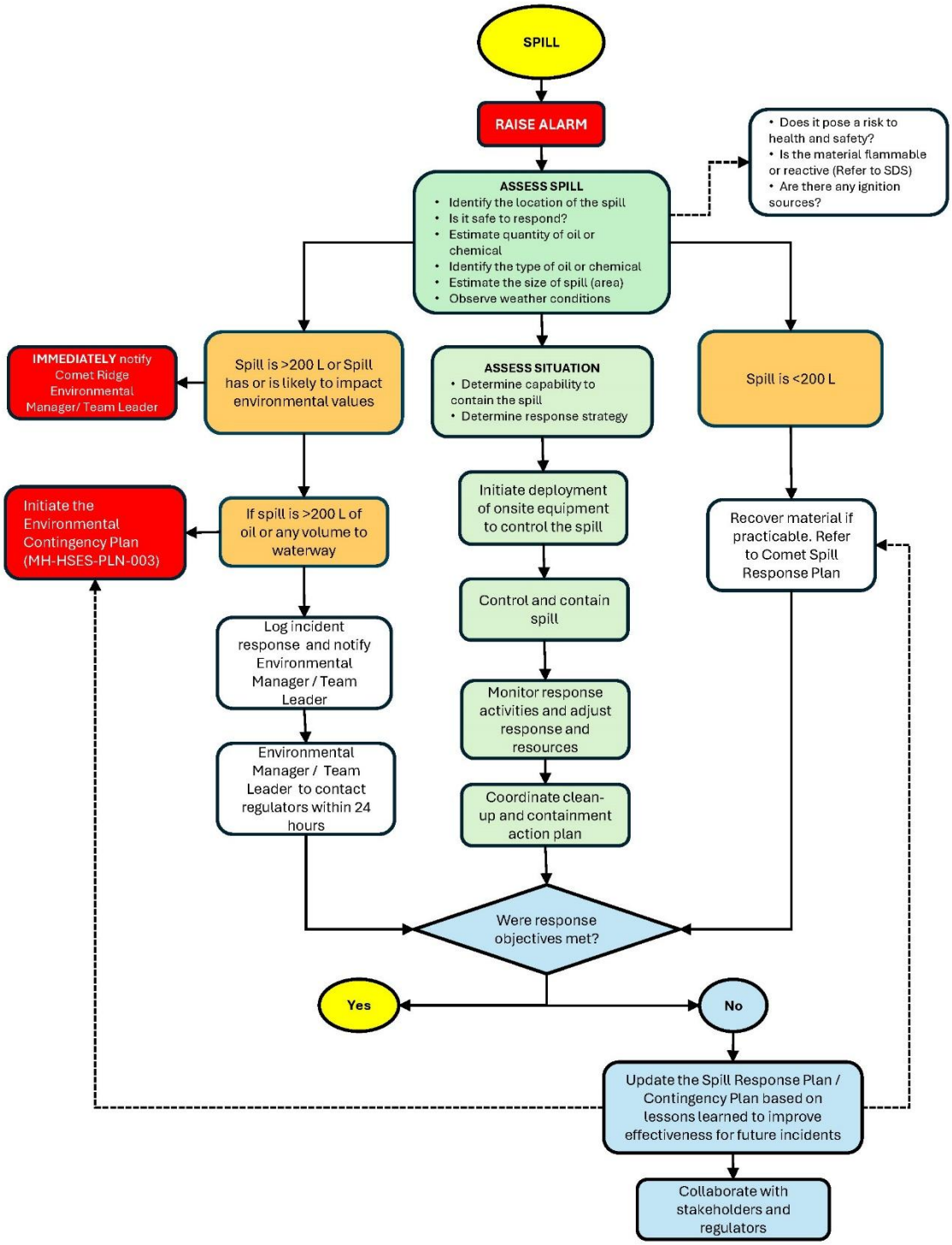

Figure 4. Spill management and adaptive response flow chart

11 SUMMARY OF POTENTIAL IMPACTS

Epic has undertaken a chemical risk assessment for chemicals that are proposed to be used in CSG extraction as part of the Mahalo North CSG Project. In summary:

- 17 chemicals are proposed to be used during the drilling, management, and abandonment of CSG wells and water treatment process
- 12 chemicals were determined to be of potentially hazardous to the environment. These chemicals were further assessed in order to understand the implications on the environment if a release occurred
- Additional characterisation of chemicals was carried out on chemicals identified to be of concern. There is the potential for chemicals to impact ecosystems if directly released to the environment
- A low risk to MNES has the potential to occur as a result of chemicals being spilt on the ground, loss of chemicals to aquifers below ground and the eventual disposal of chemicals. These risk events have the potential to impact MNES by:
  - Contamination of habitat for species that inhibit affected areas, directly or indirectly following a spill event
  - Contamination of drinking resources (surface water) for threatened species (e.g. koalas) whether directly or indirectly following a spill event
- Mitigation and management methods have been identified to minimise or eliminate risk from chemicals. These include the implementation of drilling protocols such as the *Code of Practice for the Construction and Abandonment of Coal Seam Gas and Petroleum Wells, and Associated Bores in Queensland Version 2* (DNRME 2019), environmental management practices including the Environmental Protocol for Constraints Planning and Field Development, CSG Water Management Plan, and Environmental Management Plan and a Spill Response Plan

The risk assessment has determined the likelihood for chemicals and drilling fluid to adversely impact on MNES is highly unlikely to unlikely due to the controls that will be implemented during the drilling phase, as well as the protocols in place in the event a spill was to occur. The overall risk to MNES has therefore been assessed as minor significance to insignificant.

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APPENDIX A SDS CHEMICAL REPORTS

APPENDIX B RISK ASSESSMENT REGISTER

			Document Control			Screening 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**	**Listed as a COC on relevant database**	**Persistence Tier**	**Bioaccumulation Tier**	**Acute Toxicity Tier**	**Chronic Toxicity Tier**	**Overall Tier**	**Concern / Risk Level**	**Drilling additive – Production well**
Example chemical			DD/MM/YY		DD/MM/YY	No	1	1	1	1	1	Low	

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