JINGEMIA PRODUCTION FACILITY

ENVIRONMENTAL PLAN

PUBLIC SUMMARY

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Acronyms & Abbreviations

Acronym / Abbreviatioin	Definition
ALARP	as low as reasonably practicable
C&M	care and maintenance
DFES	Department of Fire and Emergency Services
DMIRS	Department of Mines, Industry Regulation and Safety
DMP EP Guidelines	DMP Petroleum and Geothermal Environment Plan Guidelines
HES	Health Environmental and Safety
HPS	Horizontal Pumping System
JPF	Jingemia Production Facility
MEX	Computerised maintenance Management System
MYOSH	Safety management software
OMS	Operational Management System
OSCP	Oil Spill Contingency Plan
PEC	Priority Ecological Community
PGER(E)R	Petroleum and Geothermal Energy Resources (Environment) Regulations 2012
PIC	Person In Charge
PTW	Permit to Work
RCMA	RCMA Australia
RO	Reverse osmosis
UCL	Untitled Crown Land
WA	Western Australia
WIMS	Well Integrity Management System ()
WSM	Well Site Managers

1.0 Introduction

1.1 Overview

The Jingemia Production Facility (JPF) was originally developed over a four-year period with the final equipment, the Horizontal Pumping System (HPS) multi-stage centrifugal pumps installed in 2007. Between 2002 and 2007, as wells were drilled, additional production brought online and new reservoir information obtained, the plant capacity was expanded to the current configuration.

Origin Energy shut-in the JPF in December 2012 and from January 2013 to July 2017, Origin Energy operated the field under a care and maintenance (C&M) regime. During this phase, the field was normally unmanned with operations staff visiting the site 2-3 times per week to perform C&M activities.

On 17th July 2017 Cyclone Energy commenced operatorship of the JPF Production operations at the JPF re-commenced in March 2018. RCMA took over operatorship of the JPF production facilities in April 2018.

1.2 Location

The JPF is in the Shire of Irwin. It is situated on the western side of the Brand Highway, approximately 15km SSE of the Dongara town site and 360 kilometres north of Perth (**Error! Reference source not found.**). The JPF is within Production Licence L14 in the north Perth Basin, on Untitled Crown Land (UCL), being Lot 12751 Plan 37432. The well and lease areas associated with J9 is RCMA owned and operated, however this well is located within within Petroleum Licence L2. This licence is not opeated by RCMA.

1.3 Scope

This Environment Plan covers the following activities within the JPF operational area (which is defined in **Error! Reference source not found.**):

- Operation of the JPF,
- Inspection maintenance and repair of infrastructure within the JPF,
- Support operations within the JPF.

1.4 Timing & Contact Details

The JPF is currently operating and it is anticipated that the JPF will remain operational over the next five years. If within this time frame it is forecast that operations may cease, a revision to the EP will be submitted to the Department of Mines, Industry Regulation and Safety (DMIR) for assessment.

Well intervention activities may be conducted at any time over the next five years with the first program expected to comment at the end of Q4 in 2018 following acceptance of the EP.

The nominated Operator for the JPF is Chris Newport, RCMA Australia.

The RCMA Pty Ltd office is located at Suite 3, 49 Ord Street, West Perth WA 6005. The contact number of the Perth Office is 08 9321 0734.

The Jingemia Site Office is located at 1 Jingemia Road, Dongara WA 6525 and fully manned. The Contact number of the site office is 08 9227 2624.

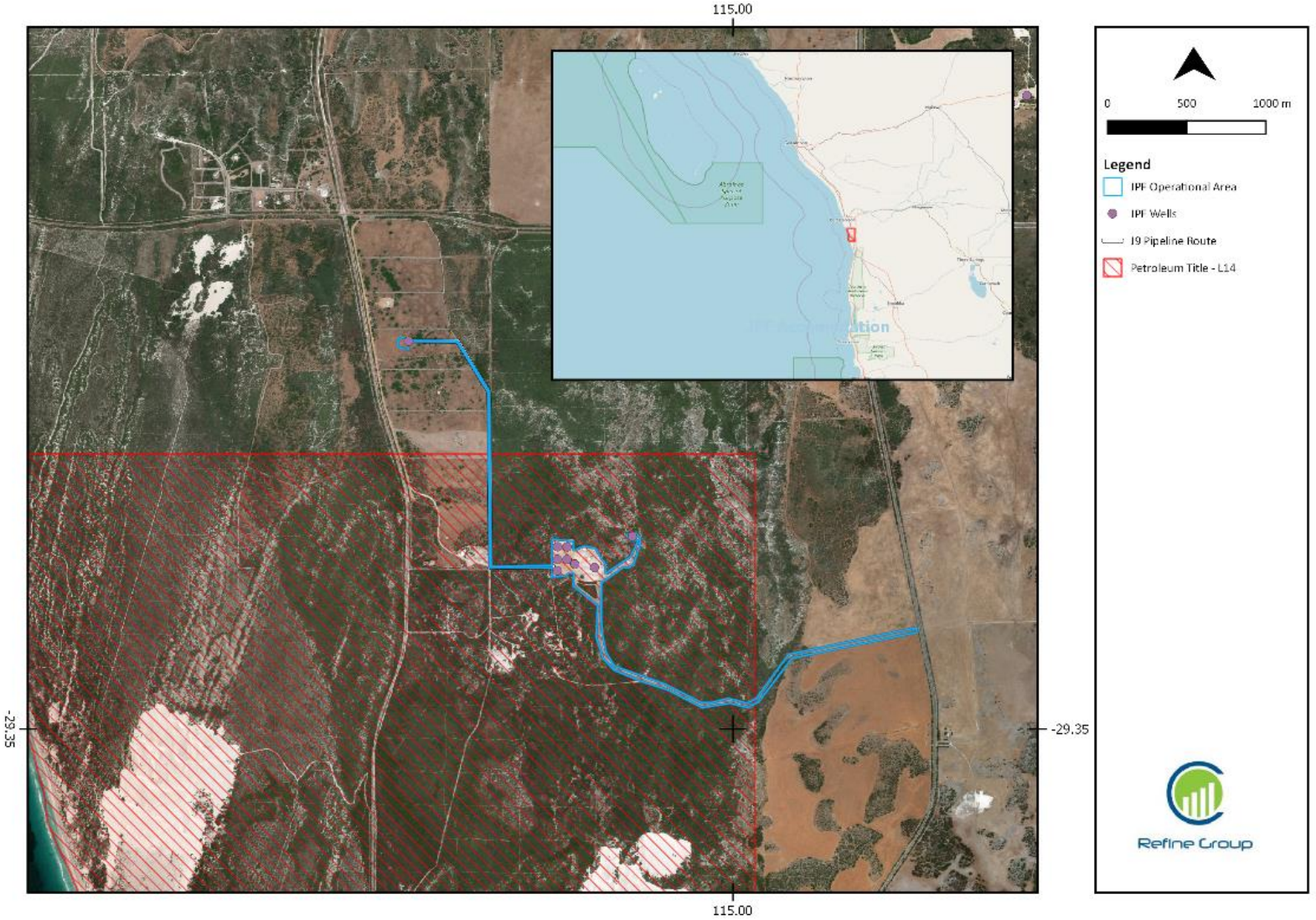
115.00
-29.35
-29.35
115.00
0
500
1000 m
Legend
IPF Operational Area
IPF Wells
19 Pipeline Route
Petroleum Title - L14
Refine Group

Figure 1-1: JPF Location

2.0 JPF Description of Activities

2.1 Facility overview

Normal activities for the production of oil and associated gas and water will occur during this phase of the life of the JPF.

Specifically, the activities associated with the EP include:

- Operation of the JPF
- Inspection, maintenance and repair of infrastructure within the JPF
- Well Intervention Activities

2.2 Operation of the JPF

Reservoir fluids which comprise crude oil, water and gas are produced via one of four production wells. Reservoir fluids are separated into the three components where crude oil is transported via infield flowlines to one of several export tanks. Once full, crude is transferred to a load out facility where export tankers are filled with crude oil, then transported offsite for further refining.

Gas is conditioned on-site and used as fuel gas to offset the use of diesel / crude. Where excess gas is generated it is diverted to a flare tower where it is flared.

Produced water is treated and stored in onsite tanks. It is transferred from the water storage tanks to HPS water injection pumps. These pumps boost the water pressure which is then is directed down one or more of the water injection wells into the production reservoir to provide hydrocarbon sweep and pressure support. All produced water ends up back in the aquifer where it originated.

The types of activities are classified operational activities:

- production of reservoir fluids,
- separation and treatment of reservoir fluids (crude oil, water and gas),
- storage and export of crude oil,
- re-injection of produced water,
- operations of flare to combust excess gas.

2.3 Inspection, maintenance and repair of infrastructure within the JPF

Inspection, maintenance and repair of infrastructure within the JPF is undertaken as required but is a continuous activity to ensure that the JPF is operating both safely and at optimum efficiency. Specifically, the types of activities classified as inspection maintenance and repair include:

- routine wellhead maintenance and monitoring,
- well intervention and workover activities,
- periodic maintenance to plant and equipment, as per statutory requirements and scheduling in the maintenance Management System,
- repair and maintenance as required to plant, equipment, hardstands and roads etc.,
- maintenance of firebreaks,

- installation of J9 flowline
- maintenance as required of site buildings.

3.0 Environment Impacts and Risks

3.1 Existing Environment

The Jingemia Production Facility is located in the coastal sandhills of the Mid-West region of WA. The area is located in the Geraldton Sandplains Biogeographical Region and consists of sand dunes (both stabilised and mobile) and dense coastal scrub, close to the coast and large areas of cleared agricultural land.

This region consists of three broad physiographical units and the facility lies within the Swan Coastal Plain. The Swan Coastal Plain is an elongated strip approximately 40km wide and runs along the coast bounded to the east by the Gingin Scarp and the west by the Indian Ocean. The region is typically low lying, gentle undulating area covered by quaternary coastal dunes and marine deposits.

3.2 Environmental Risk Assessment Methodology

The risk assessment for the EP was undertaken in accordance with RCMA's HAZID Identification and Risk Management Procedure (CE-CD-J-PDR-035.0). This approach generally aligns with the processes outlined in ISO 31000:2009 Risk Management – Principles and Guidelines (Standards Australia/Standards New Zealand 2009) and Handbook 203:2012 Managing Environment-related Risk (Standards Australia/Standards New Zealand 2012).

The risk assessment process and evaluation involved numerous consultations with environmental, operations, maintenance, and engineering personnel.

The environmental impact and risk evaluation process comprised these components:

- identification and description of the petroleum activity
- identification of particular environmental values
- identification of relevant aspects
- identification of relevant environmental hazards
- evaluation of impacts and risk
- consequence
- control measures and as low as reasonably practicable (ALARP) evaluation
- likelihood
- quantification of the level of risk
- risk acceptance evaluation
- environmental performance objectives, standards, and measurement criteria.

Table 3-1 summarises the environmental impacts, risks, and control measures in place to manage the activity

Table 3-1: Summary of Potential impacts Risks and Control Measures

Source of Environmental Impact or Risk	Potential environmental Impacts and Risks	Control Measures
Inspection, maintenance and repair of infrastructure within the JPF has the potential to result in an interaction with soil and vegetation	Spread non-indigenous species (weed / pathogens) Erosion – Disturbance to vegetation	• RCMA Weed Management strategy • Permit to Work (PTW) • No clearing of vegetation • JPF induction • Site inspection
Inspection, maintenance and repair of infrastructure and support operations at the JPF has the potential to result in an interaction with fauna	Physical interaction with fauna has the potential to result in injury or death.	• Install speed limit signage • Reduce speed limits within the JPF • JPF induction • Fauna exclusion fencing around the turkey nest • Fauna ladder installed within the turkey nest • Fauna traps (i.e well cellars) will remain closed unless they are operationally required to be opened (e.g. for a workover activity) • Inspection of fauna traps (i.e well cellars) will be conducted whilst they remain open.
Operation of the JPF and inspection, maintenance and repair of infrastructure within the JPF have the potential to cause a fire event	A fire event could result in various environmental consequences including habitat and vegetation loss, fauna mortality and contamination (in the event petroleum facilities are damaged).	• Hot works exemption • Fire break maintenance • Fire suppression systems • Emergency Response Plan • PTW
Operation of the JPF, inspection, maintenance and repair of infrastructure within the JPF and support operations within the JPF will result in planned discharges.	Planned discharge of waste waters and produced water down-well has the potential to result in the contamination of soil and water causing adverse effects on native vegetation and wildlife.	• Chemical disclosure • Chemical acquisition checklist • Monthly chemical inventory • Limit concentrations of hydrocarbons re-injected into formation • Ground water licences • Monitoring of Groundwater bores • Part V licence requirements • Planned discharges are monitoring and reported
Operation of the JPF will result in the generation of noise emissions.	Noise emissions have the potential to result in: • Behavioural disturbance of fauna,	• Noise monitoring • Access Authority in place if required (J9 and flowline) • Complaints Management System

	• Disturbance to relevant stakeholders.	• Stakeholder Consultation
Operation of the JPF, inspection, maintenance and repair of infrastructure within the JPF and support operations within the JPF will result in the generation of atmospheric emissions	Atmospheric emissions have the potential to result in a disturbance to sensitive fauna / relevant stakeholders.	• Planned discharges emissions are monitoring and reported • Complaints Management System • NGERS reporting
Operation of the JPF, inspection, maintenance and repair of infrastructure within the JPF and support operations within the JPF has the potential to result in accidental release of both solid waste and hazardous liquids and hydrocarbons	Accidental release of solid waste has the potential result in attraction and / or injury of protected fauna species within the vicinity of the JPF. An accidental release of hazardous liquids or hydrocarbons within the JPF has the potential to result in: • Contamination of soil / groundwater • Contamination and subsequent toxic effects to vegetation	• Appropriate rubbish bins and waste segregation • Appropriately licenced waste contractor: • Bulk crude tank integrity • Bulk transfer procedures • Bund valve inspections • Export facility bunded drainage system to site drain • Hose and connection integrity (for transfer and storage workover brine) • Hydrocarbons and hazardous materials are stored within secondary containment • Inspection of bund integrity • JPF induction • MEX (maintenance system) • Monitoring oil storage tank levels • Oil Spill Contingency Plan • Potential overfill / overpressure system on bulk tankers • Pressure control equipment is in place for these well intervention activities • Pressure control equipment will be tested prior to well entry • Process control system shutdown • Radiation Management Plan • Road signage • Sampling of groundwater bores • Site inspection • Spill kits • Waste Register • Well Integrity Management System (WIMS) • Well Intervention Procedure will be developed. • Well Site Managers (WSM) are trained in well control

4.0 Implementation Strategy

The implementation strategy in the EP identifies the systems, practices, and procedures used to ensure the environmental impacts and risks of the activities are continuously reduced to ALARP and the environmental performance outcomes and standards are met. These are predominantly driven through RCMA's Operational Management System (OMS).

4.1 Management System Overview

The OMS is based on the four fundamental principles of Leadership, Risk Management, Project Implementation and Continuous Improvement. These fundamental principles are not sequential but are applied to every element of the company's activities by developing and following systems as illustrated in Table 4-1 below. The OMS establish clear guidelines for JPF personnel to achieve and maintain the standards set out in the EP.

Table 4-1: OMS Overview

OMS Principle	OMS components
Leadership & Commitment	• Vision • Values • Strategy and Targets • Policies • Standards • Organisation
Risk Management	• Risk Assessment • Risk Controls • Quality Assurance • Plans, Procedures and Registers • Competency & Training
Project Implementation	• Asset Design • Inspection and Maintenance • Plans, Procedures and Schedules
Continuous Improvement	• Monitoring • Reporting • Learning • Auditing and Corrective Actions

4.2 Leadership & Commitment

4.2.1 Organisation and Responsibility

The successful implementation of the EP requires adequate resourcing, effective management structures and clear communication. RCMA has a formal organisation chart, defined responsibilities and formal reporting requirements. To meet the requirements of Regulation 15(4) of the Petroleum and Geothermal Energy Resources (Environment) Regulations 2012 (PGER(E)R), a clear chain of command and responsibilities for these positions is included in the EP.

4.3 Risk Management

4.3.1 Hazard Identification and Risk Management (CE-CD-J-PDR-035.0)

RCMA's Hazard Identification and Risk Management procedure (CE-CD-J-PDR-035.0) provides a framework for assessing Health Environmental and Safety (HES) risks and is designed to be consistent with ISO 31000:2009 Risk Management Standard.

Key steps within this process are summarised in Section 4.0 of the EP.

Additional risk assessments must be undertaken if the Management of Change Procedure (Section 6.1.2 of the EP; CE-CD-C-PLN-005.0) is triggered, in which case environmental risk assessments will be conducted in accordance with this procedure.

RCMAs procedure and the Management of Change Procedure (Section 6.3.2 of the EP) are the Management System measures used to demonstrate the requirements of Regulation 15(3)(a) that impacts and risks of the petroleum activity continue to be identified and reduced to ALARP.

4.3.2 Management of Change Procedure (CE-CD-C-PLN-005.0)

RCMAs Management of Change procedure ensures that any changes to facilities, procedures or organisation are subject to evaluation so as to prevent incidents, support reliable and efficient operations, and keep unacceptable risks from being introduced.

In conjunction with the Hazard Identification and Risk Management procedure (CE-CD-J-PDR-035.0), this process is followed to document and assess the impact of changes to activities described in Section 2.0f the EP. Changes are assessed to determine if there is potential for new or increased environmental impact or risk not already provided for in the EP. Specifically, these changes are considered with relation to Regulation 18 of the PGER(E)R which details specific triggers for resubmission of the EP.

If the identified changes do not trigger Regulation 18 of the PGER(E)R, the Plan can be revised, and changes recorded within it without resubmission to DMIRS.

4.3.3 Training and Competency

RCMA use MYOSH to track and manage competencies and required training for the RCMA workforce to ensure personnel are trained and competent to undertake their duties.

A key component of training and competencies (as outlined in the EP) include

- EP awareness, and
- JPF inductions

4.4 Project Implementation

4.4.1 Incident Management Procedure (CE-CD-J-PDR-013)

The Incident Management Procedure (CE-CD-J-PDR-013) is an open hazard and incident recording, reporting and management process which utilises the Safety Management software (MYOSH).

All incidents and general hazard observations, including injuries, or environmental impacts and process are reported to RCMA management for recording and investigation.

4.4.2 Oil Spill Contingency Plan

The Oil Spill Contingency Plan (OSCP) outlines the response structure and considers the four key aspects of prevention, preparedness, response and recovery. An OSCP is required to set out the following:

- Preparations are on hand for the possibility of an oil spill;
- Emergency response arrangements are implemented if an oil spill occurs, and
- Recovery arrangements are implemented if an oil spill occurs.

4.4.3 Emergency Response (drills and exercises)

In accordance with the JPF Emergency Response Plan (CE-CD-J-PLN-007), emergency response drills are conducted on a monthly basis at the JPF. These are coordinated and documented by the PIC.

4.4.4 Environment Plan Review

Regulation 18 of the PGER(E)R require that RCMA submit a proposed revision of the accepted EP:

- before the commencement of a new activity
- or any significant modification, change of a new stage of an existing activity
- before, or as soon as practicable after, the occurrence of any significant new environmental impact or risk, or significant increase in an existing environmental impact or risk which occurred or is to occur.

Additionally, Regulation 20 of PGER(E)R requires that RCMA submit a proposed revision of the EP five years from the date when the EP is accepted by the Minister.

4.5 Continuous Improvement

4.5.1 RCMA Audit Procedure

RCMA's audit procedure describes the process for providing assurance that applicable legal and company requirements are being met, verify necessary control measures are in place and functioning, and non-compliances are reported and tracked to closure. The EP describes the frequency and process for conducting Environmental Audits.

4.5.2 HES Inspections

In addition to compliance audits, HES inspections will be undertaken. The EP describes the frequency and process for conducting HES Inspections.

4.5.3 Monitoring

The following emissions and discharges have been identified as originating from activities described within the EP:

- Produced water injection,
- Produced Gas (Flared / Vented),
- Combustion emissions from diesel,

- Combustion emissions from crude oil.

The EP provides for ongoing monitoring and reporting requirements of these emission.

4.5.4 Reporting

Regulation 28, 29 and 30 of the PGER(E)R require the reporting of incidents under the EP. The EP provides for the reporting of both recordable and reportable incidents, with reportable incidents identified in the EP defined as:

- Bush-fire event,
- spills of hydrocarbons or hazardous materials in excess of 500 L,
- spills of hydrocarbons or hazardous materials that affect a ground surface area greater than 100 m^2.

Regulation 16 of the PGER(E)R requires the reporting of environmental performance of the EP. The EP provides for routine reporting of environmental performance, specifically comprise the following reports:

- Environmental performance reporting (annual)
- Emissions and discharge reporting (quarterly).

5.0 Stakeholder Consultation

RCMA's Community Engagement policy ensures that there is appropriate and timely consultation with relevant authorities and interested organisations and individuals in line with the requirements of the PGER(E)R, the DMP EP Guidelines, Australian Petroleum Production & Exploration Association (APPEA) land access framework, Ministerial Council on Mineral and Petroleum Resources Principles for Engagement with Communities and Stakeholder (2005) and industry best practice.

5.1.1 Stakeholder Identification

In accordance with Regulation 17 of PGER(E)R, RCMA completed a scoping exercise to determine which authorities, persons and organisations were considered to be relevant.

Given the isolated location of the JPF, limited stakeholders were identified but include:

- Department of Fire and Emergency Services (DFES),
- Yamatji Marlpa Aboriginal Corporation (YMAC),
- Shire of Irwin,
- Access Road Landholder,
- Neighbouring landholder / miners.

In addition to these stakeholders, RCMA also consulted with other companies that may be called upon in the event of a major spill to spurt response and recovery operations. These companies include:

- Dongara Bobcats,
- Dongara Midwest Crane Hire,
- Solo Resource Recovery (available 24hr for response).

5.1.2 Stakeholder Log

Table 5-1 summarises the consultation undertaken specific to activities covered under the EP.

Table 5-1: Summary of Stakeholder Engagement Register

Stakeholder	Date	Summary of Consultation	Objections / claims raised	RCMA response	Close out of Issues (if any)
Yamatji Marlpa Aboriginal Corporation (YMAC)	18 October 2018	Emailed JPF Factsheet	None provided	N/a	N/a
Department of Fire and Emergency Services (DEFES) Geraldton	18 October 2018	Emailed JPF Factsheet	None provided	N/a	N/a
Shire of Irwin	18 October 2018	Emailed JPF Factsheet	None provided	N/a	N/a
Dongara Bobcat	23 October 2018	Phone conversation Reconfirmed contact details, availability and mobilisation times.	None provided	N/a	N/a
Solo Resource Recovery	23 October 2018	Phone conversation Reconfirmed contact details, availability and mobilisation times.	None provided	N/a	N/a
Dongara Midwest Crane Hire	23 October 2018	Phone conversation Reconfirmed contact details, availability and mobilisation times.	None provided	N/a	N/a
Access Road / Farm Manager	29 October 2018	Face to Face Meeting JPF Discussed continued use of access road, gate operation, livestock movements and company contact details	None provided	N/a	N/a

Appendix A: Chemical Disclosure

A.1 Production Operations

A.1.1 System Details

System	Total Volume of System
JPF produced water	1280kL water / day (8000bbl water / day)

A.1.2 Product List

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity	Chronic toxicity	Biodegradation bioaccumulation
Citrate-Citric Blend	Environex International Pty Ltd	Water Stabilizer	0.0080	Sodium Citrate: Toxicity: LD50 655 to 825.9 mg/l Citric Acid: Fish Toxicity: LD50 440 to 706mg/l Invertebrate toxicity: LD100 Daphnia magna 120 mg/l lifetime exposure in soft water, LD0 Daphina magna 80 mgl lifetime exposure in soft water. Toxicity threshold: Pseudomonas putida >10g/l; Secendesmus quadricauda 640 mg/l; Entosiphon sulcatum 485mg/l	no information found. contact with eyes may cause irritation, swallowing may cause nausea, vomiting, diarrhoea, and abdominal pain. Inhalation may cause respiratory tract irritation.	Bio accumulative potential not available
EC2479A	Nalco Champion	Emulsion Breaker	0.0010	Component 1 (10-30%) Fish LC50(96hr): 550 mg/L (Sheepshead minnow) Crustacean LC50(48hr): 534 mg/L (Acartia tonsa) Algae EC50(96hr): 610 mg/L (Skeletonema costatum)	Component 1 (10-30%) Suspected of causing cancer.	Component 1 (10-30%) Log Pow: 4.3 (OECD 117) Biodegradation (28d): 11% (OECD 306) Component 2 (1-10%)

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity	Chronic toxicity	Biodegradation bioaccumulation
				Component 2 (1-10%) Fish LC50(96hr): >8.9 (limit) mg/L (Scophthalmus maximus) Crustacean LC50(48hr): 1021 mg/L (Acartia tonsa) Algae EC50(96hr): 8.9 mg/L (Skeletonema costatum) Component 3 (1-10%) Fish LC50(96hr): 71 mg/L (Scophthalmus maximus) Crustacean LC50(48hr): 42 mg/L (Acartia tonsa) Algae EC50(96hr): 10 mg/L (Skeletonema costatum) Component 4 (30-60%) Fish LC50(96hr): 811 mg/L (Scophthalmus maximus) Crustacean LC50(48hr): 360 mg/L (Acartia tonsa) Algae EC50(96hr): 165 mg/L (Skeletonema costatum)	Component 4 (30-60%) Suspected of causing cancer.	Log Pow: 2.7 (OECD 117) Biodegradation (28d): 88% (OECD 306) Component 3 (1-10%) Log Pow: 3.8 (OECD 117) Biodegradation (28d): 63% (BODIS) Component 4 (30-60%) Log Pow: 4.66 (OECD 117) Biodegradation (28d): 100% (OECD 306)
03VC057	Nalco Champion	Water Clarifier	0.0015	Component 1 (90-100%) Algae EC50(96hr): 1.1 mg/L (Skeletonema costatum) Component 2 (1-10%) Crustacean EC50(48hr): 40 mg/L (Daphnia magna)	Full product No known carcinogenic properties or chronic impacts.	Component 1 (90-100%) No data available Component 2 (10-30%) PLONOR Component 3 (30-60%) Non-hazardous according to NOHSC, non-dangerous goods according to ADG

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity	Chronic toxicity	Biodegradation bioaccumulation
EC6157A	Nalco Champion	Scale Inhibitor	0.0025	Component 1 (60-90%) Non-hazardous according to NOHSC, non-dangerous goods according to ADG Component 2 (30-60%) Fish LC50(96hr): 1191 mg/L (Scophthalmus maximus) Crustacean LC50(48hr): 551 mg/L (Acartia tonsa) Algae EC50(96hr): 666 mg/L (Skeletonema costatum)	No known carcinogenic properties or chronic impacts.	Component 1 (60-90%) Non-hazardous according to NOHSC, non-dangerous goods according to ADG Component 2 (30-60%) Log Pow: <0 (OECD 117) Biodegradation (28d): 41% (OECD 306)
EC6312A	Nalco Champion	Scale Dispersant	0.0001	Component 1 (10-30%) PLONOR goods according to ADG Component 4 (10-30%) Fish LC50(96hr): >1800 mg/L (Scophthalmus maximus) Crustacean LC50(48hr): >1000 mg/L (Acartia tonsa) Algae EC50(96hr): 78 mg/L (Skeletonema costatum)	No known carcinogenic properties or chronic impacts.	Component 1 (0-1%) Inorganic, test not applicable. Component 2 (1-10%) Inorganic, test not applicable. Component 3 (60-90%) Non-hazardous according to NOHSC, non-dangerous goods according to ADG Component 4 (10-30%) Log Pow: 0.4 (OECD 117) Biodegradation (28d): 0% (OECD 306)
EC6475A	Nalco Champion	Scale Remover	0.0001	Component 1 (0-1%) Fish LC50(96hr): >1000 mg/L (Sheepshead minnow)	Component 1 (0-1%) Skin sensitizer. Risk	Component 1 (10-30%) Log Pow: 2.28 (theoretical)

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity	Chronic toxicity	Biodegradation bioaccumulation
				Crustacean LC50(48hr): 159 mg/L (Acartia tonsa) Algae EC50(96hr): 720 mg/L (Skeletonema costatum) Component 2 (1-10%) PLONOR Component 3 (60-90%) Non-hazardous according to NOHSC, non-dangerous	of cancer, IARC Group 1 Carcinogen.	Biodegradation (28d): 34% (BODIS) Component 2 (60-90%) Log Pow: 0 Biodegradation (28d): 61% (OECD 306) Component 3 (0-1%) Log Pow: <0 (OECD 117) Biodegradation (28d): 83% (OECD 306)
FX2363	Nalco Champion	Corrosion Inhibitor	0.0030	Component 1 (1-10%) PLONOR Component 2 (30-60%) Non-hazardous according to NOHSC, non-dangerous goods according to ADG Component 3 (1-10%) Fish LC50(96hr): 3.4 mg/L (Scophthalmus maximus) Crustacean LC50(48hr): 1.2 mg/L (Acartia tonsa) Algae EC50(96hr): 0.5 mg/L (Skeletonema costatum) Component 4 (1-10%) Fish LC50(96hr): 811 mg/L (Scophthalmus maximus) Crustacean LC50(48hr): 360 mg/L (Acartia tonsa) Algae EC50(96hr): 165 mg/L (Skeletonema costatum)		

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity	Chronic toxicity	Biodegradation bioaccumulation
				Component 5 (10-30%) Fish LC50(96hr): 1.7* mg/L (Sheepshead minnow) Crustacean LC50(48hr): 0.4* mg/L (Acartia tonsa) Algae EC50(96hr): 0.26* mg/L (Skeletonema costatum) *Estimated data based on structural analogue Component 6 (1-10%) Fish LC50(96hr): 252 mg/L (Scophthalmus maximus) Crustacean LC50(48hr): 70 mg/L (Acartia tonsa) Algae EC50(96hr): 93 mg/L (Skeletonema costatum)		
EC73385	Nalco Champion	Biocide	0.0001	Component 1 (30-60%) Non-hazardous according to NOHSC, non-dangerous goods according to ADG Component 2 (1-10%) PLONOR Component 3 (30-60%) Fish LC50(96hr): 64 mg/L (Scophthalmus maximus) Crustacean LC50(48hr): 0.22 mg/L (Acartia tonsa) Algae EC50(96hr): 1.2 mg/L (Skeletonema costatum)	Component 3 (30-60%) Respiratory and skin sensitizer.	Component 1 (30-60%) Non-hazardous according to NOHSC, non-dangerous goods according to ADG Component 2 (1-10%) PLONOR Component 3 (30-60%) Log Pow: 0 (OECD 107(1996)) Biodegradation (28d): 71.4% (OECD 306)
EC6733A	Nalco Champion	Biocide	0.0001	Component 1 (10-30%) Fish LC50(96hr): 1.7 mg/L (Sheepshead minnow) Crustacean LC50(48hr): 0.4 mg/L (Acartia tonsa)	Component 2 (60-90%)	Component 1 (10-30%) Log Pow: 2.28 (theoretical)

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity	Chronic toxicity	Biodegradation bioaccumulation
				Algae EC50(96hr): 0.26 mg/L (Skeletonema costatum) Component 2 (60-90%) LD50 (Oral, rat): 575 mg/kg (75% active ingredient in water) LD50 (Dermal, rat): >2000 mg/kg (75% active ingredient in water) LC50 (Inhalation, rat): 0.591 mg/l (4 hrs) (75% active ingredient in water) Fish LC50(96hr): 72 mg/L (Scophthalmus maximus) Crustacean LC50(48hr): 0.6 mg/L (Acartia tonsa) Algae EC50(96hr): 0.16 mg/L (Skeletonema costatum) Component 3 (0-1%) Fish LC50(96hr): 611 mg/L (Scophthalmus maximus) Crustacean LC50(48hr): 38 mg/L (Acartia tonsa) Algae EC50(96hr): 4.1 mg/L (Skeletonema costatum)	Skin sensitizer. Reproductive toxicant to rabbits/rats at 50mg/kg/day. Component 3 (0-1%) Skin sensitizer. Risk of cancer, IARC Group 1 Carcinogen.	Biodegradation (28d): 34% (BODIS) Component 2 (60-90%) Log Pow: 0 Biodegradation (28d): 61% (OECD 306) Component 3 (0-1%) Log Pow: <0 (OECD 117) Biodegradation (28d): 83% (OECD 306)
Water	Produced water	Water disposal to water injection well	99.9840	No hazard		
Total			**100**			

A.1.3 Chemical List

Chemicals within Products	CAS number	Mass fraction (%)
Water	7732-18-5	95.7068
Crude Petroleum	8002-05-9	0.0030
Sodium Chloride	7647-14-5	3.4434
Magnesium Chloride	7786-30-3	0.2360
Calcium Chloride	10043-52-4	0.2200
Sodium Sulphate	7757-82-6	0.1983
Potassium Chloride	7447-40-7	0.0994
Sodium Bicarbonate	144-55-8	0.0689
Strontium Chloride	10476-85-4	0.0087
Silica	7631-86-9	0.0061
Iron (II) Chloride	7758-94-3	0.0023
Potassium Hydroxide	1310-58-3	0.0007
Oxyalkylated Polymer	68123-18-2	0.0003
Fumaric acid, Polymer with Sodium allylsulfonate	68715-83-3	0.0004
Citric Acid	77-92-2	0.0011
Trisodium Citrate Dihydrate	68-04-2	0.0012
Benzyl-(C12-C16 Alkyl)-Dimethyl-Ammonium Chloride	68424-85-1	0.0009
Tall Oil, DETA Imidazoline Acetates	68140-11-4	0.0003
Thioglycolic Acid	68-11-1	0.0001
Dipropylene Glycol Monomethyl Ether	34590-94-8	0.0001

Chemicals within Products	CAS number	Mass fraction (%)
Sodium Dimethyldithiocarbamate	128-04-1	0.0002
Disodium Ethylene Bisdithiocarbamate	142-59-6	0.0001
Oxyalkylated Resin	30704-64-4	0.0001
Heavy Aromatic Naphtha	64742-94-5	0.0001
2-Ethylhexanol	104-76-7	0.0001
Tetrakis(hydroxymethyl) phosphonium sulfate	55566-30-8	0.0001
Glutaraldehyde	111-30-8	0.0001
Diethylenetriaminepentaacetic Acid, Pentapotassium	7216-95-7	0.0001
Formic Acid	64-15-6	0.0001
Acetic Acid	64-19-7	0.0001
Total		**100.0000**

A.1.4 Contingency Production Operation Products Details

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity:	Chronic toxicity:	Biodegradation bioaccumulation:
EC6080A	Nalco	Scale Inhibitor	0.02	LC50 Bluegill Sunfish: > 1,000 mg/l Exposure time: 96 hrs Test substance: Product LC50 Oncorhynchus mykiss (rainbow trout): > 1,000 mg/l	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.	The organic portion of this preparation is expected to be inherently biodegradable. If released into the environment this material is expected to distribute to

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity:	**Chronic toxicity:**	**Biodegradation bioaccumulation:**
				Exposure time: 96 hrs Test substance: Product LC50 Oncorhynchus mykiss (rainbow trout): > 1,800 mg/l Exposure time: 96 hrs Test substance: Product NOEC Lepomis macrochirus (Bluegill sunfish): 1,000 mg/l Exposure time: 96 hrs Test substance: Product NOEC Oncorhynchus mykiss (rainbow trout): 1,000 mg/l Exposure time: 96 hrs Test substance: Product NOEC Oncorhynchus mykiss (rainbow trout): 1,800 mg/l Exposure time: 96 hrs Test substance: Product NOEC Turbot: 1,831 mg/l Exposure time: 96 h Test substance: Product	Two chronic feeding studies, using rats and mice, have not produced any evidence that ethylene glycol causes dose-related increases in tumor incidence, or a different pattern of tumors when compared to untreated controls. The absence of a carcinogenic potential for ethylene glycol has been supported by numerous in vitro genotoxicity studies showing that it does not produce chromosomal breakage or mutagenic effects.	the air, water and soil/sediment in the approximate respective percentages; Air : <5% Water : 30 - 50% Soil : 50 - 70%

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity:	Chronic toxicity:	Biodegradation bioaccumulation:
				LC50 Turbot: > 1,831 mg/l Exposure time: 96 h Test substance: Product LC50 Daphnia magna (Water flea): > 2,000 mg/l Exposure time: 48 hrs Test substance: Product NOEC Daphnia magna (Water flea): 2,000 mg/l Exposure time: 48 hrs Test substance: Product LC50 Acartia tonsa: 426 mg/l Exposure time: 48 h Test substance: Product		
Cleartron ZB-673	Nalco	Water clarifier	0.0015	This product has no known ecotoxicological effects	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.	Based on the suppliers hazard characterization, the potential environmental hazard is: Low
Cleartron IZB-245	Nalco	Water clarifier	0.0015	LC50 Inland Silverside: > 5,000 mg/l Exposure time: 96 hrs	No component of this product present at levels greater than or equal to 0.1% is identified	Greater than 95% of this product consists of inorganic substances for

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity:	**Chronic toxicity:**	**Biodegradation bioaccumulation:**
				Test substance: Product LC50 Rainbow Trout: 590 mg/l Exposure time: 96 hrs Test substance: Product LC50 Fathead Minnow: 1,094 mg/l Exposure time: 96 hrs Test substance: Product NOEC Inland Silverside: 5,000 mg/l Exposure time: 96 hrs Test substance: Product NOEC Rainbow Trout: 250 mg/l Exposure time: 96 hrs Test substance: Product NOEC Fathead Minnow: 313 mg/l Exposure time: 96 hrs Test substance: Product LC50 Daphnia magna: > 5,000 mg/l Exposure time: 48 hrs Test substance: Product	as probable, possible or confirmed human carcinogen by IARC.	which a biodegradation value is not applicable If released into the environment this material is expected to distribute to the air, water and soil/sediment in the approximate respective percentages; Air: <5% Water: 30 - 50% Soil: 50 - 70% This preparation or material is not expected to bioaccumulate

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity:	Chronic toxicity:	Biodegradation bioaccumulation:
				LC50 Mysid Shrimp (Mysidopsis bahia): 4,773 mg/l Exposure time: 96 hrs Test substance: Product LC50 Ceriodaphnia dubia: > 5,000 mg/l Exposure time: 48 hrs Test substance: Product NOEC Daphnia magna: 5,000 mg/l Exposure time: 48 hrs Test substance: Product NOEC Mysid Shrimp (Mysidopsis bahia): 1,250 mg/l Exposure time: 96 hrs Test substance: Product NOEC Ceriodaphnia dubia: 2,500 mg/l Exposure time: 48 hrs Test substance: Product NOEC: 15 mg/l Exposure time: 7 Days Species: Ceriodaphnia dubia Test substance: Product		

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity:	Chronic toxicity:	Biodegradation bioaccumulation:
				LOEC: 30 mg/l Exposure time: 7 Days Species: Ceriodaphnia dubia Test substance: Product EC25 / IC25: 7.2 mg/l Exposure time: 7 Days Species: Ceriodaphnia dubia Test substance: Product IC50: 10.3 mg/l Exposure time: 7 Days Species: Ceriodaphnia dubia Test substance: Product NOEC: 7.5 mg/l Exposure time: 7 Days Species: Ceriodaphnia dubia Test substance: Product LOEC: 15 mg/l Exposure time: 7 Days Species: Ceriodaphnia dubia Test substance: Product		

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity:	Chronic toxicity:	Biodegradation bioaccumulation:
EC2034A	Nalco	Emulsion Breaker	0.0010	LC50 Fish: 1 - 10 mg/l Exposure time: 96 hrs Test substance: Product (estimated) LC50 Daphnia magna: 1 - 10 mg/l Exposure time: 48 hrs Test substance: Product (estimated) Toxicity to algae : Methanol EC50 : 22,000 mg/l Exposure time: 72 h	Toxicity to fish (Chronic toxicity) : Methanol NOEC: 7,900 mg/l Exposure time: 8.3 d May cause damage to organs. Suspected of causing cancer This product contains ethylbenzene. The International Agency for Research on Cancer (IARC) has evaluated ethylbenzene and determined it to be possibly carcinogenic to humans (Group 2B, based on sufficient evidence in experimental animals and inadequate evidence in humans). This product contains naphthalene. The International Agency for Research on Cancer (IARC) has evaluated naphthalene and determined it to be possibly carcinogenic to humans (Group 2B, based on sufficient evidence in experimental animals and inadequate evidence in humans).	If released into the environment this material is expected to distribute to the air, water and soil/sediment in the approximate respective percentages; Air: 10 - 30% Wate: 10 - 30% Soil: 50 - 70% The portion in water is expected to be soluble or dispersible.
EC9610A	Nalco	Cleaner	0.01%	LC50 Bluegill Sunfish: > 1,000 mg/l Exposure time: 96 hrs		The organic portion of this preparation is expected to be readily biodegradable.

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity:	Chronic toxicity:	Biodegradation bioaccumulation:
				Test substance: Product LC50 Inland Silverside: > 1,000 mg/l Exposure time: 96 hrs Test substance: Product LC50 Mosquito Fish (Gambusia spp.): > 1,000 mg/l Exposure time: 96 hrs Test substance: Product LC50 Acartia tonsa: 730 mg/l Exposure time: 48 hrs Test substance: Product EC50 Marine Algae (Skeletonema costatum): 109 mg/l Exposure time: 72 hrs Test substance: Product		If released into the environment this material is expected to distribute to the air, water and soil/sediment in the approximate respective percentages; Air: <5% Water: 50 - 70% Soil: 30 - 50% This preparation or material is not expected to bioaccumulate
Alfloc 3443	Nalco	Coolant premix	0.2	This product has no known ecotoxicological effects	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.	If released into the environment this material is expected to distribute to the air, water and soil/sediment in the approximate respective percentages; Air: <5%

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity:	Chronic toxicity:	Biodegradation bioaccumulation:
						Water: 30 - 50% Soil: 50 - 70% The portion in water is expected to be soluble or dispersible. Based on the hazard characterization, the potential environmental hazard is: Low
EC2211A	Nalco	Demulsifier	0.0010	Heavy Aromatic Naphtha LC50 Oncorhynchus mykiss (rainbow trout): 3.5 mg/l Exposure time: 96 h	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.	If released into the environment this material is expected to distribute to the air, water and soil/sediment in the approximate respective percentages; Air: 10 - 30% Water: 30 - 50% Soil: 30 - 50% Based on the suppliers hazard characterization, the potential environmental hazard is: Low

A.1.5 Contingency Chemical List

Chemicals within Products	CAS number	Mass fraction (%)
1,2,4-Trimethylbenzene	95-63-6	0.00005%
2-Butoxyethanol	111-76-2	0.01%
Aluminum Chloride Hydroxide	12042-91-0	0.0009%
Amine Triphosphate	56-65-5	0.0015%
Ethylbenzene	100-41-4	0.00005%
Ethylene Glycol	107-21-1	0.00012%
Heavy Aromatic Naphtha	64742-94-5	0.0016%
Hydrotreated Heavy Naphtha	64742-48-9	0.0003%
Methanol	67-56-1	0.0003%
Naphthalene	91-20-3	0.00015%
Sodium Phosphate, Tribasic	7601-54-9	0.0075%
Xylene	1330-20-7	0.00005%

A.2 Well Intervention Solution

A.2.1 System Details

System	Total Volume of System
Well Test / Intervention Solution	14.3 kL

A.2.2 Product List

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity	Chronic toxicity	Biodegradation bioaccumulation
Idcide 20	Newpark Drilling Fluids	Biocide	0.05%	TETRAKIS(HYDROXYMETHYL)PHOSPHONIUM SULPHATE (55566-30-8) LD50 (ingestion) 248 mg/kg (rat) TDLo (ingestion) 650 mg/kg/13 weeks - intermittent (rat) LC50 (Rainbow Trout) = 119 mg/L/96 hr LC50(Bluegill Sunfish) = 93 mg/L/ 96 hr EC50 (Daphnia Magna) = 19 mg/L/48 hr LC50 (Brown Shrimp) = 340 mg/L/96 hr LC50 (Mysid Shrimp) = 9.5 mg/L/96 hr LC50 (Sheepshead Minnow) = 94 mg/L/96 hr LC50 (Jevenile Plaice) = 86 mg/L/96 hr Waste Water management EC50 (Activated Sludge) = 24 mg/L/3 hr	Low to moderate irritant. Over exposure to vapours may result in irritation of the nose and throat, with coughing. High level exposure may result in dizziness, nausea and headache. Due to the low vapour pressure, an inhalation hazard is not anticipated with normal use	This product is readily biodegradable.
Sodium Sulphite	Newpark Drilling Fluids	Oxygen scavenger	0.27%	Oral Toxicity (LD50) Dermal Toxicity (LD50) Inhalation Toxicity (LC50) SODIUM SULPHITE 820 mg/kg (mouse) -- -- SODIUM SULPHATE 5989 mg/kg (mouse) -- --	Not classified as causing skin or respiratory sensitisation. Some individuals are hypersensitive to sulphites, and may experience asthma like symptoms (wheezing and shortness of breath) immediately following exposure.	Biodegradability does not pertain to inorganic substances. This product does not bioaccumulate

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity	Chronic toxicity	Biodegradation bioaccumulation
				SODIUM CARBONATE 4090 mg/kg (rat) > 2000 mg/kg (rabbit) 800 mg/mÑ/2 hours Skin Not classified as a skin irritant. Contact may result in mild irritation, redness, rash and dermatitis. Eye Causes serious eye damage. Contact may result in irritation, lacrimation, pain and redness. Additional ingredient toxicity value(s): SODIUM SULPHITE (7757-83-7) LD50 (intraperitoneal) 950 mg/kg (mouse) LD50 (intravenous) 175 mg/kg (mouse) LDLo (intravenous) 400 mg/kg (cat) LDLo (oral) 2825 mg/kg (rabbit) LDLo (subcutaneous) 600 mg/kg (rabbit) SODIUM SULPHATE (7757-82-6) LD50 (intravenous) 1220 mg/kg (rabbit) LDLo (intravenous) 1220 mg/kg (mouse) TDLo (oral) 14 g/kg (mouse - 8-12 days pregnant) TDLo (subcutaneous) 806 mg/kg/26 weeks intermittently (mouse) SODIUM CARBONATE (497-19-8) LD50 (intraperitoneal) 117 mg/kg (mouse) Sensitisation Not classified as causing skin or respiratory sensitisation. Some individuals are		

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity	Chronic toxicity	Biodegradation bioaccumulation
				hypersensitive to sulphites, and may experience asthma like symptoms (wheezing and shortness of breath) immediately following exposure. STOT – single Over exposure may result in mucous membrane irritation of the respiratory tract, with coughing. exposure Aspiration Not classified as causing aspiration.		
Potassium Chloride	Redox / Condor	Salt – Clay Control	2.55%	Fathead minnow LC50/96hr (Fish): 880mg/L Daphnia magna LC50/48hr: 357mg/L Daphnia magna EC50/48hr: 141mg/L	Not included in NTP 11th report on Carcinogens. Not classified by IARC, OSHA, EPA. No adverse effect were observed on fertility and/or on the development.	Biodegradation is not relevant for inorganic substance Bioaccumulation is not likely to occur since this material is highly soluble in water
Water	Site Bore	Base Fluid	97.13	N/a		
Total			**100**			

A.2.3 Chemical List

Chemicals within Products	CAS number	Mass fraction (%)
Water	7732-18-5	99.2623%

Chemicals within Products	CAS number	Mass fraction (%)
Potassium Chloride	7447-40-7	2.52%
Sodium Chloride	647-14-5	0.12%
Tetrakis(hydroxymethyl) Phosphonium Sulfate	55566-30-8	0.0125%
Sodium Sulphite	7757-83-7	0.2619%
Sodium Sulphate	7757-82-6	0.00675%
Sodium Carbonate	497-19-8	0.0002%
Total		**100.0000**

A.2.4 Contingency Well Intervention Chemicals

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity:	Chronic toxicity:	Biodegradation bioaccumulation:
CA370FE	Nalco Champion	Iron Control Additive	0.02%	Component 1 - Sodium erythorbate Acute Toxicity: Fish: LC50 (48h) 5.25 mg/L; Invertebrate: EC50 (24h) 1.3 mg/L; Algae: EC50 (72h) 86.2 mg/L	Component 1 - Sodium erythorbate No known carcinogenic properties or chronic impacts	Component 1 - Sodium erythorbate Log Kow -1.88 The environmental fate was estimated using a level III fugacity model embedded in the PlanI (estimation program interface) SuiteTM, provided by the US EPA. If released into the environment this material is expected to distribute to the air, water and soil/sediment in the

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity:	Chronic toxicity:	Biodegradation bioaccumulation:
						approximate respective percentages; Air <1% Water 30-60% Soil/Sediment 60-90% The portion in water is expected to be soluble or dispersible. This preparation or material is not expected to bioaccumulate
Soda Ash Alkaline Salt	Redox	Neutraliser	0.05%	LD50 (oral): 4090 mg/kg (rat) LD50 (dermal): >2000mg/kg (rabbit) Toxicity to fish LC50 – Lepomis macrochirus (Bluegill) – 300mg/l – 96h Toxicity to daphnia and other aquatic invertebrates C50 – Daphnia magna (Water flea) – 265 mg/l – 48 h	This product for not contain and substances that are considered by OSHA, NTP, IARC or ACGIH to be probably or suspected human carcinogens.	Biodegradability does not pertain to inorganic substances. Does not bioaccumulate
CF210PH	Nalco Champion	Fracturing Additive	0.24%	This product has no known ecotoxicological effects Toxicity to fish LC50 (96 h) Fish- > 100 mg/l Based on the suppliers hazard characterization, the potential environmental hazard is: Low		The environmental fate was estimated using a level III fugacity model embedded in the Plan (estimation program interface) Suite TM, provided by the US EPA. If released into the environment this material is expected to distribute to the air, water and soil/sediment in the approximate respective

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity:	Chronic toxicity:	Biodegradation bioaccumulation:
						percentages; Air: <5% Water: 30 - 50% Soil:50 - 70%
CF600CI	Condor	Acid Corrosion Inhibitor	0.27%	Component 1 Formic Acid Leuciscus idus (Fish)- LC50 (48 h) 122 mg/L D. Magna (Invertebrate)- EC50 (48 h) 120 mg/L Scenedesmus quadricauda (Algae)- EC50 (72 h) 26.9 mg/L LD50 (rat)- 730 mg/kg Chronic Toxicity: Component 2 Cinnamaldehyde Scop (Fish)- LC50 (96 h) 1-10 mg/L; Acar (Invertebrate)- LC50 (48 h) 1-10 mg/L; Skel (Algae)- EC50 (72 h) 1-10 mg/L Chronic Component 3 Tar bases, quinoline derivs, benzyl chloridequaternized Scop (Fish)- LC50 (96 h) 10-100 mg/L; Acar (Invertebrate)- LC50 (48 h) 1-10 mg/L; Skel (Algae)- EC50 (72 h) 1-10 mg/L Chronic Component 4 Isopropanol	Component 1 Formic Acid No known carcinogenic properties or chronic impacts Component 2 Cinnamaldehyde No known carcinogenic properties or chronic impacts Component 3 Tar bases, quinoline derivs, benzyl chloridequaternized No known carcinogenic properties or chronic impacts Component 4 Isopropanol No known carcinogenic properties or chronic impacts Biodegradation/bioaccumulation: Component 5 N-Benzyl-Alkylpyridinium Chloride No known carcinogenic properties or chronic impacts	Component 1 Formic Acid Log Pow -0.54 Biodegradation: 100% (11 d) readily biodegradable Component 2 Cinnamaldehyde Log Pow 2.22 @18C Biodegradation: 91% (14 d) activated sludge for cinnamyl alcohol (cinnamylaldehyde is metoblite of cinnamyl alcohol so would also be readily biodegradable) Component 3 Tar bases, quinoline derivs, benzyl chloridequaternized Log Pow >3 Biodegradation: 41% (28 d)

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity:	Chronic toxicity:	Biodegradation bioaccumulation:
				Pimephales promelas(Fish)- LC50 (96 h) 9640 mg/L; Daphnia Magna (Invertebrate)- EC50 (48 h) 13299 mg/L Scenedesmus subspicatus(Algae)- EC50 (96 h) >1,000 mg/L LD50 (rat)- 4396 mg/kg Chronic Toxicity: Component 5 N-Benzyl-Alkylpyridinium Chloride Acar (Invertebrate)- LC50 (48 h) 10-100 mg/L (WAF); Skel (Algae)- EC50 (72 h) 1-10 mg/L (WAF)		Component 4 Isopropanol Log Pow 0.05 @ 25C; Biodegradation: 95% (21d) readily biodegradable Component 5 N-Benzyl-Alkylpyridinium Chloride Log Pow 2.9-4.8 (avg 4.0 Biodegradation: 34% (28 d)

A.2.5 Contingency Chemical List

Chemicals within Products	CAS number	Mass fraction (%)
1,2,4-Trimethylbenzene	95-63-6	0.0027%
Cinnamaldehyde	104-55-2	0.07%
Citric Acid	77-92-9	0.144%
Formic Acid	64-18-6	0.15%
Heavy Aromatic Naphtha	64742-94-5	0.002%

Chemicals within Products	CAS number	Mass fraction (%)
Isopropanol	67-63-0	0.02%
Methanol	67-56-1	0.002%
Naphthalene	91-20-3	0.0027%
N-Benzyl-Alkylpyridinium Chloride	68909-18-2	0.002%
Sodium carbonate anhydrous	497-19-8	0.05%
Sodium erythorbate	6381-77-7	0.02%
Tar Bases, Quinoline Derivatives, Benzyl Chloride-Quat	72480-70-7	0.07%

A.3 Freshwater Production (Reverse Osmosis) System

A.3.1 System Details

System	Total Volume of System
Freshwater Production System	200-2000 L(per day) Or throughput of minimum 73 000 L per year

A.3.2 Product List

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity	Chronic toxicity	Biodegradation bioaccumulation
PermaClean PC98	Nalco	Alkaline Cleaner	0.011%	No toxicity studies are available.	None of the substances in this product are listed as carcinogens by the NTP, IARC or ACGIH to be probably or	The environmental fate was estimated using a level III fugacity model embedded in the PlanI (estimation

Product Name	Supplier	Purpose	Volume in System (%)	Toxicity and Ecotoxicity		
				Acute environment toxicity	Chronic toxicity	Biodegradation bioaccumulation
					suspected human carcinogens.	program interface) SuiteTM, provided by the US EPA. If released into the environment this material is expected to distribute to the air, water and soil/sediment in the approximate respective percentages; Air <5% Water 30-50% Soil/Sediment 30-50% The portion in water is expected to be soluble or dispersible
PermaTreat PD510T	Nalco	Scale Inhibitor	0.252%	No toxicity studies are available. Based on the suppliers hazard characterization, the potential environmental hazard is: Low	None of the substances in this product are listed as carcinogens by the NTP, IARC or ACGIH to be probably or suspected human carcinogens.	
Citric Acid monohydrate	Redox	Descaler	0.0055%	Fathead minnow LC50/96hr : GT 1000mg/L Water Flea LC50/96hr : GT 1000mg/L Golden orfe (minnow) LC50/48hr : 760mg/L		Easily degradable. Air pollution: 50mg/m^3 for a mass emission > 0.5Kg/hr
Water	Site Bore	Freshwater source	99.7316%	N/a		
Total			**100%**			

A.3.3 Chemical List

Chemicals within Products	CAS number	Mass fraction (%)
Bore water	7732-18-5	99.994
Tetrasodium EDTA	64-02-8	0.0005
Citric Acid Monohydrate	5949-29-1	0.0055%
Total		**100.0000**


RCMA SDS List 1.pdf


RCMA SDS List 2.pdf