Imperial Oil & Gas

EP 187

Appendix 07

Spill Management Plan

IMP 5-1

Document Control

Date	Rev	Description	Author(s)	Reviewed	Approved
05/02/24	1	Issued as an Appendix of EMP IMP 5-1	Damian O., Pete S.	Vic F., Trent S., Spiros K., Jon B., Nicholas F., Kelvin W., Mikhail K.	Robin P.

Table of Contents

List of Tables

List of Figures

1 Purpose

The *Code of Practice: Onshore Petroleum Activities in the Northern Territory* 2019 (*the Code*) (Part C) provides a framework for the management of well pad water used in and produced by petroleum activities, including storage, handling, transport, re-use, recycling, treatment, and disposal of wastewater.

Section C.7.2 of *the Code* details the requirements of a spill management plan (SMP). A SMP must assess and manage the risks posed by potential spills of waste, wastewater, produced oil or condensate, fluids and any chemicals used or stored as part of petroleum activity.

Section D.5 of *the Code* details the requirements of a Methane Emissions Management Plan (MEMP) for the prevention, monitoring, management, and reporting of methane emissions from, petroleum activities. A MEMP is include with the EMP as **Appendix 13**.

2 Objectives

The objective of this plan is to assess the potential for any loss of containment and to minimise the potential and actual harm should a loss occur. In addition, this plan provides details to ensure a rapid response to and recovery from a loss as required under section C.7.2 of *the Code*.

Broadly, this plan is designed to:

- Identify points of failure that could result in a loss of primary containment.
- Ensure secondary containment (bunds, liners, double skinned tanks) are adequately designed and maintained to control the impact of a loss on the receiving environment.
- Describe the hazards and risks associated with foreseeable spills or leaks associated with the use, storage and transport of chemicals, wastewater, and petroleum.
- Detail monitoring that will aid in the management of a loss through early detection and control.
- Detail the process for the management and disposal of contaminated soils and spilled products to reduce the potential for ongoing impacts.

This document is one of a suite of plans that support EP 187 EMP and should be read in conjunction with the **EMP** and its appendices.

3 Threats to the Receiving Environment

The effective management of threats to the environment from onshore petroleum spill scenarios relies upon the principles of isolation-containment-integrity and monitoring. Threats to the receiving environment from the proposed activity may include:

- Spills that can migrate offsite to sensitive receptors. The threat of spills migrating off site may be increased during the wet season.
- Loss of primary containment such as overflows, compromised integrity or damage by mobile plant.
- Ineffective secondary containment such as water in bunds or damage by mobile plant. The effectiveness of secondary containment may be compromised during the wet season.
- Loss of containment during transportation of wastewater or chemicals by road or flowlines.
- Loss of containment during well operations.

4 Potential Spill Materials

4.1 Petroleum Well Chemicals

4.1.1 Hydraulic Fracturing

Hydraulic fracturing chemicals have been assessed in **Appendix 08** Human Health and Environment Chemical Risk Assessment (HHECRA). The HHECRA report used a tiered assessment following the *Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework* and *National Industrial Chemicals Notification Scheme: National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia* [NICNAS, 2019; NICNAS et al., 2017]. The assessment was carried out on the compiled hydraulic fracturing fluid systems in **Appendix 08**, using screening of the potential human health and ecological hazards that should be considered for potential exposure to the hydraulic fracturing fluids during transportation, hydraulic fracturing activities (including storage), and subsequent treatment and disposal of flowback. The tiered assessment in the HHECRA includes the following steps:

- Tier 1 – Identify chemicals of low human health and ecological concern that do not require additional chemical risk assessment in the tier assessment process. It is not expected to cause harm under normal use conditions.

- Tier 2 – Chemicals that are not identified as a low human health and ecological concern and therefore require an additional risk assessment to characterise potential risks. This is done using a quantitative evaluation of the risks based on the potential complete exposure pathways and Tier 1 assessment.
- Tier 3 – These assessments are carried out to address specific concerns that could not be resolved in a Tier 2 assessment. These are conducted by staff of the *National Industrial Chemicals Notification and Assessment Scheme* (NICNAS) using the *Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework* [NICNAS, 2019].

The outcome of the HHECRA Tier 1 assessment identified the HF chemicals of lower potential human health and environmental concern. A Tier 1 chemical is a chemical that is considered to be of low risk to human health and the environment.

Ten of the 11 chemicals were identified in the Tier 2 assessment with a high ecotoxicity hazard and therefore having a potential risk to avian wildlife exposed to fluids stored in treatment tanks. One chemical (Hydrotreated light petroleum distillate) has the potential for inhalation exposures to workers during hydraulic fracturing activities.

The HHECRA in **Appendix 08** included an assessment of potential exposure pathway for avian wildlife based on the potential ingestion of waters containing the selected chemicals (including flowback) from treatment tanks that are used for storage during the hydraulic fracturing activities of approximately three weeks (see Appendix F of the HHECRA **Appendix 08**). The HHECRA concluded that the hazard quotient for all the assessed avian species was orders of magnitude less than the threshold hazard quotient level of 1. Therefore, there were no unacceptable exposures to the avian species. In addition, as a further conservative consideration, even if the potential exposure period is expanded to one year, the hazard quotient for the assessed avian species still will be orders of magnitude less than the threshold hazard quotient level of 1.

The HHECRA concluded that, based on the range of systems and plans to control the transportation and storage of chemicals during field development and operational activities and outcomes of the risk assessment, no further management controls were considered necessary.

A summary of risk assessment for Tier 2 chemicals is shown in **Table 4—1**. Three organosilicon chemicals were found to potentially persist in the environment (shown as red in **Table 4—3**). These chemicals are not considered to be of human health risk and are widely used in cosmetics.

They are highly volatile liquids used at maximum concentrations of 0.001 mg/L (1ppb) in HF fluid. The HHECRA noted that significant acute toxic effects are unlikely to occur as a result of exposure to these chemicals in the water column because this would require unfeasibly long exposures at concentrations that are a significant fraction of the saturation concentration of each chemical. The HHECRA also found that exposure through aquatic food-chains will provide a more environmentally significant exposure pathway for the organosilicon compounds which

are very hydrophobic (water repelling) chemicals [NICNAS, 2020] It also noted these chemicals will adsorb to particulate matter and will partition to soil and sediment compartments.

Table 4—1 Tier 2 Chemicals Summary Assessment (Appendix 08 HHECRA)

Tier 2	Chemical Name	CAS #	HF Concentration (mg/L)	LC50 mg/L	Rat Lethal Dose (mg/kg)	Ratio of Lethal Dose to Maximum Concentration	Human Health	Bioaccumulation	Persistence	ADG – Code Transport
1	**Chlorous acid, sodium salt**	7758-19-2	0.118	ND	284				Inorganic, N/A	Class 8
2	**Copper (II) sulfate**	7758-98-7	0.001	ND	481				Inorganic, N/A	
3	**Crontonaldehyde**	123-73-9	0.121	0.2	174					Class 6.1
4	**Decamethyl-cyclopenta siloxane**	541-02-6	0.001	> 0.02	> 5,000					
5	**Dicoco dimethyl quatemary ammonium chloride**	61789-77-3	0.1	ND	226					
6	**Dodecamethyl-cyclohexa siloxane**	540-97-6	0.001	ND	> 2,000					
7	**Glutaraldehyde**	111-30-8	1	0.8	123					Class 8
8	**Hydrotreated light petroleum distillate**	64742-47-8	3.15	4.9	> 5,000					
9	**Octamethyl-cyclotetra siloxane**	556-67-2	0.001	> 0.02	> 4,800					
10	**Tributyl tetradecyl phosphonium chloride**	81741-28-28	28	< 0.05	> 10,000					Class 6.1
11	**Amine oxides, cocoalkyldimethyl**	61788-90-7)	3							

Table 4—2 Ratio of Lethan Dose to Maximum Concentration Key

Ratio of Lethal Dose to Maximum Concentration Key	
	No Data
	≥ 100

Table 4—3 Persistence Legend

Persistence Legend	
Colour	**Risk Level**
	Very High
	Very Low
	Low but uncertain. Predicted risk or similar chemical tested.

4.1.2 Drilling Chemicals and Cementing Additives

The results of a hazardous chemical analysis conducted by reviewing the SDS are detailed in **Sections 11.1** and **11.2** below.

4.2 HF Flowback

The HF flowback water contains the chemicals used in the HF. For details of the potential risks pose by flowback water see **Section 4.1.1** above. HF flowback may also contain geogenic constituents of potential concern (CoPC). The key COPC in HF flowback may be Chlorides, Lithium, Phenol, and the Biocide (Tributyl Tetradecyl Phosphonium Chloride (TTPC)). The ability of these chemicals to cause environmental harm will depend upon their concentration, toxicity, the circumstances of the spill event and effectiveness of the spill response.

The anticipated volume of flowback water to be stored at the Water Handling Station (WHS) represents a significant risk from catastrophic failure of containment with a remote likelihood of occurrence given the controls described in **Section 2.8.1** of **Appendix 06** (Waste and Wastewater Management Plan).

4.3 Uncontrolled Methane Emissions

Uncontrolled methane emissions (leaks) may occur in upset conditions such as containment equipment failures.

Imperial will estimate and report all greenhouse gas emissions including uncontrolled methane emissions in accordance with the *National Greenhouse and Energy Reporting Act 2007 (Cth) and* to the Northern Territory Government in accordance with D.6.2 (b) and D.5.6 of *the Code.*

A detailed Methane Emissions Management Plan is included with the EMP as **Appendix 13**.

4.4 Fuels

Bulk fuel will be stored in tanks equipped with safety features such as double skins or temporary bunding. Spill, leak, and drip trays will be used to address the risks associated with refuelling operations. Any unused fuel at the end of the Activity will be removed from the CPP Area.

4.5 General Equipment Maintenance Chemicals

Equipment maintenance chemicals will be transported in their original containers or in tankers equipped with safety features such as double skins. Liquid maintenance chemicals will be stored in their original containers with temporary bunding or bulk tanks with double skins in a bunded area. Spill, leak, and drip trays and environmental liners will be used to address the risk of minor drips and spills associated with filling operations. Any unrequired general equipment maintenance chemicals will be removed from the CPP Area at the end of the Activity.

General equipment and maintenance chemicals are not anticipated to be hazardous, but all would be stored and handled in accordance with the SDS to limit the potential for environmental harm.

5 Potential Spill Scenarios

Spill scenarios identified as potentially occurring during the Activity are listed in **Table 5—1**. The risks presented by these scenarios are considered to have been reduced to ALARP. For details of risk assessment refer to **Table 6.1-6** (Risk Assessment Table) in **Section 6** of the EMP.

Table 5—1 Summary of Quality and Quantity of Potential Spill Scenarios

Potential Spill Scenario	Approximate Duration	Mechanisms	Location	Estimated Quantity	Worst Case Quantity	Maximum Time to Locate Spill	Quality of Spill	Controls

HF Flowback / Wastewater During Transfer, Treatment, Storage	Until removal of all above-ground tanks	• Coupling, hoses, or valve failure
		• Wastewater flowline leak
		• Overflow of an above ground tank
		• Leak in an above ground tank liner
		• Catastrophic failure of storage tank.
			• Well pads
			• Wastewater flowlines
			• Water Handling Station
			• CPP Area
				< 5,000 L	55 ML	Immediate	Chloride contamination
							Potentially hazardous chemicals
							Geogenic metals
							Non hazardous
							Condensed water
								• Double lined above ground tanks for secondary containment.
								• Process equipment will be pressure tested and leak tested on installation.
								• Atmospheric pressure open separator and any, open process vessels to be double lined or within a bund with 110% capacity.
								• Freeboard maintained in the dry season and in the wet season.
								• Flowline pressures monitored during pumping.
								• Flowline buried to 750 mm depth of cover (DOC) to reduce risks from fire and vehicle impacts.
								  ○ DOC increased to 1,200 mm under access tracks and watercourses.
								  ○ Flowlines designed, installed, and operated in accordance with APGAPEGN Code [APGA, 2019].
								• Leak detection sensors placed between liners that can be monitored remotely.
								• Remote monitoring of above ground tanks by camera and/or site personnel.
								• Level sensors installed in the above-ground tanks to measure freeboard.
								• Overland flow managed by fluid control berm to avoid washouts at tank base.
								• Tanks maintained in accordance with manufacturers recommendations.
								• Above ground tanks designed to withstand bushfires and be placed on pads with ~8 m fire break.

Potential Spill Scenario	Approximate Duration	Mechanisms	Location	Estimated Quantity	Worst Case Quantity	Maximum Time to Locate Spill	Quality of Spill	Controls
								• Tanks designed to meet local wind loading conditions and installed on compacted pads to ensure stability. • Any transfer to cease in the event a leak being identified
Transport of Chemicals or Wastewater	One day per transport	• Loss of containment • Vehicle accident • Bogged vehicle in the wet season	Access tracks Highway CPP Area	< 25,000 L	25,000 L	Immediate	Potentially hazardous chemicals	• All transport providers licensed under the *Waste Management and Pollution Control Act 1998.* • Transport of chemicals or wastewater on unsealed roads during the wet season will only be approved by the Supervisor when the road is assessed to be in suitable condition, and when no significant rainfall events are forecast. A record of this Wet Season Transport of Chemicals/ Wastewater Checklist undertaken by the Supervisor will be kept. • Chemicals and wastewater will not be transported across flowing water. • CPP Traffic Management Procedure.
Handling of Chemicals	Duration of the Activity	• Coupling/hose/valve failure • Overfill of containers. • Broken or leaking containers	Well pad Water Handling Station CGP CPP Area	< 1,000 L	1,000 L	Immediate	Chemical contamination Potentially hazardous chemicals	• Containment bunds under connections when in use. • Dedicated / segregated area for chemical storage and handling with secondary containment Spill kits stocked where chemicals are stored and handled. • Open vessels handling HF fluid or flowback fluid will have secondary containment.
Storage of Chemicals	Duration of the Activity	• Broken or leaking containers • Bunds inundated with rainwater	Well pad CGP CPP Area	< 1,000 L	1,000 L	2 hr	Chloride contamination Potentially hazardous chemicals	• Dedicated / segregated area for chemical storage and handling with secondary containment. • Spill kits stocked and available where chemicals are stored and handled.

Potential Spill Scenario	Approximate Duration	Mechanisms	Location	Estimated Quantity	Worst Case Quantity	Maximum Time to Locate Spill	Quality of Spill	Controls
								• Secondary containment, when in use, is to be monitored weekly during the dry season and daily during the wet season for damage, spills, or water for management in accordance with A.3.8.(i) of *the Code*. Inspection may be by remote camera or physical inspection. • Storage of chemical in accordance with relevant MSDS requirement.
Use of Drilling Sump	Until sump rehabilitation	• Overfilling of a sump with drilling fluid, cuttings, or water • Leak in liner	Well pad CPP Area	< 5,000 L	~2.5 ML	~12 h	Chloride contamination Potentially hazardous chemicals	• Freeboard maintained in the dry season in the wet season. • The drilling sump will have a raised bund around the perimeter of 500 mm to prevent rainwater from flowing into the sump. • Remote monitoring of sumps via camera and/or level transmitters installed in wastewater sumps to measure freeboard.
Diesel Refuelling	Duration of the Activity	• Coupling/hose failure • Overfill fuel tank • Storage tank failure	Well pad Camp site CPP Area	< 1,000 L	1,000 L	Immediate	Combustible C1	• Drip trays available for use. • No fuel transfers without personnel present. • Spill kits available when refuelling.
Storage of Diesel	Duration of the Activity	• Tank failure • Impact by mobile plant	Well pad CPP Area	< 50,000 L	50,000 L	2 hr	Combustible C1	• Secondary containment with sufficient capacity to hold 110% of the volume of the largest container stored in the area or be contained in double skinned tanks.
Uncontrolled Methane Emissions	Duration of the Activity	• Well integrity failure • Loss of containment • Emergency release	Well pad CGP CPP Area	3 MMscf	3 MMscf	Immediate	Flammable gas	• Methane Emissions Management Plan.
Storage and use of Hydraulic Fluid or Lubricant	Duration of the Activity	• Failure of storage container and/or hydraulic systems.	Well pad CPP Area	< 1,000 L	3,800 L	2 hr	Not hazardous and not a Dangerous Good	• Secondary containment where hydraulic fluids and lubricants are stored.
Wastewater Flowlines (Large Scenario)	Duration of the Activity	• Flowline pierced by mechanical means.	Flowline system (buried pipeline) CPP Area	70 kL	300 kL	Rapid – initiating event is a buried pipeline strike with mechanical plant and the leak location.	As above	• Pipeline signage located within easement and minimum depth of cover of 750mm to

Potential Spill Scenario	Approximate Duration	Mechanisms	Location	Estimated Quantity	Worst Case Quantity	Maximum Time to Locate Spill	Quality of Spill	Controls
								mitigate risk of pipeline strikes by 3rd parties. • Future Tie-in Connections included in initial pipeline installation to reduce requirement for excavation activities in future in close proximity to operational flowlines. • Event response consists of shutting down inflow of wastewater into the network which can be actioned remotely by an operator. • 0.3 ML represents the highest volume of an individual segment of the network within topographical constraints that could be fully released due to pipeline strike. • The estimated quantity of 0.07 ML represents the average volume of water that could be spilt within topographical constraints due to a pipeline strike at a random location on the pipeline.
Wastewater Flowlines (Small scenario)	Duration of the Activity	• Pinhole leak from high point vent (HPV) valve and/or from flanged joints in HPV assembly.	High point vent installations CPP Area	3 kL	7 kL	Immediate – visual inspections of HPV assemblies will take place at least on a weekly basis by field operators. Due to the small size of leaks, visual inspections are the only credible means to identify the leaks – much sooner than any instrumented system.	As above	• Visual checking of High Point Vents. • HPVs can be manually isolated from flowlines when they are not required for flowline operation. • Engineering controls include leveraging learnings from the QLD CSG industry with respect to HPV valve selection to minimise leak potential. • Worst case leak quantity based on 1 mm pinhole leak in HPV assembly going unnoticed for 1 week with maximum pressure at HPV of ~300 kPag experienced when gathering system utilised for supply of water to frac spread. • Estimated leak quantity based on 1 mm pinhole leak in HPV assembly going

Potential Spill Scenario	Approximate Duration	Mechanisms	Location	Estimated Quantity	Worst Case Quantity	Maximum Time to Locate Spill	Quality of Spill	Controls
								unnoticed for 1 week with more typical pressure at HPV of ~50 kPag experienced during periods outside of gathering system frac water supply.
Transport of Gas in Flowlines	Duration of the Activity	• Flowline low point drain fluid loss of containment.	Gas flowline system CPP Area	< 1,000 L	1,000 L	Immediate	Not hazardous and not a Dangerous Good	• Transfer from low point drain to storage IBC / drain point completed manually under supervision.

6 Pooled Water Area and Infiltration in Soil

The CPP Area is located on gradational medium to deep hard-setting loamy red Kandosol earth, over neutral to slightly acidic medium to heavy clay subsoils, with some fine ferro-manganiferous concretions throughout the profile [Young L et al; DEPWS, 2023]. Subsoil horizons are generally weak to non-structured reddish clay Kandosol loams and medium clays.

Kaolinite is the clay present in the sandy clay loam red kandosol soil dominant within the CPP Area. Kaolinite is a non-expanding clay, and this characteristic is important in assessing the suitability of this material for road base for operational purposes both at the well pads and on the well pad access tracks, which are required to carry repeated heavy loads and to mitigate the risk of infiltration in the event of a spill.

A conservative, worst-case, numerical modelling approach was used to assess both the potential area and depth of soil infiltration from spill scenarios at a CPP well pad. This is found in the HHECRA**, Appendix 08**, which includes Appendix B (Potential Risk to Groundwater from Hypothetical Water Releases). The water table at the well pads is > 50m bgl.

6.1 Pooled Water Area

The pooled water area model in **Appendix 08** (HHECRA) modelling results found that an unbunded release of 1 ML of HF flowback could impact an area of up to 30.8 ha. A release of 100,000 L could impact up to 4.7 ha, an area equivalent to over a third of the area of the potential well pad hardstand size.

To prevent a release above ground storage and treatment tanks are double lined with leak detection and are monitored weekly in the dry season and daily in the wet season for integrity and leaks reducing the risk of a spill to ALARP.

6.2 Infiltration of Soil

The results of infiltration modelling in **Appendix 08** (HHECRA) indicate that organic HF chemicals such as methanol and glutaraldehyde would take approximately 100 years to infiltrate the soil to 20m bgl.

The potential for chloride contamination of the soil in the event of a significant spill of flowback fluid is a key consideration. The elevated chloride levels in HF flowback are primarily from geogenic sources in the target shale formation.

Modelling in **Appendix 08** (HHECRA) indicated in that the time taken for chloride to reach steady state conditions is likely to be more than 20 to 50 yrs. The steady state concentration of chloride that could potentially discharge to groundwater is estimated as 29 mg/L which is below the aesthetic criteria for drinking water.

The modelling results show that predicted chloride concentrations in the surface soil from a flowback spill may increase soil chloride levels by more than 25 mg/kg above the baseline of 40 mg/kg. The resultant increased chloride concentrations may restrict future plant growth in the affected area to salt tolerant species **Figure 6—1**.

The choice of remediation of flowback fluid (aka brine) spills depends on the severity of contamination, environmental factors, cost-effectiveness, and relative efficiency of salt removal.

The Australian Petroleum Institute's *Strategies for Addressing Salt Impacts of Produced Water Releases to Plants, Soil, and* Groundwater, common remediation types are as follows:

- Natural – Natural remediation is unenhanced and/or passive. This process is usually recommended when the salt impacts are minor. The natural process requires little to no intervention. Natural remediation should be considered when reviewing any remediation effort.
- Chemical – In Situ chemical remediation are used to remove salts from the root zone. Chemical remediation is somewhat more expensive than natural remediation and could possibly be the hardest of the three techniques. There are a variety of chemical amendments can be used to remobilize salts including:
    - Neutral soils. Gypsum (CaSO4:2H2O), Calcium Chloride (CaCl2:2H2O), Limestone (CaCO3), Dolomite (CaCO3:MgCO3), Calcium Oxide (CaO), Calcium Hydroxide [Ca(OH)2]
    - Alkaline soils PH>8.5. Sulfur, Sulfuric acid (H2SO4), Aluminum sulfate [Al2(SO4)3:18H2O], Iron Sulfate (FeSO4:7H2O)
    - Other. Polymers, Proprietary chemicals, Diammonium phosphate [(NH4)2(HPO4)]

- Mechanical – Mechanical remediation involves mechanically moving the soil such as tilling or excavating. There are two basic types of mechanical treatment:
    - Dilution by land spreading effected soils into unaffected areas to reduce concentrations to an acceptable level or enhance other treatment options. Care must be taken so that land spreading does not create a larger area of contamination.
    - Disposal is usually the most expensive of treatments and is usually only considered as a last resort [Australian Petroleum Institute, 2006].

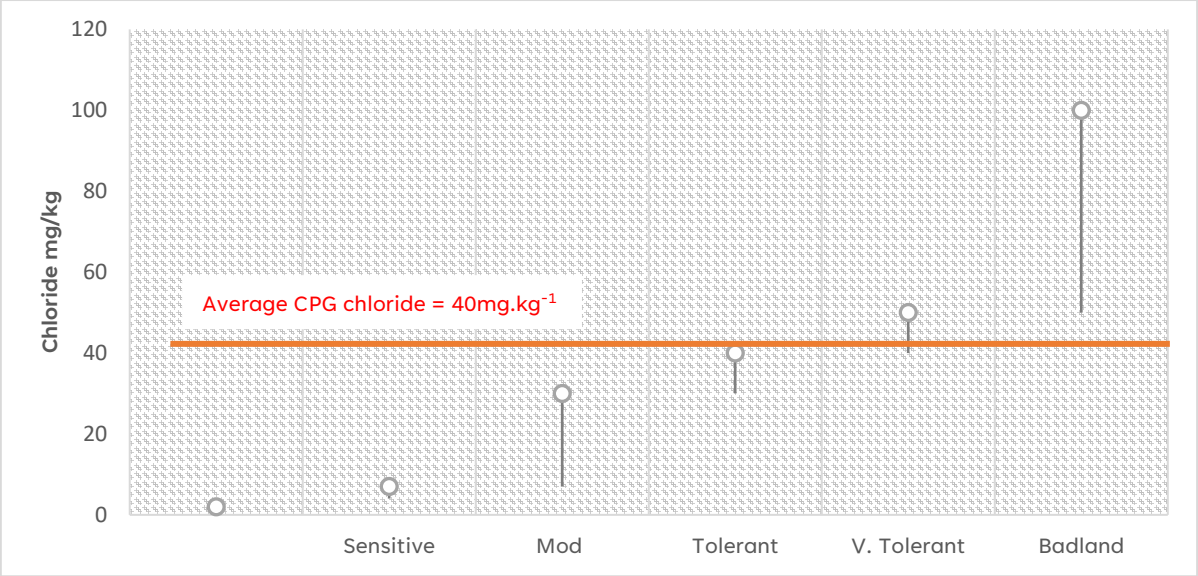

Figure 6—1 CPP Soil Chloride Level Baseline and Plant Tolerance Chloride

7 Control Measures

7.1 Key Control Measures

The key control measures to manage spills associated with the Activity are summarised in the list below.

- Well pad, water handling station (WHS) and CGP site selection criteria to reduce the likelihood and mitigate the consequence of spills, including ground truthing to avoid waterways and flood zones.
- Well pads, WHS and CGP constructed with runoff diversion bunds to prevent run-on and chemical storage areas that comply with Section B.4.16.2 (h) of *the Code* where needed.
- All contaminated materials/waste stored on the well pads, WHS and CGP or at the campsite in containers with secondary containment or in containers in bunds to prevent off-site release.
- All drilling, HF and completion fluids, liquid chemicals additives, hazardous chemicals, oil, and fuel will be stored on the well pad in a dedicated area with secondary containment so spilled material can be removed or treated.
- Secondary containment will have sufficient capacity to hold 110% of the volume of the largest container stored in the area, unless the container is equipped with individual secondary containment (Section A.3.8 (g) (i) of *the Code*). An instance of this is, above-ground tanks will be doubled lined for secondary containment or be within a bund that has the capacity to store 110% of the largest single walled tank in that bunded area.
- The drilling sump will be lined with Aquacon345, HDPE, or equivalent, which meets the Code requirements for an impermeable membrane.
- The drilling sump, and above ground tanks will be constructed and/or operated in accordance with seasonal freeboard requirements.
- The drilling sump will have a raised bund around the perimeter of 500 mm to prevent rainwater from flowing into the sump.
- Above ground tanks pad/s will be constructed to minimise the impact of a potential spill of wastewater; this includes compacting the tank pad surface to reduce infiltration and constructing a perimeter bund to avoid erosion around the base of the tank and as a contingency to contain any overflow from going off-site.
- Spill kits will be readily available at each worksite while operational and on all mobile service trucks or vehicles where hydrocarbons, chemicals or wastewater are stored, used, or transported.

- Weekly inspections of the wastewater and gas flowlines to detect leaks.

7.2 Transport of Wastewater and Chemicals

HF flowback wastewater will be transferred and managed between well pads and the WHS by buried flowlines. Situations may arise where wastewater will be transported by heavy vehicles.

Flowline installation will be carried out in a manner to reduce the risks of loss of containment as detailed in **Section 4.2** – Flowline Design in **Appendix 06** (Waste and Wastewater Management Plan).

The Code requires that the wet season transport of chemicals and wastewater on unsealed roads must not be undertaken unless the risk of spills is demonstrated to be ALARP and acceptable.

To demonstrate that the risks of a spill during transport in the wet season of a chemicals or wastewater are reduced to ALARP and acceptable, the following key controls are to be put in place:

- During the wet season, chemicals or wastewater are not to be transported on unsealed roads if significant rainfall (> 300 mm over 4 days) is forecast.
- On-site unsealed tracks on the planned route have been visually inspected and are in good condition.
- Emergency response measures (e.g. spill kit, communication tools) are available and functional.
- Chemicals and wastewater will not be transported via road across flowing creeks or watercourses on the route.
- Wet season transport of chemicals or wastewater will not be authorised until Site Supervisor has undertaken the checklist of the above key controls.
- If a chemical or wastewater transport vehicle becomes bogged, the response scenario outlined in the Emergency Response (Contingency) Management Plan, **Table 4—1** is to be followed.

If there is a spill incident that is not a bogged transport vehicle, refer to **Section 8** below for details of the spill response.

7.3 Monitoring

Monitoring includes:

- Secondary containment monitored weekly during the dry season and daily during the wet season in accordance with A.3.8.(i) of *the Code*. If secondary containment is compromised, it must be repaired as soon as practicable.
    - Monitoring of secondary containment may be done remotely via camera.
- Above ground tanks will be double-lined and have leak detection sensors placed between liners that can be monitored remotely.
- Level sensors will be installed in the above-ground tanks and wastewater sumps to measure freeboard and will be calibrated to ensure accuracy. Frequency is described in Section 6.2 of **Appendix 06** (Waste and Wastewater Management Plan).

8 Spill Response and Management

The following sections provides an overview of the response to spills.

8.1 Interaction with Emergency Response (Contingency) Management Plan

Where the spill results in an emergency, **Appendix 09** (the Emergency Response [Contingency] Plan) will take precedence over this plan.

Emergency Response (Contingency) Plan activation triggers include, but are not limited to the following:

- Serious injury/loss of life or emotional harm.
- Serious impact on the biological, physical environment or ecosystem functions.
- Significant damage or threat to property/assets.
- Impact on community, cultural heritage sites, or both.
- Serious regulatory breach.
- Loss or extended disruption to critical services and ability to continue operations.

8.2 Spill Incident Priority Assessment

A tiered priority framework for spills, is provided in **Table 8—1**.

Table 8—1 Spill Incident Priority Assessment

ADG Code or Description	Trigger Volume	Priority
Chemicals* with ADG Codes 2 to 8 inclusive	> 50 L	**Level 1**
Chemicals* with ADG Code 9 - Miscellaneous	> 1,000 L	
Chemicals* with ADG Code C1 – Combustible bulk diesel	> 10,000 L	
Chemicals* without an ADG Code	> 5,000 L	
HF Fluid	> 10,000 L	
Drilling Fluid	> 10,000 L	
HF Flowback	> 10,000 L	
Chemicals* with ADG Codes 2 to 8 listed in Level 1	< 50 L	**Level 2**
Chemicals* with ADG Code 9 – Miscellaneous	500 to 1,000 L	
Chemicals* with ADG Code C1 – Combustible bulk diesel	5,000 to 10,000 L	
Chemicals* without an ADG Code	1,000 to 5,000 L	
HF Fluid	5,000 to 10,000 L	
Drilling Fluid	5,000 to 10,000 L	
HF Flowback	5,000 to 10,000 L	
Chemicals* with ADG Code 9 – Miscellaneous	< 500	**Level 3**
Chemicals* with ADG Code C1 – Combustible bulk diesel	1,000 to 5,000 L	

ADG Code or Description	Trigger Volume	Priority
Chemicals* without an ADG Code	500 to 1,000 L	
HF Fluid	1,000 to 5,000 L	
Drilling Fluid	1,000 to 5,000 L	
HF Flowback	1,000 to 5,000 L	
Chemicals* with ADG Code C1 – Combustible Bulk Diesel	500 to 1,000 L	**Level 4**
Chemicals* without an ADG Code	< 500 L	
HF Fluid	500 to 1,000 L	
Drilling Fluid	500 to 1,000 L	
HF Flowback	500 to 1,000 L	
Chemicals* with ADG Code C1 – Combustible Bulk Diesel	< 500 L	**Level 5**
HF Fluid	< 500 L	
Drilling Fluid	< 500 L	
HF Flowback	< 500 L	

Table 8—2 Priority Level Spill Action

Priority Level	Action
1	• Ensure all personnel are safe and accounted for. • Immediately stop all work in vicinity of incident. Size of area of stop work will depend on risks posed by incident e.g. toxic gas release may require are larger safety buffer. • Assess situation to determine if activation of the Emergency Response (Contingency) Plan is required. • If incident not an emergency and it is safe, start Initial Spill Response in **Section 8.2**. • Work cannot recommence until area is safe and spill cleaned up. • Refer to **Section 9** to determine if the incident is reportable or recordable. • Carry out detailed investigation of cause of the incident and implement corrective actions.
2	• Ensure all personnel are safe and accounted for. • Stop all work in vicinity of incident. If chemical has an ADG Code 2 to 8, the size of area of stop work will depend on risks posed by incident e.g. toxic gas release may require are larger safety buffer. • Assess situation to determine if activation of the Emergency Response (Contingency) Plan is required. • If incident not an emergency and it is safe, start Initial Spill Response in **Section 8.2**. • Work cannot recommence until area is safe and spill cleaned up. • Refer to **Section 9** to determine if the incident is reportable or recordable. • Carry out review of work practices and implement corrective actions.
3	• Ensure all personnel are safe and accounted for. • Cordon off area in vicinity of incident.

Priority Level	Action
	• Assess situation to determine if activation of the Emergency Response (Contingency) Plan is required. • If incident not an emergency and it is safe, start Initial Spill Response in **Section 8.2**. • Area to remain cordoned off until area is safe, and spill cleaned up. • Refer to **Section 9** to determine if the incident is reportable or recordable. • Carry out review of work practices and the cause of the incident and implement corrective actions.
4	• Ensure all personnel are safe and accounted for. • Start Initial Spill Response in **Section 8.2**. • Carry out review of work practices and implement corrective actions.
5	• Ensure all personnel are safe and accounted for. • Start Initial Spill Response in **Section 8.2**.

8.3 Initial Spill Response

All personnel onsite must report all spills as soon as possible to their supervisor. Site induction must include this requirement.

When a spill occurs, the priority is to ensure all personnel are safe by:

- Removing all personnel from site of the spill until the nature of the spill can be determined.
- Keeping personnel away from areas of vapours, fumes, and smoke.
- Safety-related equipment such as breathing apparatus may be required to extract personnel if in immediate danger.

After it has been determined that all personnel are safe, the Site Supervisor will conduct an initial assessment of the nature of the spill to identify the potential hazards, and to determine if an emergency response is required (see **Section 8.1** above).

The assessment is to consider:

1. Type, location and extent/volume of spill and weather conditions.
2. The material's hazardous characteristics and the associated control measures, including any potential risks associated with chemical mixing, such as oxidising and reducing agents, as outlined in the Safety Data Sheet.
3. Removing all sources of ignition if material is combustible liquid or produces combustible vapours.
4. Safely shutting down any impacted plant.
5. Limiting vehicle movements. No engines to be started in the vicinity if material released flammable vapours.
6. Isolate the source of the spill if it can be done safely.
7. Deploy containment measures that can safely be implemented.
8. Determine the spill movement, including factors affecting the movement.
9. Determine safety hazards by referring to the SDS to brief response personnel and identify if what PPE is needed and if additional resources (e.g., emergency services, specialised equipment, or advice) are required to manage the spill safely.
10. Determine relevant personnel and parties to notify.

8.4 Clean Up

- Refer to SDS for instructions and PPE requirements.
- Retrieve as much as possible with sorbents or vac truck.
- Remove contaminated subsoil to reduce the spread of potential contamination.
- Isolate contaminated material in sealed containers and take and keep samples for later analysis and confirmation of disposal options. Quantities of contaminated material too large for sealed containers, must be dealt with by engaging licensed contractors as soon as practicable.
- Only licenced waste contractors are permitted to transport, receive, and dispose of listed wastes.

8.5 Contaminated Material Disposal

- Off-site disposal must be undertaken following the *Waste Management and Pollution Control Act 1998 (NT)*.
- All listed waste transportation shall be undertaken by licenced contractors and be tracked and disposed of at approved waste management facilities.
- Waste containers should be labelled in accordance with *Globally Harmonized System of Classification and Labelling of Chemicals (GHS)* based on type of hazard spill material [United Nations, 2023].
- Materials that escape from primary containment or are otherwise spilled onto secondary containment will be removed as soon as possible and returned to containment if able to be reused or disposed in accordance with this subsection.
- Quantities of contaminated material too large for sealed containers must be dealt with by engaging licensed contractors as soon as practicable.

8.6 Spill Register

Spill register completed for all liquid contaminant or hazardous chemical spills including:

- Nature and extent of spill
- Circumstances that caused the spill
- Corrective actions to prevent a similar spill
- GPS coordinates of spill location
- Inclusion of chemical product identifier(s)

8.7 Communications Plan

Site induction includes overview of the importance of preventing spills:

- Site induction includes importance of reporting all spills to the Site Supervisor.
- Site Supervisor will conduct the initial assessment of the spill to identify the potential hazards, type, location, to inform an emergency response (see Section 3 of the Emergency Response Plan).
- Complete spill register and escalate if the incident is reportable see **Section 9**.

9 Incident Reporting

Incidents may have to be reported under the *Petroleum (Environment) Regulations 2016 (NT)* (PER), the *Petroleum Regulations 2020 (NT*), the *Waste Management and Pollution Control Act 1998 (NT)*.

9.1 Petroleum (Environment) Regulations 2016

9.1.1 Reportable Incidents

Regulation 3 of the *PER* defines a Reportable Incident as an incident arising from a regulated activity that has caused or has the potential to cause material environmental harm or serious environmental harm.

Section 8 of the *Environment Protection Act 2019 (NT):*

> Material environmental harm means environmental harm that:
>
> (a) is not trivial or negligible in nature; and
>
> (b) is less serious than significant environmental harm.

Section 9 of the *Environment Protection Act 2019 (NT):*

> Significant environmental harm means environmental harm that:
>
> (a) is of major consequence having regard to:
>
> (i) the context and intensity of the harm; and
>
> (ii) the sensitivity, value and quality of the environment harmed and the duration, magnitude, and geographic extent of the harm; or
>
> (b) would, or is likely to, cost more to remediate than the monetary amount prescribed by the *Environment Protection Regulations 2020 (NT)* Regulation 4 ($50,000).

Imperial will notify the Minister for Environment Parks and Water Security (DEPWS) orally or in writing as soon as practical but not later than two hours after a reportable incident occurred or when Imperial becomes aware of the incident. The notification will comply with Regulation 33 (3)(c) of the *PER*.

If the Imperial gives notice orally, a written notice will be given to the Minister, not later than 24 hours after giving oral notice, that specifies all the matters mentioned in Regulation 33 (3)(c).

There are several different reports required to be provided for reportable incidents, with different timing. Templates have been developed for each stage of reporting and are available on the Onshore Gas website.

Reporting on reportable incidents is an iterative process that occurs in four stages:

1. An initial notice of a reportable incident
2. An initial reportable incident report
3. Subsequent interim report/s (where required), and
4. A final report about the reportable incident.

Refer to the *Onshore Petroleum Incident Reporting Guideline 2023* for more details [DEPWS, 2023].

9.1.2 Recordable Incidents

Regulation 3 of the *PER* defines a recordable incident as an incident arising from a regulated activity that has:

- Resulted in an environmental impact or environmental risk not specified in the current plan for the Activity; or
- Has resulted in a contravention of an environmental performance standard specified in the current plan for the Activity; or
- Is inconsistent with an environmental outcome specified in the current plan for the Activity; and
- Is not a reportable incident.

Imperial will give the Minister for Environment, Parks and Water Security (DEPWS) a written report about recordable incident as soon as practicable, but no later than 15 days, after the end of the reporting period.

Regulation 35(4)(b) of the *PER* requires a recordable incident report to be provided each 90 days after the day on which an EMP is approved (the reporting period), unless an agreement is made in writing between the Minister and an interest holder about an alternative reporting period under Regulation 35(4)(a).

Imperial agrees to the uniform reporting periods previously proposed:

- Quarter 1: 1 January to 31 March. Due date 15th April.
- Quarter 2: 1 April to 30 June. Due date 15th July.

- Quarter 3: 1 July to 30 September. Due date 15th October.
- Quarter 4: 1 October to 31 December. Due date 15th January.

All recordable incident reports are to be submitted to onshoregas.DEPWS@nt.gov.au and must include:

- reference to the relevant EMP title and unique code, and
- reference to the submission being made under Regulation 35(1).

Imperial will provide recordable incident reports using the template provided on the Onshore Gas website.

To achieve accurate recordable incident reporting, the interest holder must have a system for:

- checking compliance against environmental outcomes and environmental performance standards on at least a quarterly basis, and
- reviewing all incidents to determine whether a new environmental impact or risk has arisen that is not accounted for in the approved EMP.

Refer to *Onshore Petroleum Incident Reporting Guideline 2023* for more details.

9.2 Petroleum Regulations 2020 (NT)

The following is a summary of information on how to report a petroleum operations incident taken from the Report a petroleum operations incident [NTG, 2023]:

- Under the *Petroleum Regulations 2020 (NT)*, Imperial must report any serious and reportable incidents that occur on its petroleum interest to the minister (Department of Industry, Tourism and Trade).
- Imperial will retain all incident records and reports for at least five years after the incident occurred and acknowledges they may be prosecuted for failing to comply with incident reporting and recordkeeping obligations.

9.2.1 Serious Incidents

A serious incident is an incident arising from activities conducted under a permit or licence as a result of which any of the following occur:

- A person suffers serious injury or illness or is killed.
- An uncontrolled fire or explosion occurs.

- An uncontrolled flow of formation fluids or well fluids into the environment or into a separate underground formation occurs.
- There is a failure of, or damage to barriers, infrastructure or systems that leads to or could lead to a loss of integrity in a well or petroleum surface infrastructure that requires emergency intervention.
- A blowout preventer, pressure control equipment or emergency shutdown system is activated.
- Both primary and secondary well barriers are no longer intact.
- The security of national gas supply is prejudices or an imminent risk to the security of natural gas supply arises.

9.2.1.1 How to Report

Imperial must:

- Call 1300 935 250 within two hours of the incident happening.
- Email a written notification to DITTPetroleumOperations@nt.gov.au within 24 hours.

If the serious incident results from a failure of the integrity of a well or surface infrastructure, Imperial must provide a written investigation report, including all related documents, within one month after the incident occurred.

9.2.2 Reportable Incidents

A reportable incident is an incident arising from activities conducted under a permit or license as a result of which any of the following occur:

- immediate action is required to prevent a serious incident.
- a single barrier or control remains intact so as to prevent loss of integrity in a well or petroleum surface infrastructure and no other barrier or control exists.
- equipment or systems that are designed to reduce the consequences of a serious incident fail or are compromised.
- a designed operating envelope is exceeded.

9.2.2.1 How to Report

Fill in an incident notification form and email it to DITTPetroleumOperations@nt.gov.au within 72 hours.

Imperial will use the approved form and include all the information set out in the Petroleum Regulations 2020 (Regulation 66M).

9.2.3 Other Incident Reporting

Imperial may be required to report the same incident to another agency under NT legislation.

Reportable and recordable incidents under the *Petroleum (Environment) Regulations 2016* must be reported to the Department of Environment, Parks and Water Security (DEPWS) (see Section 9.1 above).

Serious injuries, dangerous incidents or a death at a workplace must also be notified to NT WorkSafe under the *Work Health and Safety (National Uniform Legislation) Act 2011*.

For more information, contact NT WorkSafe on 1800 019 115 or visit the NT WorkSafe website.

9.3 Waste Management and Pollution Control Act Incident Reporting

The NT EPA website provides the following information about reporting an incident under Section 14 of *Waste Management and Pollution Control Act 1998* (NT) under the section, *Notification of an Incident*.

Imperial can notify the EPA in any of the following ways:

- Email completed Section 14 Incident Report Form.
- Submit an Online Pollution Report.
- Contact the Pollution Hotline on 1800 064 567.

9.3.1 Written Notice to the Department (as the administering authority)

The Section 14 Incident Report Form should be used for providing written notice to the EPA when a person becomes aware of an incident that may have caused or threatens serious or material environmental harm.

When reporting an incident, Imperial are to give as much of the following information as they can:

- What happened (the incident).
- Where the incident occurred.
- The date and time of the incident.
- How the pollution is occurring, or if it is not yet happening, how you think it may occur.
- The attempts being made to:
    - Prevent
    - Reduce
    - Control
    - Rectify or clean up the pollution and
    - Address any environmental harm.
- Your identity.

If Imperial reports the incident within 24 hours, the EPA cannot use the report as evidence to take legal action.

Imperial does not have to make a report if the potential pollution or environmental harm is trivial or negligible, or if the incident results in only localised:

- Noise
- Smoke
- Dust
- Fumes Or
- Odour.

Generally, Imperial will need to make a report if there has been a spill of a contaminant or waste (such as hydrocarbons, paint, pesticides, or other toxic chemicals), and the spill:

- Has entered a waterway (including a drain)
- Spread more than three metres or
- Left your premises.

If you unsure about making a report, contact the EPA.

If written notice is required to be given to the occupiers or registered owners of affected land, the person responsible for giving that written notice can use the Section 14 Incident Report Form as a guide for what information to give.

9.3.2 Calling the NT EPA Pollution Hotline

In addition to providing the written notice, if Imperial becomes aware of an event which has caused or threatens serious or material environmental harm, Imperial should immediately call the Pollution Hotline on **1800 064 567** and report the event.

Reporting the event through the Pollution Hotline allows the department to take necessary measures to prevent further harm and to mitigate the effects of an incident or event.

10 Records and Record Keeping

Imperial will create and keep all prescribed records required by Regulation 36(1) and defined in Regulation 36(3) of the *PER*.

11 Chemical Tables

Drilling, completions, workovers, and cementing fluids are selected and used in accordance with their designed function, the manufacturer's recommendations, and relevant Safety Data Sheets (SDS).

The below tables provide an indicative list of additives that may be used on the wells being drilled, completed, or worked over under this EMP to enable an assessment of what chemicals may be hazardous or have the potential to cause environmental harm. The hazardous chemical analysis was conducted by reviewing the SDS for chemical additives within a primary function/description category. If a functional group contains additives that were deemed hazardous, then the environmental/disposal considerations were added along with the recommended handling and storage considerations (in addition to the requirement for secondary containment) to enable safe use on site. It is to be noted that the below list is not a complete list of what may be used on the well.

Any change in the components or composition of chemicals or their hazardousness will need to be formalised through a modification or revision to the EMP in accordance with the *PER*, before the change is enacted. Chemicals that are identical but are supplied under different trade names will not require a formal modification or revision to the EMP. Please see **Appendix 08** for the assessment of HF chemicals.

11.1 Indicative Chemicals in Drilling, Completions or Workover Fluids

Table 11—1 Indicative Chemicals in Drilling Fluids

Primary Function (group) Description	Description	Example Additives Names	Hazardous (Y/N)	Typical Environmental / Disposal Considerations (if hazardous)	Recommended Handling and Storage Considerations (if hazardous)
Alkalinity pH Control	pH Buffering Agent / pH Adjustment	Lime	Y	• Prevent product from entering drains and waterways. • Neutralise with dilute acid (e.g., 3 mol/L hydrochloric acid) or similar. For small amounts, absorb with sand or similar and dispose of to an approved landfill site. Contact the manufacturer/supplier for additional information (if required). • Dispose of in accordance with relevant local legislation.	• Store in a cool, dry, well-ventilated area, removed from incompatible substances and foodstuffs. Ensure packages are adequately labelled, protected from physical damage, and sealed when not in use. • Incompatible (violently) with acids (e.g., nitric acid), maleic anhydride, nitroethane, nitromethane, nitroparaffins, nitropropane and phosphorus
		Caustic Soda	Y	• Do not let the product enter drains. • Contact local environmental authorities for approved disposal or recycling methods in your jurisdiction. • Dispose of contents in accordance with local, regional, national, and international regulations. • Contact with water causes violent frothing and spattering.	• Store in a well-ventilated area. • Keep the storage container tightly closed. • Reacts with metals (aluminium, tin, and zinc to generate flammable and explosive hydrogen gas). • Heat is generated when mixed with water. Spattering and boiling can occur. Flammable hydrogen may be generated from contact with metals such as: aluminium, brass, tin, zinc, and alloys of these metals. • Avoid contact with acids, halogenated organics, organic nitro compounds, and glycols. Caustic soda solution reacts readily with various reducing sugars (i.e., fructose, lactose, maltose, dry whey solids) to produce carbon monoxide. Precautions should be taken, including atmospheric monitoring of the tank to ensure personnel.
		Citric Acid	Y	• Do not let the product enter drains. • For containment, if contaminated with other materials, collect as any solid in suitable containers. • For cleaning up, recover the product by vacuuming, shovelling, or sweeping, and place it in an appropriate container to be disposed of at an appropriate disposal facility.	• When heated, the material emits irritating fumes. • Store tightly closed in a dry, cool, and well-ventilated place. • Protect from moisture. • Handle with gloves. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands. • Incompatible materials (alkalis and caustic products).
	Conditioning Chemical	Magnesium Oxide	N		

Primary Function (group) Description	Description	Example Additives Names	Hazardous (Y/N)	Typical Environmental / Disposal Considerations (if hazardous)	Recommended Handling and Storage Considerations (if hazardous)
Bacteriacides	Biocide	Glute 9 THPS20 Idcide 20 Nuosept	Y	• Prevent product from entering drains and waterways. • For clean-up, contain spillage, then cover/absorb spill with non-combustible absorbent material (vermiculite, sand, or similar), collect and place in suitable containers for disposal. • For disposal of small amounts, absorb with sand, vermiculite or similar and dispose of to an approved landfill site. For larger amounts, contact the manufacturer for additional information.	• Store in a cool, dry, well-ventilated area, removed from incompatible substances, heat or ignition sources and foodstuffs. • Incompatible with oxidising agents (e.g., hypochlorites) and acids (e.g., nitric acid)
Calcium Remover	Sodium Carbonate	Soda Ash, Sodium Bicarbonate	N		
	Potassium Carbonate	Potassium Carbonate	Y	• Prevent from entering drains, ditches, rivers, or the sea. • For clean-up, sweep up (avoid generating dust) and remove to a suitable, clearly labelled container for disposal in accordance with local regulations.	• Store in a cool, dry place. Keep containers always closed. • Store at room temperature (15 - 25 °C). Keep away from direct sunlight. • Use only outdoors or in a well-ventilated area. Should avoid moisture. • The constituents may react with aluminium, alkaline earth metals in powder form, non-metals (heat), carbon/heat, fluorine, alkali metals, non-metallic oxides (heat), organic nitro compounds, halogenated hydrocarbons, acids, concentrated, sulfuric acid, strong oxidising agents.
Corrosion Inhibitor	Phosphonate Corrosion Inhibitor with O2 Scavenger	Ancor 1, CI 100, CI1000	Y	• Avoid discharge into drains/sewers or waterways. • May form explosive dust air -mixtures. • For cleaning up, recover the product by absorbing it with sand, shovelling, or sweeping. Use of water wash down after spill clean is not recommended.	• Store in a cool, dry place. • It is stable under normal storage conditions in steel drums/barrels. • Not compatible with strong oxidising and reducing agents.
	Catalyzed Amonium Bisulfate, Oxygen Scavenger OS-I	Sodium Sulphite SAFE-SCAV NA	Y	• Do not allow the product to enter drains, sewers, or watercourses. • For cleaning up, absorb the spillage with suitable absorbent material. Shovel into dry containers. Flush the area with water. • For disposal of small amounts, absorb with sand or similar and dispose of to an approved landfill site. Contact the manufacturer/supplier for additional information (if required). Ensure that appropriate personal protective equipment is used during disposal.	• Store in a cool and well-ventilated place. • Store in closed original container at temperatures between 5°C and 30°C. • Slowly releases sulphur dioxide when in contact with air. • Ventilate well. • Incompatible with oxidising agents (e.g., hypochlorites) and acids (e.g., nitric acid).

Primary Function (group) Description	Description	Example Additives Names	Hazardous (Y/N)	Typical Environmental / Disposal Considerations (if hazardous)	Recommended Handling and Storage Considerations (if hazardous)
	Zinc Oxide	H2s Scavenger	Y	• Marine pollutant. • Prevent product from entering drains and waterways.	• Store in a cool, dry, well-ventilated area, removed from incompatible substances. • Incompatible with metals if heated and with acids (e.g., nitric acid).
Defoamer	Drilling Defoaming Agent	Coho Defoam X, Anti Foam XLRT	Y	• Prevent product from entering drains and waterways. • In case of spillage, contain spillage, then cover/absorb spill with non-combustible absorbent material (vermiculite, sand, or similar).	• Store in a cool, dry, well-ventilated area. • Store below 30°C. Do not freeze. • Incompatible with oxidising agents (e.g., hypochlorites) and acids (e.g., nitric acid).
Filtrate Reducers	Fluid Loss Reducer	Flo-trol	N		
	High-Temperature Viscosifier and Filtrate Reducer	Driscal D	N		
Viscous sweep material	Well-bore Clean-up	Super-sweep Fibre	N		
Foaming Agents	Drilling Foam Agent	Drillfoam	N		
Lost Circulation Material	Organic LCM used to prevent and cure fluid losses Cellulose Fibre	Fiber C,M,F Quickseal C,M,F	N		
Lubricants	Spotting Agent / Friction Reducer	Pipefree Lub X BaraLube W-933	N		
	Lubricant	Starglide	Y	• Do not let product reach drains, water courses or the soil. • Avoid releases to the environment. Local authorities should be advised if significant spills cannot be controlled	• Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin and eyes. Do not breathe vapours or spray mist. Avoid spills and splashing during use. • Keep containers tightly closed in a dry, cool and well-ventilated place. Avoid contact with Oxidizing agents Acids Bases
	Extreme Pressure Lubricant	NXS-Lube, Interflon EP	N		

Primary Function (group) Description	Description	Example Additives Names	Hazardous (Y/N)	Typical Environmental / Disposal Considerations (if hazardous)	Recommended Handling and Storage Considerations (if hazardous)
Polymer Stabliser	HT Polymer Stabiliser	TEA	N		
Shale Control Inhibitors	Calcium Chloride	Calcium Chloride	Y	• Do not let product reach drains or waterways. If product does enter a waterway, advise the *Environmental Protection Authority* or your local waste management. • Dispose of in accordance with all local, state, and federal regulations. • All empty packaging should be disposed of in accordance with local, state, and federal regulations or recycled/reconditioned at an approved facility. • In case of spill, cover with damp absorbent (inert material, sand, or soil). Sweep or vacuum up but avoid generating dust. Collect and seal in properly labelled containers or drums for disposal. Wash area down with excess water.	• Store in a cool, dry, well-ventilated area. Keep containers tightly closed when not in use. • Store in the original packaging as approved by the manufacturer. • Reacts with acids. Reacts with strong bases.
	Shale Control	KLA-HIB	Y	• Do not allow to enter drains, sewers, or watercourses.	• Avoid spilling, skin, and eye contact. Avoid inhalation of vapours and spray mists. • Store in tightly closed original container in a dry, cool, and well-ventilated place.
	Encapsulating Agent	PHPA	N		
	Filtrate Reducer	PAC LV	N		
		Sodium Polyacrylate	N		
	Potassium Chloride	KCl	N		
Surface Active Agent	Specialised Well-displacement Surfactant	Deepclean	Y	• Contains butyl glycol – hazardous. • Do not allow to enter drains, sewers, or watercourses. • In case of spill, dike far ahead of larger spills for later disposal. • Absorb spillage with suitable absorbent material. • Shovel into dry containers.	• Store in tightly closed original container in a dry, cool, and well-ventilated place. Keep away from heat, sparks, and open flame. • Harmful if inhaled. • Materials to avoid are strong oxidising substances, strong reducing agents, strong acids, and strong alkalis.

Primary Function (group) Description	Description	Example Additives Names	Hazardous (Y/N)	Typical Environmental / Disposal Considerations (if hazardous)	Recommended Handling and Storage Considerations (if hazardous)
				• Flush the area with water.	
Thinner	Dispersant	Drill Thin	Y	• Very toxic to aquatic life with long-lasting effects. • Prevent product from entering drains. Prevent further leakage or spillage if safe to do so. • For cleaning up, contain and sweep/shovel up spills with dust binding material or use an industrial vacuum cleaner. • Transfer to a suitable, labelled container and dispose of it promptly as it is hazardous waste.	• Avoid the formation of respirable particles. • Avoid exposure. • Obtain special instructions before use. • Keep container tightly closed in a dry and well-ventilated place. • Prevent the formation of dust. • Avoid strong oxidising agents, and store in the original packaging as approved by the manufacturer.
		SAPP (Sodium Acid Pyrophosphate)			
Tracer	Potassium Nitrite		Y	• Should not be released into the environment. Preventing from reaching drains, sewers, or waterway. • For spillage, sweep up and shovel. Keep in suitable containers for disposal.	• Store in a cool location. • Protect from freezing and physical damage. • Provide ventilation. • Incompatible materials are strong reducing agents, powdered metals, strong acids.
Viscosifier	Polyanionic Cellulose	Strata Vanguard, Frac Attack, Squeeze N Lock	N		
	Thickening Agent	Xanthan Gum	N		
	Thickener in lubricating greases	Bentonite 13A	Y	• Prevent this material from entering waterways, drains and sewers. • The disposal of the spilled or waste material must be done in accordance with applicable local and national regulations. • In case of accidental spillage, increase ventilation. Evacuate all unprotected personnel. Wear sufficient respiratory protection and full protective clothing to prevent exposure. Sweep up material, avoiding dust generation or dampen spilled material with water to avoid airborne dust, then transfer material to a suitable container. Wash surfaces well	• Use in a well-ventilated area. • Keep containers sealed when not in use. • Prevent the build-up of dust in the work atmosphere. Do not breathe dust/fume/gas/mist/vapours/spray. • Use personal protective equipment as required. • May cause cancer by inhalation. • May cause damage to organs through prolonged or repeated exposure by inhalation.

Primary Function (group) Description	Description	Example Additives Names	Hazardous (Y/N)	Typical Environmental / Disposal Considerations (if hazardous)	Recommended Handling and Storage Considerations (if hazardous)
				with soap and water. Seal all wastes in labelled plastic containers for subsequent recycling or disposal.	• Store in a cool, dry, well-ventilated area, out of direct sunlight and moisture. Store in suitable, labelled containers. Keep containers tightly closed. Store away from incompatible materials.
Weighting Agent	NaCl	Salt	N		
	Processed Barites	Barite, Barium Sulphate, Baryte	N		
	Sized Calcium Carbonate	Calcium Carbonate	N		

As per Clause B.4.10.2 (a) of *the Code*, additives must be selected and managed to ensure they are used in accordance with the manufacturer's recommendations and relevant safety data sheets (SDS)

11.2 Indicative Cementing Additives

Table 11—2 Indicative Cementing Additives

Primary Function (group) Description	Code	Hazardous Y/N	Environmental Considerations, Handling, and Storage Considerations (if hazardous)	Recommended Handling and Storage Considerations (if hazardous)
Retarder	D013	N	N/A	N/A
Bentonite Extender (60 lb/ft3)	D020	N	N/A	N/A
Weighting agent /Barite	D031	N	N/A	N/A
Low temp Solid Dispersant	D202	N	N/A	N/A
Liquid Antifoam Agent	D047	N	N/A	N/A
TIC Dispersant	D065	N	N/A	N/A
Liquid Extender, Silicate Cement Additive	D75	N	N/A	N/A
Liquid Retarder, Low temperature	D081	N	N/A	N/A
Uniflac-L	D168	N	N/A	N/A
Uniflac-L	D168A	N	N/A	N/A
Uniflac-S	D167	N	N/A	N/A
Liquid Fluid Loss additive	D193	N	N/A	N/A
MUDPUSH II Spacer	D182	N	N/A	N/A
Fly Ash	Fly Ash	N	N/A	N/A
Calcium Chloride	S001	N	N/A	N/A
Mid-Range FLAC	D255	N	N/A	N/A
Cement Retarder	D110	N	N/A	N/A

11.3 Chemicals in HF Fluid

For details of indicative chemicals in HF Fluid and human health and environmental risk assessment see **Appendix 08** Human Health and Environmental Chemical Risk Assessment.

12 References

DEPWS. (2023). *Compliance and reporting*. Northern Territory Government. Retrieved 30/01/2024 from **https://depws.nt.gov.au/onshore-gas/onshore-gas-in-the-northern-territory/industry-compliance-and-reporting**

DEPWS, Young L et al;. (2023). *Terrestrial Ecosystems Baseline Report: Strategic Regional Environmental and Baseline Assessment for the Beetaloo Sub-basin*.

Institute, Australian Petroleum. (2006). *Strategies for Addressing Salt Impacts of Produced Water Releases to Plants, Soil, and Groundwater*. **https://www.gsienv.com/wp-content/uploads/2021/04/5_API-Brine_Guide.pdf**

Nations, United. (2023). *Globally Harmonized System of Classification and Labelling of Chemicals (GHS)* (10 ed.). United Nations Publication.

NICNAS. (2019). *Australian Inventory Multi-tiered Assessment and Prioritisation (IMAP)* **https://chemycal.com/news/16a8b049-34c1-454d-ac37-1fd5d140c843/Australian_Inventory_Multi-tiered_Assessment_and_Prioritisation_IMAP__Tranche_26_published**

NICNAS. (2020). *Cyclic Volatile Methyl Siloxanes: Environment Tier 11 Assessment*. **https://www.industrialchemicals.gov.au/sites/default/files/Cyclic%20volatile%20methyl%20siloxanes_%20Environment%20tier%20II%20assessment.pdf**

NICNAS, & CSIRO. (2017). *National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia*. National Industrial Chemicals Notification and Assessment Scheme. Retrieved from **https://www.awe.gov.au/sites/default/files/documents/national-assessment-chemicals-overview.pdf**

NTG. (2023). *Report a petroleum operations incident*. Northern Territory Government. Retrieved 31/12/2023 from **https://nt.gov.au/industry/energy/petroleum-operations/report-a-petroleum-operations-incident**