

Modification Notice - Regulation 22

Interest Holder	Imperial Oil and Gas Pty Ltd	EMP Title	2021-2025 EP187 Work Program	Unique EMP ID No.	IMP4-3	Mod No.	12	Date	January 2025
Brief Description	Imperial proposes to modify the regulated activity in IMP4-3 by including additional hydraulic stimulation tracers from Core Laboratories International. A human health and environmental risk assessment (HHERA) has been undertaken in January 2025 for the additional chemical list. Based on the outcomes of this assessment, no further management controls are considered necessary.								
Geospatial Files Included?	NA								

Does the proposed change result in a new, or increased, potential or actual environmental impact or risk?	If an INCREASE in an existing potential or actual environmental impact or risk is it provided for in the approved EMP?	Does the proposed change require additional mitigation measures to be included?	Has additional stakeholder engagement been conducted?	Does it require additional environmental performance standards and measurement criteria?	Does it affect compliance with Sacred Site Authority Certificates?	Does it affect current rehabilitation, weed, fire, wastewater, erosion and sediment control, spill or emergency response plans?	Will the environmental outcome continue to be achieved and will the impacts and risks be managed to ALARP and acceptable?
<p>No.</p> <p>There are no new or increased environmental impacts or risks through the addition of the new chemicals. The chemical list has undergone a human health and environmental risk assessment (HHERA) by a qualified third party (AECOM Australia Pty Ltd) which identified no further management controls are considered necessary.</p>	<p>N/A</p>	<p>No.</p> <p>HHERA determined that no further management controls are considered necessary.</p>	<p>No.</p> <p>Previous stakeholder engagement has included chemical use.</p>	<p>No.</p> <p>Environmental performance standards within the existing approved EMP are sufficient.</p>	<p>No.</p> <p>Activity covered under existing AAPA certificate.</p>	<p>Yes.</p> <p>IMP 4-3 Appendix 6 Wastewater Management Plan and Appendix 7 Spill Management plan is updated to include the additional proposed chemicals. All other plans remain valid and appropriate.</p>	<p>Yes.</p>

Current EMP Text	Amended EMP Text
<p>IMP 4-3 Executive Summary Section g. Chemical Risk Assessment</p> <p>A chemical risk assessment has been completed for all chemicals to be used in the Hydraulic Fracturing process. This risk assessment provides the details about any chemical or other substance that may be in or added to any treatment fluids to be used in the course of Hydraulic Fracturing.</p> <p>A risk assessment was carried on HF Chemicals; the full risk assessment is provided in Appendix 06.01 (HF Chemical Risk Assessment, date of issue May 2021).</p> <p>An additional human health and environmental risk assessment (HHERA) was undertaken in October 2024 to incorporate a change of chemical suppliers from 2024 onwards. The full HHERA is provided as in an additional Appendix 06.02 (HHERA). Based on the outcomes of this assessment, no further management controls are considered necessary.</p>	<p>IMP 4-3 Section g. Chemical Risk Assessment</p> <p><i>Amend EMP text to modify text and include additional Appendix 06.02 in IMP 4-3 WWMP as provided in Section B of this Reg 22. Changes bolded.</i></p> <p>A chemical risk assessment has been completed for all chemicals to be used in the Hydraulic Fracturing process. This risk assessment provides the details about any chemical or other substance that may be in or added to any treatment fluids to be used in the course of Hydraulic Fracturing.</p> <p>A risk assessment was carried on HF Chemicals; the full risk assessment is provided in Appendix 06.01 (HF Chemical Risk Assessment, date of issue May 2021).</p> <p>An additional human health and environmental risk assessment (HHERA) was undertaken in October 2024 to incorporate a change of chemical suppliers from 2024 onwards. The full HHERA is provided as an additional Appendix 06.02 (HHERA). Similarly, a HHERA was undertaken in January 2025 to incorporate more chemicals. The full HHERA is provided as an additional Appendix 06.03 (HHERA). Based on the outcomes of this assessment, no further management controls are considered necessary.</p>
<p>IMP 4-3 Appendix 06 WWMP Appendix 1. Full Hydraulic Fracturing Chemical List</p> <p><i>Original list of Schlumberger chemicals.</i></p>	<p>IMP 4-3 Appendix 06 WWMP Appendix 1. Full Hydraulic Fracturing Chemical List</p> <p><i>Amend EMP text to include additional chemical list provided in Section A of this Reg 22.</i></p>

Current EMP Text	Amended EMP Text
<p>Appendix 07 Spill Management Plan</p> <p>New table to be added to Section 14 Chemical Tables</p>	<p>Appendix 07 Spill Management Plan</p> <p>Section 14 Table 9. Additional Tracer List of potential HF fluids to be used (excerpt of Appendix 6.03).</p> <p><i>List provided Section B of this Reg 22</i></p>

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Commencing on following page.

Tracers Chemical Risk Assessment

Northern Territory

27-May-2025
inGauge Chemical Risk Assessment
Commercial-in-Confidence

Tracers Chemical Risk Assessment

Northern Territory

Client: inGauge Energy Pty Ltd

ABN: 51 164 429 190

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Quality Information

Document Tracers Chemical Risk Assessment

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Revision History

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			Name/Position	Signature
A	14-Jan-2024	Draft	Michael Archer Technical Director - Environment	
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1.0 Introduction

inGauge Energy Pty Ltd (inGauge) commissioned AECOM Australia Pty Ltd (AECOM) to perform a Chemical Risk Assessment (CRA) for a stimulation event in the Carpentaria Basin in the Northern Territory. The CRA was conducted to assess the potential human health and environmental effects of the chemical water tracer (product name CFT) chemicals proposed to be used in Imperial Oil & Gas and Imperial Oil & Gas A (Imperial) hydraulic fracturing campaign for the Carpentaria 2/3 well site within EP187. It is noted that inGauge, acting for Imperial, has been supporting their program and that Core Laboratories International B.V. is the chemical provider.

A previous human health and environmental risk assessment (HHERA) has been prepared by EHS Support (2024) which documents the relevant Environmental Management Plan (EMP) requirements utilising the chemicals present in the hydraulic stimulation formulations as well as the updated formulation proposed for future stimulation activities. This assessment is an update to and should be read in conjunction with the EHS Support (2024) Human Health and Environmental Risk Assessment for Carpentaria Gas Project for a full understanding of the chemical risk assessment methodology and approach utilised in this report.

1.1 Scope

AECOM understands that Imperial is proposing to use CFTs to improve the efficiency of hydraulic fracture stimulation operations. The CRA was undertaken to assess the potential human health and environmental risks of the CFTs proposed to be used during future stimulation activities.

1.2 Approach

This risk assessment aligns with the *Northern Territory Government, Department of Environment, Parks and Water Security, Environment Management Plan Content Guideline, 2021* (herein referred to as DEPWS 2021) and is in accordance with requirements of the *Petroleum (Environment) Regulations 2016* (herein referred to as the Regulations).

The methods used for this chemical risk assessment also follow the guidance provided by the *Department of the Environment and Energy, Exposure Draft - Chemical Risk Assessment Guidance Manual: for chemicals associated with coal seam gas extraction, 2017* (DoEE, 2017) and the methodology adopted for the chemical risk assessment is in general accordance with the following:

- Australian Industrial Chemicals Introduction Scheme (AICIS) (formerly National Industrial Chemicals Notifications and Assessment Scheme (NICNAS)), *National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia, 2017* (herein referred to as NICNAS 2017), which includes the approach outlined in the *National Chemical Risk Assessment Guidance Manuals* published by the National Environmental Protection Council (NEPC)
- enHealth. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards, 2012*
- National Environment Protection (Assessment of Site Contamination) Measure 1999 (ASC NEPM); Schedule B4, *Site-specific health risk assessment methodology, 2013*.

This chemical risk assessment comprised the following tasks:

- **Hazard assessment.** An evaluation of the environmental hazard of the chemical additives in the hydraulic fracturing fluid systems, based on their environmental persistence, bioaccumulation and aquatic toxicity properties. Also included was an evaluation of potential human health effects (i.e. genotoxicity, carcinogenicity, reproductive toxicity, oral toxicity, inhalation toxicity, dermal toxicity, chronic repeated dose toxicity).
- **Exposure assessment.** The exposure assessment comprised an evaluation of surface and sub-surface exposure pathways.
- **Screening and validation processes via Tier 1 and Tier 2 assessments.** Determination of chemicals known to be of low concern, and identification of chemicals for further risk assessment.

- Tier 1: using published information about each chemical proposed to be used in the hydraulic fracturing fluid systems.
- Tier 2: A quantitative evaluation of the potential risks using toxicity values and quantitative estimates of chemical intake to provide an estimate of potential human health risk associated with the hydraulic fracturing activities, based on the identification of complete exposure pathways using generic field level information and hazard identification.

2.0 Tier 1 Screen

2.1.1 Tier 1 Screen Methodology

The screening process for the hydraulic fracturing chemicals in the human health assessment is consistent with the approach outlined in DoEE (2017) and Appendix C of DEPWS (2021).

The following general approach was used to screen the chemicals of potential concern (COPCs):

- If the chemicals are found on any of the following national or international lists of substances applicable to chemicals associated with coal seam gas extraction as being of low concern, then a Tier 2 assessment was deemed not to be warranted.
 - AICIS Inventory Multi-tiered Assessment and Prioritisation (IMAP) Tier 1 Lists
 - National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia, Technical Report Number 11. Chemicals of low concern for human health based on initial assessment of hazards (NICNAS 2017a)
 - USEPA High Production Volume (Indicator 1)¹
 - REACH Annex IV².
- If the chemical was not listed as a chemical of low concern (i.e. due to not being previously evaluated by national/international agencies) but was not a PBT substance and no human health hazard was identified, then a Tier 2 assessment was deemed not to be warranted.

The outcome of the Tier 1 assessment identifies the chemicals of low human health and environmental concern for which no further management or mitigation is considered necessary.

2.1.2 Outcome of Tier 1 Screen

Comparison of the CFT with the assessment criteria as presented in DoEE (2017) and in Appendix C of DEPWS (2021) indicated that all 71 chemicals required a Tier 2 assessment.

It is to be noted that none of these chemicals were identified to be PBT (i.e., none of the organic chemicals meet all three criteria of being persistent *and* bioaccumulative *and* toxic).

The 71 CFT from the stimulation fluid recipe are proprietary. In accordance with s.105 of the *Industrial Chemical Act 2019*, for the proprietary chemicals, the CAS number and name have been redacted from the public submission to protect the intellectual property of the chemical manufacturer. Although the proprietary details of the chemicals have been redacted in this report, AECOM had access to the chemical names and CAS numbers and the assessment of risk from the redacted chemicals are presented in this report.

The Tier 1 screening is provided in **Appendix A**, the chemical toxicological profiles are provided in **Appendix B** and the SDS are provided in **Appendix C**.

¹ The US EPA High Production Volume (HPV) chemicals are those which are manufactured in or imported into the US in amounts \geq 1million pounds/year. Indicator 1 denotes those chemicals not considered a candidate for testing, based on a preliminary US EPA review indicating testing would not further our understanding of the chemical's properties (NICNAS 2017).

² Annex IV of the European REACH regulation (i.e. Registration; Evaluation; Authorisation; and restriction of Chemicals) contains a list of substances exempt from registration on the basis that they are considered to cause minimum risk due to their intrinsic properties (NICNAS 2017).

3.0 Tier 2 Screen

3.1.1 Tier 2 Screen Methodology

The purpose of the risk characterisation portion of the assessment is to provide a conservative estimate of the potential risk resulting from exposure to the COPCs that may occur during hydraulic fracturing activities. The risk characterisation evaluates the toxicity of the COPC and characterises the risk of the chemical assessed for specific exposure pathways identified below.

A two-stage process is employed during risk characterisation. First, risk ratios are developed for the chemical for potentially complete exposure pathways associated with applicable release scenarios. For the assessment of the overall potential for adverse human health effects posed by simultaneous exposure to multiple chemicals, the estimated daily intake of the chemicals by inhalation and direct (ingestion and dermal) contact were compared to tolerable daily intakes to calculate an individual hazard quotient (HQ) and then summed for all constituents into a hazard index (HI). The identification of toxicity values undertaken in this risk assessment has followed DoEE (2017), NICNAS (2017) and enHealth (2012) guidance. The toxicity values selected for this assessment were from Level 1 or 2 sources such as NICNAS (2017), AICIS, or the European Chemicals Agency (ECHA) REACH databases.

Consistent with Australian risk assessment methodologies, if the HI is less than or equal to 1, then no adverse health effects are likely associated with exposures and no risk / hazard reduction measures are required. There should be no need for further management controls on the chemical additional to those already in place (DoEE, 2017).

However, if the total HI is greater than 1, adverse health effects may be possible and therefore the assumptions inherent in the risk characterisation process warrant further evaluation via Tier 3 analysis.

3.1.2 Conceptual Exposure Model

Based on the risk mitigation measures identified in the NT Government *Scientific Inquiry into Hydraulic Fracturing in the Northern Territory*, the *Code of Practice for Onshore Petroleum Activities* in the Northern Territory (the Code) and mitigation measures outlined by Imperial in its [EMPs](#), no potentially complete exposure pathways were identified for hydraulic fracturing chemicals to impact groundwater that is used for beneficial uses in the project area. The specific controls implemented by Imperial focused on the protection of aquifers follow industry standard practice and include:

- the physical vertical separation distances of 1,400 m between the aquifer and target formation to prevent migration of stimulation fluid to aquifer units
- the horizontal separation distance between the exploration well and the closest groundwater extraction bores of at least 1 km, as per the Code
- use of double lined wastewater tanks with leak detection
- implementation of a spill management plan
- use of enclosed tanks and freeboard requirements
- mandatory secondary containment requirements.

In addition, unmitigated risks from the improbable scenario where fluids were to overflow to the bunded area were also assessed by EHS Support (2024). The following release scenarios were considered:

- Smaller release volumes of 1,000 L and 100,000 L which would reflect small scale releases.
- An improbable release out of the bunded area (1,000,000 L).

The assessment concluded that:

- The potential impact to groundwater was considered low.
- The potential for a complete pathway to surface water bodies associated with runoff was considered unlikely with the planned management control of the construction of a bunded area surrounding the treatment tanks.

- The potential for a spill in the event of a vehicular accident was considered unlikely.
- No permanent storage of chemicals, flowback wastes will be conducted in ponds and sumps and therefore the potential for releases was considered limited.
- The well pad sites are fenced to limit access to the public and prevent entry by livestock and large native fauna. Therefore, the potential for exposures to receptors other than workers was considered unlikely.
- Chemical exposures to workers are controlled through engineering, management controls and personal protective equipment, which are focused on elimination and mitigation of the potential for dermal contact and potential for incidental ingestion. Therefore, the potential for exposures to workers are considered unlikely.

Further, the following additional control will be implemented in the 2025 campaign:

- Closed top storage tanks will be used to manage fluids including flowback water.

Therefore, avian access to fluids in treatment tanks is considered limited, the potential for exposure to avian receptors is considered unlikely and will not be assessed further.

Potential exposures to hydraulic fracturing chemicals at the project area were therefore assessed to be limited to the above ground storage and handling of flowback water. Management of flowback water involves temporary storage in above ground fluid holding tanks.

The Tier 2 assessment evaluated the toxicity of the individual chemicals and characterised the cumulative risks of the total fluid mixtures to workers. The methodology incorporated an assessment of potential exposures to the workers, with the following identified as the only potentially complete exposure pathways:

- Incidental ingestion and dermal contact of flowback fluid by workers during the hydraulic stimulation period for a maximum duration of 40 days (EHS Support, 2024)

This scenario is also deemed protective of the following due to the less frequent and short duration of these exposures occurring:

- Worker exposure during a spill (i.e., a coupling breaks on a tank and releases product onto the worker) or leak scenarios.

Exposure parameters were selected based on a combination of default assumptions for workers from ASC NEPM, enHealth (2012) and site-specific information from inGauge and Imperial (i.e. if personal protective equipment is used). Exposure parameters are provided in **Appendix A** and toxicological profiles are provided in **Appendix B**.

3.1.3 Chemicals of Potential Concern

Exposure point concentrations (EPC) for the COPC were provided to AECOM by the chemical provider (Core Laboratories International B.V.). It was assumed that 100% of the mass of the chemicals injected into the well will be present in the hydraulic fracturing fluid. This is a conservative approach as observed recovery of drilling, well development and hydraulic fracturing fluids chemicals in flowback from other regional operators of Oil and Gas petroleum tenements is approximately 20% or less of the injected fluid chemical concentration (EHS Support, 2024).

All COPCs are proprietary, require a Tier 2 assessment and the EPC for each chemical is 0.7 mg/L. The COPCs and associated EPCs are presented in **Appendix A**.

Toxicity reference values (TRVs) were selected to be consistent with the TRVs used in the National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia (NICNAS, 2017) and benchmarked with other regulator approved CRAs of similar operations in the Bowen, Surat and Beetaloo Basins.

3.1.4 Outcome of Tier 2 Screen

For the assessment of the overall potential for adverse human health effects posed by simultaneous exposure to multiple chemicals, the estimated daily intake of each COPC (via incidental ingestion and dermal contact) were compared to tolerable daily intakes to calculate an individual hazard quotient (HQ) and then summed for all COPC into a hazard index (HI).

A summary of the estimated potential risks for the workers that are relevant to the assessment of potential exposure to COPCs in the CFTs based on the available data is presented in **Table 1**. The Tier 2 screening risk calculations are provided in **Appendix A**.

Table 1 Risk associated with potential exposure to Workers

Receptor and Pathway	Threshold Hazard Index
	100% Mass Return
Worker - Exposure to CFT	
Ingestion of chemicals via incidental contact with CFT	2.5×10^{-5}
Dermal exposure to chemicals via incidental contact with CFT	6.5×10^{-5}
Total Hazard Index	9.0×10^{-5}

The following can be concluded from the Tier 2 screening:

- The estimated HI associated with potential exposure to COPC identified in CFT and assuming 100% mass recovery, is below the target 1, hence, potential risks are considered to be acceptable.

4.0 Chemical Transport, Storage and Handling

AECOM understands that Imperial aligns its transport, storage, and handling of hazardous chemicals with WHS Regulations, and the prescribed chemical legislation including all obligations and duties for storage and handling of hazardous chemicals and eliminating risks to workers from potential exposure and the potential requirements for health monitoring. For further information, refer to EHS Support (2024) Human Health and Environmental Risk Assessment for Carpentaria Gas Project.

Further, it is assumed that the following prescribed chemical legislation, as defined by the *Petroleum (Environment) Regulations 2016*, will be followed as it relates to the transport, storage, and handling of hydraulic fracturing chemicals:

- *Medicines, Poisons and Therapeutic Goods Act 2012 and Medicines, Poisons and Therapeutic Goods Regulations 2014*
- *Dangerous Goods Act 1998*
- *Water Act 1992*
- *Waste Management and Pollution Control Act 1998*
- *Work Health and Safety (National Uniform Legislation) Act 2011*
- *Radiation Protection Act 2004.*

5.0 Conclusion

The evaluation of potential risks to human health and the environment associated with the proposed use of CFT chemicals in stimulation activities conducted by Imperial at the Carpentaria 2/3 well site within EP187 has involved the assessment of potential exposures to chemicals used or formed in the stimulation activities.

Based on the conceptual site model, operational controls, and management practices implemented by Imperial, the only potentially complete exposure pathway identified and quantified in the risk assessment was the incidental ingestion and dermal contact of flowback fluid by workers during the stimulation period. No complete exposure pathways have been identified for environmental receptors due to the control measures implemented by Imperial.

Based on the conservative assessment undertaken, the potential risks to human health and the environment from the use of CFTs are considered low and acceptable.

6.0 References

- ANZG (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines
- DoEE (2017). Department of the Environment and Energy, Exposure Draft - Chemical Risk Assessment Guidance Manual: for chemicals associated with coal seam gas extraction, 2017
- EHS Support (2024). Human Health and Environmental Risk Assessment for Carpentaria Gas Project, Imperial Oil & Gas and Imperial Oil and Gas A Northern Territory Tenement, January 2024.
- enHealth (2012). Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards, 2012
- ASC NEPM (2013). National Environment Protection (Assessment of Site Contamination) Measure 1999; Schedule B4, Site-specific health risk assessment methodology, 2013
- NEPC (2009). National Chemical Risk Assessment Guidance Manuals.
<https://www.nepc.gov.au/projects/chemical-risk-assessment-guidance-manuals>
- NICNAS (2017). National Industrial Chemicals Notification and Assessment Scheme, National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia, 2017
- DEPWS (2021). Northern Territory Government, Department of Environment, Parks and Water Security, Environment Management Plan Content Guideline, 2021
- Scientific Inquiry into Hydraulic Fracturing in the Northern Territory, Draft Final Report, December 2017.

Appendix A

Tier 1 and Tier 2 Risk Screen Calculations

Chemical Name	CAS Number	Volume or Mass of Chemical (L or kg)	Concentration in Injected Fluid (mg/L)	Parent Compound Purpose	Ecotoxicity ¹	Toxicity ²	Biodegradation ³	Bioaccumulative ⁴	Tier 1 Screening Assessment	Discussion	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Hazard Quotient	Outcomes of Tier 2 Worker Risk Assessment ¹
		8	0.7	Tracer	Acute toxicity: Daphnia ES50 > 100 mg/L Algal EC50 33.1 mg/L Chronic toxicity: Fish NOEC 120 mg/L (28 days) Daphnia NOEC 25 mg/L (21 days) Algal EC10 3.4 mg/L Acute toxicity: Fish LC50 44.6 mg/L Algal EC50 33.1 mg/L	Based on chronic: Moderate	No. Readily biodegradable	Not bioaccumulative (Based on a log low value of 1.87, and BCF value of <10 to 21)	Tier 2	The risk was classified as moderate based on chronic data. A Tier 2 assessment is required.	9.5E-07	9.1E-07	1.3E-06	Based on the calculated HQ the chemicals is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
		8	0.7	Tracer	Chronic toxicity: Daphnia NOEC 120 mg/L (28 days) Fish NOEC 25 mg/L (21 days) Algal EC10 3.4 mg/L Acute toxicity: Fish LC50 44.6 mg/L Algal EC50 33.1 mg/L	Based on chronic: Moderate	No. Readily biodegradable	Not bioaccumulative (Based on a log low value of 1.87, and BCF value of <10 to 21)	Tier 2	The risk was classified as moderate based on chronic data. A Tier 2 assessment is required.	9.5E-07	9.1E-07	1.3E-06	Based on the calculated HQ the chemicals is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
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Chemical Name	CAS Number	Volume or Mass of Chemical (L or kg)	Concentration in Injected Fluid (mg/L)	Parent Compound Purpose	Ecotoxicity ¹	Toxicity ²	Biodegradability ³	Bioaccumulative ⁴	Tier 1 Screening Assessment	Discussion	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Hazard Quotient	Outcomes of Tier 2 Worker Risk Assessment ¹
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Chemical Name	CAS Number	Volume or Mass of Chemical (L or kg)	Concentration in Injected Fluid (mg/L)	Parent Compound Purpose	Ecotoxicity ¹	Toxicity ²	Biodegradability ³	Bioaccumulative ⁴	Tier 1 Screening Assessment	Discussion	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Hazard Quotient	Outcomes of Tier 2 Worker Risk Assessment ⁵
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										The chronic health risks associated with potential exposure to COPC identified in flowback water, where the COPC are not listed in the table above, assuming 100% mass recovery are considered to be acceptable.				

Notes:
 * Chemical composition and information not provided to AECOM due to proprietary control by the chemical manufacturer
 1 - Tier 1 (INCNAS) - Chemical identified as of low concern for human health, as published in the National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia (INCNAS 2017).
 2 - Toxicity assessed using NT (2021).
 3 - Biodegradability assessed as per NT (2021) and DoEE (2017).
 NA - Not Applicable
 INCNAS 2017 - National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia
 Dual Use Assessment Guidelines Manual for Chemicals Associated with Coal Seam Gas Extraction, Australian Government, Department of Energy
 NT 2021 - Northern Territory Government, Department of Environment, Parks and Water Security, Environment Management Plan Content Guidelines 2021

Summary of Risk to Workers - inGauge Chemical Water Tracers Recipe Exposure fo Target Chemicals - Theoretical Data

Receptor/Exposure Pathway		Calculated HI
		100% Mass Return
<u>Use of Stimulation Fluid in Hydraulic Fracturing</u>		
<u>Planned Recipe</u>		
Workers		
Ingestion of Chemicals via Incidental Contact with Flowback Water		2.5E-05
Dermal Exposure to Chemicals via Incidental Contact with Flowback Water		6.5E-05
Total Risk		9.0E-05

Appendix B

Toxicological Profiles

Toxicity Summary - Chemical Frac Tracers (CFT)

Chemical and Physical Properties¹

CAS number

Chemical water tracer (CFT) chemicals.



Molecular formula	
Molecular weight	140 – 260 (approximate)
Solubility in water	3.5 g/L at 25 °C
Melting point	122.4 °C
Boiling point	249.2 °C
Vapour pressure	0.11 Pa at 20 °C
Henrys law constant	No data available
Explosive potential	Non-flammable
Flammability potential	Non explosive
Colour/Form	A white crystalline powder with a pleasant odour.
Overview	
Environmental Fate^{1,2,3}	
Soil/Water/Air	<p>If released to air, a vapor pressure of 7.0×10^{-4} mm Hg at 25 deg C indicates [redacted] will exist solely as a vapor in the atmosphere. Vapor-phase [redacted] will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 9 days. [redacted] absorbs light at wavelengths >290 nm and, therefore, may be susceptible to direct photolysis by sunlight. If released to soil, [redacted] is expected to have very high mobility based upon an estimated Koc of 15 (log Kow of 1.87). The pKa of [redacted] is 4.20, indicating that this compound will exist almost entirely in the anion form in the environment and anions generally do not adsorb more strongly to soils containing organic carbon and clay than their neutral counterparts. Volatilization from moist soil is not expected because the compound exists as an anion and anions do not volatilize. [redacted] is not expected to volatilize from dry soil surfaces based upon its vapor pressure. If released into water, [redacted] is not expected to adsorb to suspended solids and sediment based upon the estimated Koc. Biodegradation half-lives of 0.85 and 3.6 days using inoculum from a polluted river and a reservoir, respectively, suggest that biodegradation may be an important fate process in water.</p>

	<p>Measured BCF values of <10, 14, and 21 were reported for Golden ide (<i>Leuciscus idus melanotus</i>), trout, and mosquito fish (<i>Gambusia affinis</i>), respectively. This BCF range suggests the potential for bioconcentration in aquatic organisms is low.</p>
<p>Human Health Toxicity Summary ¹</p>	
<p>Chronic Repeated Dose Toxicity</p>	<p>Based on the weight of evidence the chemical is not considered to cause serious damage to health by repeated oral exposure (no observed adverse effect level (NOAEL) of 825 mg/kg bw/d). Effects observed at > 1000 mg/kg bw/d included increased mortality, reduced weight gain, and liver and kidney effects in a chronic toxicity study > 90 days (ECHA, OECD, 2004).</p> <p>Available animal data suggest that the chemical is not likely to cause serious damage to health via repeated dermal exposure. No treatment-related effects in rabbits at doses of up to 2500 mg/kg bw/d applied 5 d/wk for 3 weeks (OECD, 2004).</p> <p>Available animal data suggest that the chemical is not likely to cause serious damage to health via repeated inhalation exposure. The only available rat study for this chemical reported 2/20 mortalities at 1.2 mg/L 6 h/d (5 d/wk over 4 wk). Local reddish discharge around the nostrils and inflammatory cell infiltrates and interstitial fibrosis of the lung secondary to local irritant effects were also observed at 0.25 mg/L. On the basis of systemic effects, the NOAEC is considered to be > 0.25 mg/L 6 h/d (ECHA, 2011).</p>
<p>Carcinogenicity</p>	<p>Based on the available data, the chemical is not considered carcinogenic.</p> <p>The chemical was not carcinogenic (NOAEL 500 mg/kg bw/d) in a lifetime 3-generation study in rats when given with the diet at doses up to 500 mg/kg bw/d. No increase in the lifetime tumour incidence, clinical abnormalities or histopathological changes were observed (OECD, 2004).</p> <p>A lifelong study using male/female Swiss Albino mice given the chemical (2 %) continuously in drinking water showed no carcinogenic effect (such as effect on survival or incidence of tumours) (CICAD, 2000).</p>
<p>Mutagenicity/ Genotoxicity</p>	<p>Based on the weight of the evidence of the in vitro and in vivo genotoxicity data, the chemical is not considered mutagenic or clastogenic.</p> <p>In vitro data using the reverse mutation assays with various strains of <i>Salmonella typhimurium</i> (with and without metabolic activation) and sister chromatid exchange assays (except one equivocal result) were negative. Weak genotoxic effects or equivocal results were observed in most of the chromosome aberration assays in three mammalian cell lines and two of the recombination assays in <i>Bacillus subtilis</i> (no further information available, only summary given) (REACH). No genotoxicity was observed in the in vivo cytogenetic, micronucleus, or other assays at either somatic or germ cell level (OECD, 2004).</p>
<p>Reproductive Toxicity / Developmental Toxicity/Teratogenicity</p>	<p>No evidence of reproductive or developmental toxicity was observed for the chemical.</p>
<p>Acute Toxicity</p>	<p>The chemical is of low acute toxicity in animal tests following oral exposure. The median lethal dose (LD50) in rats and mice is greater than 2000 mg/kg bw/d. LD50 in rats ranged from 1700-3040 mg/kg bw/d and in mouse ranged from 1940-2370 mg/kg bw/d. However, the studies that reported the lower LD50s were all pre-guideline studies and no further information was available to critically assess the data. LD50s reported in two reliable studies were 2250 mg/kg bw/d (mice) and 2565 mg/kg bw/d (rats) (OECD, 2004). The chemical is of low acute toxicity in animal tests following oral exposure. The median lethal dose (LD50) in rats and mice is greater than 2000 mg/kg bw/d.</p> <p>LD50 in rats ranged from 1700-3040 mg/kg bw/d and in mouse ranged from 1940-2370 mg/kg bw/d. However, the studies that reported the lower LD50s were all pre-guideline studies and no further information was available to critically assess the data. LD50s reported in two reliable studies were 2250 mg/kg bw/d (mice) and 2565 mg/kg bw/d (rats) (OECD, 2004).</p>

	<p>The chemical exhibits low acute toxicity in animal tests as evidenced by reported dermal LD50 (median lethal concentration) in rats of greater than 2000 mg/kg bw (OECD, 2004).</p> <p>The chemical exhibits low acute toxicity in animal tests following inhalation exposure. No mortalities or toxic effects were observed in rats and mice with the reported median lethal concentration (LC50) > 12.2 mg/L/4-h (ECHA, 2011; OECD, 2004).</p>
Irritation	<p>Inhalation toxicity of the chemical was evaluated in one rat study (0, 0.025, 0.25 and 1.2 mg/L, 6 h/d 5 d/wk over 4 weeks) using fine [REDACTED] dust (see Repeat dose toxicity - Inhalation). A reddish discharge around the nostrils was seen in the mid and high dose groups. An increased incidence and intensity of interstitial inflammatory cell infiltrate and interstitial fibrosis (indicating upper respiratory tract irritation) was noted at all doses. Observed histopathological changes were most likely due to a persistent irritating effect of the test substance on the lung. No changes in gross pathology were noted (REACH).</p> <p>The chemical was irritating (erythema and swelling of the ear lobe) in the guinea pig ear swelling test at 1%, particularly when dissolved in ethanol, although it was not found irritating in the rabbit (OECD, 2004).</p> <p>The chemical was highly irritating in rabbit eyes, causing irreversible corneal opacity and chemosis in 2/3 animals, and increasing conjunctival redness severity with white/grey discoloration after 2-day observation. A Draize score of 35 was given based on the effects (REACH). In another rabbit study an irritation score of 65.0/110 was noted. No further details were available from this study (OECD, 2004).</p>
Sensitisation	<p>The negative results seen for the chemical from several skin sensitisation animal studies including guinea pig maximisation test (GPMT), Buehler test and local lymph node assay (LLNA) support a conclusion that the chemical is not a skin sensitiser (REACH).</p> <p>The chemical did not induce sensitisation in healthy volunteers although some allergic reactions were noted in 34/537 patients with suspected contact dermatitis (at 2 %) (SCCP, 2005) and 9/121 patients with dermatoses and 10/57 patients with chronic urticaria (at 5 %) (ECHA, 2011).</p>
Health Effects Summary	<p>The critical health effects associated with the chemical (but not the salts) are skin, eye and respiratory tract irritation. However, no systemic effects were seen with [REDACTED]. The salts are expected to exist almost entirely as the benzoate ion under normal physiological conditions and will not have the local irritant properties that arise from the acidity of [REDACTED]. Therefore, it is unlikely that any systemic effects will be observed with the salts of [REDACTED].</p>
Key Study/Critical Effect for Screening Criteria	<p>The critical lowest No Observed Adverse Effect (NOAEL) level for the purposes of risk assessment is 825 mg/kg bw/day from the repeated chronic oral toxicity study.</p>
Ecological Toxicity ²	
Aquatic Toxicity	<p>Studies on three trophic levels are available with the lowest EC50 found in algae (33.1 mg/L). In this study the concentrations decreased significantly over the exposure period of 72 hours. The LC50 for fish is 44.6 mg/L and for daphnia an EC50 of > 100 mg/L was derived.</p> <p>The EC10 from the algae study is 3.4 mg/L, which is much lower than the NOEC for fish (120 mg/L in a 28 day study) and daphnia (25 mg/L in 21 day reproduction test).</p>
Determination of PNEC aquatic	<p>Long-term data was available for a fish, invertebrate and algae. An assessment factor of 10 was used on the lowest NOEC of 3.4 mg/L for algae for a resulting PNEC of 0.34 mg/L.</p>
Current Regulatory Controls¹	
Australian Hazard Classification	<p>The chemical is not listed on the Hazardous Substances Information System (HSIS) (Safe Work Australia).</p>

Australian Occupational Exposure Standards	No specific exposure standards are available.
International Occupational Exposure Standards	The following exposure standards are identified (Galleria Chemica): An exposure limit (TWA) of 5–10 mg/m ³ in different countries such as USA (California, Tennessee), Canada and England.
Australian Food Standards	No data available.
Australian Drinking Water Guidelines	No data available.
Aquatic Toxicity Guidelines	No data available.
PBT Assessment	
P/vP Criteria fulfilled?	██████████ is readily biodegradable and as such not persistent in the environment.
B/vB criteria fulfilled?	Based on the measured BCF values of <10 to 21 and a log Kow of 1.87 ██████████ ██████████ is not expected to be bioaccumulative.
T criteria fulfilled?	The acute aquatic toxicity of this chemical is >0.01 mg/L. Thus, it is not expected to meet the screening criteria for toxicity.
Overall conclusion	Not PBT

References

1. Australian Industrial Chemicals Introduction Scheme (AICIS) online database. IMAP, Human Health Tier II Assessment for ██████████ ██████████: Retrieved: ██████████ ██████████
2. ECHA REACH, ██████████ ██████████: Retrieved: <https://echa.europa.eu/>
3. HSDB (n.d.). *Hazardous Substances Data Bank*. Retrieved from Toxnet, Toxicology Data Network, National Library of Medicine: ██████████ ██████████

Appendix C

Safety Data Sheets

SAFETY DATA SHEET



Date-Issued: 05-2015
SDS Ref. No: CFT
Date-Revised: 4/10/17
Revision No:007

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product Identifiers

Product name : Chemical Frac Tracer

Product number : 1000, 1100, 1200, 1300, 1400, 1500, 1600, 1700, 1900, 2000, 2100, 2200, 2300, 2400, 2500, 2800, 2900, 3000, 3700, 3900, 4000, 4800, 10100, 10125, 10175, 10200, 10225, 10250, 10275, 10300, 10325, 10350, 10375, 10400, 10425, 10450, 10475, 10500, 10525, 10550, 10575, 10600, 10625, 10650, 10675, 10700, 10725, 10750, 10775, 10800, 10825, 10850, 10875, 10900, 10925

Generic name : CFT-1000, CFT-1100, CFT-1200, CFT-1300, CFT-1400, CFT-1500, CFT-1600, CFT-1700, CFT-1900, CFT-2000, CFT-2100, CFT-2200, CFT-2300, CFT-2400, CFT-2500, CFT-2800, CFT-2900, CFT-3000, CFT-3700, CFT-3900, CFT-4000, CFT-4800, CFT-10100, CFT-10125, CFT-10175, CFT-10200, CFT-10225, CFT-10250, CFT-10275, CFT-10300, CFT-10325, CFT-10350, CFT-10375, CFT-10400, CFT-10425, CFT-10450, CFT-10475, CFT-10500, CFT-10525, CFT-10550, CFT-10575, CFT-10600, CFT-10625, CFT-10650, CFT-10675, CFT-10700, CFT-10725, CFT-10750, CFT-10775, CFT-10800, CFT-10825, CFT-10850, CFT-10875, CFT-10900, CFT-10925

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Diagnostic
Uses advised against : Not available

1.3 Details of the supplier of the safety data sheet

Company : ProTechnics
Division of Core Laboratories
6510 W. Sam Houston Parkway N.
Houston, Texas 77041

Telephone : 713-328-2320

1.4 Emergency telephone number

Emergency phone number : 713-328-2320
Transportation emergency : 1-800-535-5053 (inside US)
1-352-323-3500 collect (outside US)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS classification in accordance with 29 CFR 1910 (OSHA HCS)
Skin irritation (Category 2), H315

Eye irritation (Category 2), H319
Specific target organ toxicity – single exposure (Category 3), Respiratory system, H335

2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Warning

Hazard statement(s)

H315

Causes skin irritation.

H319

Causes serious eye irritation.

H335

May cause respiratory irritation.

Precautionary statement(s)

P261

Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.

P264

Wash skin thoroughly after handling.

P280

Wear protective gloves.

P302 + P352

IF ON SKIN: Wash with plenty of soap and water.

P304 + P340

IF INHALED: Remove affected person into fresh air and keep at rest in a position comfortable for breathing.

P332 + P313

If skin irritation occurs: Get medical advice/ attention.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION / INFORMATION ON INGREDIENTS

3.1 Substances

Substance/ mixture

Mixture

Ingredient	CAS/Exempt No	Percent	Hazardous
Proprietary Ingredient supplied as 10% w/v Aqueous Solution	Proprietary	10	No
Water	7732-18-5	90	No

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled

Move person into fresh air. If cough or other symptoms develop, consult a physician.

In case of skin contact

Remove contaminated clothing including shoes and immediately wash affected area with plenty of soap and water. If irritation continues, consult a physician. Wash contaminated clothing and shoes before reuse.

In case of eye contact

Immediately flush eyes with plenty of water for two to three minutes. Remove any contact lenses and continue flushing for 15 minutes. If irritation continues, consult a physician.

If swallowed

Wash out mouth with water and keep at rest. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labeling (see Section 2.2) and/or in Section 11.

4.3 Indication of any immediate medical attention and special treatment needed

No data available.

5. FIRE FIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media

Use fire-extinguishing media appropriate for surrounding materials.

5.2 Special hazards arising from the substance or mixture

Carbon oxides, halogenated hydrogen gas.

5.3 Advice for firefighters

As in any fire, wear full protective clothing and equipment.

5.4 Further information

No data available.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours or mist. Evacuate personnel to safe areas.

6.2 Environmental precautions

Do not let product enter drains, if safe to do so.

6.3 Methods and materials for containment and cleanup

Construct temporary dikes of dirt or any appropriate readily available material to prevent spreading of the material. Cover with appropriate absorbent and sweep or shovel into an appropriate container.

6.4 Reference to other sections

For protective clothing, see Section 8. For disposal, see Section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of aerosols. Provide adequate exhaust ventilation at places where aerosols are formed. For precautions, see Section 2.2. Handle and use in a manner consistent with good industrial/manufacturing techniques and practices.

7.2 Conditions for safe storage

Keep container tightly closed in a dry, cool, and well-ventilated place. Do not store with, or close to, strong acids.

7.3 Specific end uses(s)

Apart from the uses mentioned in Section 1.2, no other specific uses are stipulated.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

No PELs, TLVs, or OELs for this product or its ingredients are listed in the current issue of ACGIH's Guide to Occupational Exposure Values, nor have they been determined by the manufacturer.

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of the workday.

Personal protective equipment

Eye/face protection

Safety glasses with side-shields conforming to EN166. Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN166 (EU).

Skin protection

Handle with chemical-resistant gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Body protection

Impervious clothing. The type of protective equipment must be selected according to the amount of dangerous substance at the specific workplace.

Control of environmental exposure

Do not let product enter drains.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: aqueous liquid Color: translucent
b)	Odor	Odorless
c)	Boiling point	Approximately 100°C
d)	Freeze point	0°C
e)	Density	1.05 g/mL
f)	Flash point	Not flammable
g)	pH	Approximately 9
h)	Evaporation factor	Not determined
i)	Solubility	Soluble in water
j)	Vapor pressure	Not determined
k)	Oxidizing properties	Not determined
l)	Vapor density	Not determined
m)	Viscosity	Not determined

9.2 Other safety information

No data available.

10. STABILITY AND REACTIVITY

10.1 Reactivity

Strong acids. Oxidizing materials.

10.2 Chemical stability

The product is stable under normal ambient conditions of temperature and pressure.

10.3 Possibility of hazardous reactions

Will not polymerize.

10.4 Conditions to avoid

Extreme cold.

10.5 Incompatible materials

Strong acids. Oxidizing materials.

10.6 Hazardous decomposition products

None.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity – oral

Based on available data the classification criteria are not met.

Acute toxicity – dermal

Based on available data the classification criteria are not met.

Acute toxicity – inhalation

Based on available data the classification criteria are not met.

Skin corrosion/irritation

Skin irritant 2 – H315 Causes skin irritation.

Serious eye damage/irritation

Eye irritant 2 – H319 May cause severe eye irritation.

Respiratory sensitization

Based on available data the classification criteria are not met.

Skin sensitization

Based on available data the classification criteria are not met.

Germ cell mutagenicity

Genotoxicity – in vitro

Based on available data the classification criteria are not met.

Genotoxicity- in vivo

Based on available data the classification criteria are not met.

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible, or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity

Reproductive toxicity – fertility

Based on available data the classification criteria are not met.

Reproductive toxicity – development

Based on available data the classification criteria are not met.

Specific target organ toxicity – single exposure

STOT SE 3 – H335 May cause respiratory irritation.

Specific target organ toxicity – repeated exposure

Based on available data the classification criteria are not met.

Aspiration hazard

Not anticipated to present an aspiration hazard, based on chemical structure.

Additional information

RTECS: Not available.

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

No data available.

12.2 Persistence and degradability

Presumed to be persistent.

12.3 Bioaccumulative potential

No data available.

12.4 Mobility in soil

No data available.

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment are not available as chemical safety assessment not required/ not conducted.

12.6 Other adverse effects

No data available.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product

Dispose of at a supervised appropriate waste disposal facility according to current applicable laws and regulations and product characteristics at time of disposal.

Contaminated packaging

Contaminated containers should be cleaned and disposed of in the same manner as the product in accordance with applicable regulations.

14. TRANSPORT INFORMATION

DOT (US)

Not dangerous goods.

IMDG

Not dangerous goods.

IATA

Not dangerous goods.

15. REGULATORY INFORMATION

SARA 302 Components

SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components

SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards

SAR 311/312: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 311/312.

CERCLA (Comprehensive Response, Compensation, and Liability Act)

Not Applicable.

TSCA (Toxic Substance Control Act)

The components of this product are in compliance with the chemical notification requirements of TSCA.

German Water Endangerment Class

WGK: 1

16. OTHER INFORMATION

HMIS Rating

Health Hazard: 1

Chronic Health Hazard:

Flammability: 0

Physical Hazard: 0

NFPA Rating

Health Hazard: 1

Fire Hazard: 0

Reactivity Hazard: 0

MANUFACTURER DISCLAIMER: Information given herein is offered in good faith as accurate, but without guarantee. Conditions of use and suitability of the product for particular uses are beyond our control; all risks of use of the product are therefore assumed by the user. Nothing is intended as a recommendation for uses which infringe valid patents or as extending license under valid patents. Appropriate warnings and safe handling procedures should be provided to handlers and users.

Prepared by: ProTechnics Environmental Compliance Department

Date of revision: 4/10/17

Contact information: 713-328-2320

Section B - IMP 4-3 Appendix 07 Spill Management Plan Section 14 Table 9. Additional List of potential HF fluids to be used.

Commencing on following page.

Table 9. Additional Tracer List of potential HF fluids to be used (excerpt of Appendix 6.03)

Chemical Name	CAS Number	Volume or Mass of Chemical (L or kg)	Concentration in Injected Fluid (mg/L)	Parent Compound Purpose	Ecotoxicity ¹	Toxicity ²	Biodegradation ³	Bioaccumulative ¹	Tier 1 Screening Assessment	Discussion	Tier 2 Assessment Worker Ingestion Risk	Tier 2 Assessment Worker Dermal Risk	Hazard Quotient	Outcome of Tier 2 Worker Risk Assessment ¹
		8	0.7	Tracer	Acute toxicity: Fish LC50 44.6 mg/L Daphnia EC50 > 100 mg/L Algal EC50 33.1 mg/L Chronic toxicity: Fish NOEC 120 mg/L (28 days) Daphnia NOEC 25 mg/L (21 days) Algae EC10 3.4 mg/L	Based on chronic: Moderate	No. Readily biodegradable	Not bioaccumulative (Based on a log Kow value of 1.87, and BCF value of <10 to 21)	Tier 2	The risk was classified as moderate based on chronic data. A Tier 2 assessment is required.	3.5E-07	9.1E-07	1.3E-06	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
		8	0.7	Tracer	Acute toxicity: Fish LC50 44.6 mg/L Daphnia EC50 > 100 mg/L Algal EC50 33.1 mg/L Chronic toxicity: Fish NOEC 120 mg/L (28 days) Daphnia NOEC 25 mg/L (21 days) Algae EC10 3.4 mg/L	Based on chronic: Moderate	No. Readily biodegradable	Not bioaccumulative (Based on a log Kow value of 1.87, and BCF value of <10 to 21)	Tier 2	The risk was classified as moderate based on chronic data. A Tier 2 assessment is required.	3.5E-07	9.1E-07	1.3E-06	Based on the calculated HQ the chemical is of low concern for workers (refer to individual toxicity profile and risk calculations for further detail).
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													9.0E-05	The chronic health risks associated with potential exposure to COPC identified in flowback water, where the Chemical Water Tracers Recipe is used and assuming 100% mass recovery are considered to be acceptable.

Notes
 * Chemical composition and information not provided to AECOM due to proprietary controls by the chemical manufacturer
 Tier 1 (NICNAS) - Chemical identified as of low concern for human health, as published in the National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia (NICNAS 2017).
 1 - Please refer to the individual toxicity profiles for further detail.
 2 - Toxicity assessed using NT (2021)
 3 - Biodegradation assessed as per NT (2021) and DoEE (2017)
 BCF - Bioconcentration Factor
 NA - Not Applicable
 NICNAS 2017 - National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia
 DoEE 2017 - Draft Risk Assessment Guidance Manual: For Chemicals Associated with Coal Seam Gas Extraction, Australian Government, Department of Energy
 NT 2021 - Northern Territory Government, Department of Environment, Parks and Water Security, Environment Management Plan Content Guideline, 2021