Yara Pilbara Fertilisers Pty Ltd

Application for Licence
Part V, Division 3, *Environmental Protection Act 1996*

Ammonia Plant
Burrup Peninsula

17 October 2019

56928/123286 (Rev 1)

JBS&G Australia Pty Ltd T/A Strategen-JBS&G

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Abbreviations

Term	Definition
BMIE	Burrup and Maitland Industrial Estates
CALM	Conservation and Land Management
CEMS	Continuous Emissions Monitoring System
CEO	Chief Executive Officer
CGA	Cylinder Gas Audit
DEC	Department of Environment and Conservation
DGJS	Deep Gorge Joint Statement
DJTSI	Department of Jobs, Tourism, Science and Innovation
DMIRS	Department of Mines, Industry Regulation and Safety
DoEE	Department of Environmental and Energy
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
EP	Environmental Protection
EPA	Environmental Protection Authority
EPBC	Environment Protection and Biodiversity Conservation
EQC	Environmental Quality Criteria
EQMF	Environmental Quality Management Framework
FAT	Factory Acceptance Testing
GLC	Ground Level Concentration
HDPE	High Density Polyethylene
MAC	Murujuga Aboriginal Corporation
MDEA	Methyl Diethanolamine
MHF	Major Hazards Facility
MRASRG	Murujuga Rock Art Stakeholder Reference Group
MS	Ministerial Statement
MUBRL	Multi User Brine Return Line
OMEMP	Operational Marine Environmental Management Plan
PER	Public Environment Review
RATA	Relative Accuracy Test Audit
STP	Sewage Treatment Plant
TAN	Technical Ammonium Nitrate
TN	Total Nitrogen
TP	Total Phosphorous
USEPA	United States Environmental Protection Authority
WA	Western Australia
YPF	Yara Pilbara Fertilisers
YPN	Yara Pilbara Nitrates

1. Introduction

1.1 Background

Yara Pilbara Fertilisers Pty Ltd (YPF) operates a liquid ammonia plant (Ammonia Plant) located on Lot 564 Village Road on the Burrup Peninsula. The Ammonia Plant has been operating since 2006 and produces 950,000 tonnes of anhydrous liquid ammonia per year using the KBR (Kellogg Brown & Root) purifier process.

The Ammonia Plant currently operates under Licence L7997/2002/11 granted by the Department of Water and Environmental Regulation (DWER) under Part V of the *Environmental Protection Act 1986* (EP Act). Licence L7997/2002/11 was issued on 21 April 2015 and last amended on 29 June 2018 to include the operation of the Yara Pilbara Nitrates Pty Ltd Technical Ammonium Nitrate (TAN) Plant under a combined licence (current licence).

The current licence will expire on 20 April 2020. Accordingly, a new licence application is required.

There have been no changes to the operation of the Ammonia Plant since the assessment by DWER for the current licence issued on 29 June 2018.

Through this application, YPF is seeking grant of a materially equivalent licence for the Ammonia Plant as presently authorised under the current licence. In effect, this will extend the current licence duration beyond the existing licence term of 20 April 2020. It is intended that the current licence (which licenses both the Ammonia Plant and the adjacent TAN Plant) will be replaced by a separate licence for each of the Ammonia Plant and the TAN Plant.

1.2 Regulatory framework

The EP Act is the principle legislation in WA that provides for "*the prevention, control and abatement of pollution and environmental harm*" and for "*the conservation, preservation, protection, enhancement and management of the environment*".

The object of the EP Act is to protect the environment of the state, having regard to a number of principles, including:

1. The precautionary principle, which holds that where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, decisions are to be guided by:
    a. careful evaluation to avoid, where practicable, serious or irreversible damage to the environment
    b. an assessment of the risk weighted consequences of various options.
2. The principle of intergenerational equity, which holds that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.
3. The principle of waste minimisation, which holds that all reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.
4. Principles relating to improved valuation, pricing and incentive mechanisms, which include the 'polluter pays principle' whereby those who generate pollution and waste should bear the costs of containment, avoidance or abatement.

The object and principles guide the overall application of the powers of the EP Act, and have been considered in the preparation of this application.

1.2.1 Part IV of the EP Act

Under Part IV of the EP Act, the Environmental Protection Authority (EPA) is responsible for assessing proposals that have a significant effect on the environment and reporting to the Minister for Environment on whether proposals should be implemented. The EPA also recommends conditions to mitigate the detrimental impact on the environment that a proposal may cause.

The EPA is required to have regard for the objects and principles of the EP Act, outlined above, as a condition of the valid exercise of its powers to assess and report on proposals under Part IV of the EP Act. The EPA encourages the application of all reasonable and practical measures to minimise harmful emissions to air, which can include facility design, technology choice, operation and closure. 'Reasonable and practical' measures include those that are reasonably practicable, having regard to, among other things, local conditions and circumstances (including costs) and the current state of technical knowledge.

The Ammonia Plant was assessed under Part IV of the EP Act and is subject to conditions under Ministerial Statement (MS) 586. The EPA's assessment of the proposal considered the principles of the EP Act and the application of Best Available Technology (BAT) to the plant (EPA 2001).

The Ministerial Statement was amended in August 2015 under Section 45C of the EP Act to authorise an increase in production capacity from 2,200 tpd to no more than 2,600 tpd.

An integral component of the operation of the Ammonia Plant is the supply of seawater and desalinated water, and the discharge of liquid waste to King Bay via the Multi-User Brine Return Line (MUBRL), as part of the Water Corporation's Desalination and Seawater Supplies Project. The Water Corporation holds MS 567 and MS 594 for the use of the MUBRL to discharge industrial wastewater to King Bay.

Section 57(4) of the EP Act provides that the determination of an application for a licence shall not be contrary to or otherwise than in accordance with a Ministerial Statement (i.e. the new licence must be in accordance with both Ministerial Statements 586, and 567 and 594). It is not the intention of the EP Act that a licence issued under Part V duplicate the requirements imposed under Part IV of the EP Act.

The requirements of the Ministerial Statements have been considered in the preparation of this application.

1.2.2 Part V of the EP Act

The DWER regulates industrial emissions and discharges to the environment through a works approval and licensing process under Part V of the EP Act. The principles of the EP Act guide DWER's environmental regulatory functions.

Industrial premises with potential to cause emissions and discharges to air, land or water are known as prescribed premises and trigger regulation under the EP Act. Prescribed premises categories are outlined in Schedule 1 of the Environmental Protection Regulations 1987 (EP Regulations). The EP Act requires a works approval to be obtained before constructing a Prescribed Premises and makes it an offence to cause an emission or discharge unless a licence or registration is held for the premises.

Pursuant to section 62(1) of the EP Act, conditions may be imposed on a licence for the purposes of the EP Act relating to the prevention of, control, abatement or mitigation of pollution or environmental harm. In preparing this application, consideration has been given to appropriate controls that comply with this legislative requirement.

As noted above, the EP Act requires that licences must be in accordance with or not inconsistent with a Ministerial Statement. Additionally, section 57(3)(b) of the EP Act provides that, where the prescribed premises have been constructed in accordance with the requirements of a works approval issued under Part V of the EP Act, a licence must be granted and must be granted subject to conditions that are not inconsistent with the conditions imposed on the works approval. The Ammonia Plant was constructed in accordance with Works Approvals W3589/2002/1, W3791/2002/1 and W3838/2002/1 granted between May 2002 and October 2013. The requirements of these works approvals have been considered in the preparation of this application.

YPF hold Licence L7997/2002 for the operation of the Ammonia Plant. The licence was first granted in 2005. The licence was amended in June 2018 to include the adjacent TAN Plant.

In preparing this application, YPF has reviewed any changes in the relevant regulatory framework since the grant of the current licence. No significant changes were identified; therefore, the previous environmental assessments (including, where available, DWER decision reports) have been considered in the preparation of this application.

1.2.3 Legislative framework for assessing and managing potential impacts on rock art (petroglyphs)

Murujuga (the Dampier Archipelago, including the Burrup Peninsula and surrounds) is a unique ecological and archaeological area containing one of the largest collections of Aboriginal engraved rock art in the world. The rock art (petroglyphs) are of immense cultural and spiritual significance to Aboriginal people, and of national and international heritage value.

Existing legislative mechanisms and agreements that provide for the protection of the rock art on Murujuga are summarised in Table 1.1.

Table 1.1: Existing State and Commonwealth mechanisms and agreements that provide for the protection of the rock art on Murujuga

Mechanism and (responsible government)	Date	Summary of the provisions for the protection of the rock art on Murujuga
Aboriginal Heritage Act 1972 (AH Act) (WA)	Various	The Department of Planning, Lands and Heritage (DPLH) maintains a Register of Aboriginal Places and Objects that includes more than 2,800 records for Murujuga. However, many more on Murujuga have not yet been registered. It is an offence under s.17 of the AH Act to excavate, destroy, damage, conceal or otherwise alter any Aboriginal site unless authorised by the Registrar of Aboriginal Sites (s.16) or the Minister for Aboriginal Affairs (s.18). Section 19 of the AH Act provides for the declaration and gazettal of Protected Areas, which are Aboriginal sites of 'outstanding importance'. Once an area has been gazetted as a Protected Area, regulations may be made prohibiting or imposing conditions or restrictions on use of the Protected Area and activities (s.26). There are two areas on Murujuga declared as Protected Areas under s.19: the 'Climbing Men' site near Withnell Bay and the northern portion of the Burrup Peninsula. Section 15 of the AH Act requires the reporting to the Registrar of the location of anything to which there is a reasonable expectation the AH Act might apply.
Burrup and Maitland Industrial Estates Agreement Implementation Deed (the BMIEA Agreement) (WA)	January 2003	The State Government entered into the BMIEA Agreement with three Aboriginal groups (the Ngarluma Yindjibarndi, the Yaburara-Mardudhunera and the Wong-Goo-Tt-Oo) in 2003. The BMIEA Agreement enabled the State Government to acquire native title rights and interests in the Burrup Peninsula and parcels of land near Karratha. The BMIEA Agreement allows for industrial development to progress at the southern end of the Burrup Peninsula, provided for the development of newly created conservation estate (Murujuga National Park) and ensures the protection of Aboriginal heritage. The Department of Jobs, Tourism, Science and Innovation (JTSI) is the lead agency for the development of the Burrup Strategic Industrial Area and LandCorp is the estate manager.
Burrup Maitland Industrial Estates Agreement Additional Deed (WA)	January 2003	The State Government committed to organise and fund a minimum four-year study into the effects of industrial emissions on rock art within and near part of the industrial estate on the Burrup Peninsula.

Mechanism and (responsible government)	Date	Summary of the provisions for the protection of the rock art on Murujuga
Listing of the Dampier Archipelago as a National Heritage Place – Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (Cwlth)	July 2007	The EPBC Act contains provisions relating to the listing of national heritage. The national heritage management principles are set out in Schedule 5B of the *Environment Protection and Biodiversity Conservation Regulations 2000* and in the document *Australia's National Heritage: Applying the Principles*. The Dampier Archipelago was assessed by the Australian Heritage Council in 2007 and found to meet five of the eight criteria for national heritage listing under the EPBC Act. The listing of the Dampier Archipelago 'recognised the extraordinary extent, diversity and significance of petroglyphs, standing stones and circular stone arrangements of the place'. National heritage listing means that any proposed action that could have a significant impact on the National Heritage listed portion of the Burrup Peninsula must be referred to the Commonwealth Minister for the Environment as a matter of national environmental significance for assessment and decision.
EPBC Act Conservation Agreements (Cwlth)	July 2007	At the time of listing on the National Heritage List, EPBC Act Conservation Agreements were signed by the then Commonwealth Minister for the Environment and Water Resources with Woodside Energy Ltd, and with Hamersley Iron Pty Ltd and Dampier Salt Ltd (Rio Tinto). Under the agreements, these companies provide funding for research, management and monitoring of the National Heritage values of the place.
Ministerial Statement No. 757 Pluto Liquefied Natural Gas Development (Pluto LNG) (Woodside Energy Ltd) (WA)	December 2007	The offsets package for Pluto LNG required the rehabilitation/restoration of degraded areas that fall both outside of the lease and outside of areas of potential industrial development on the Burrup Peninsula, with a focus on Murujuga National Park and adjacent areas. The program initiated as a result of this requirement aims to rehabilitate and restore degraded areas on the Burrup Peninsula. It includes rock art site rehabilitation and restoration.
EPBC Act Approval (EPBC 2008/4546) for the Construction of the Technical Ammonium Nitrate Production Facility (TANPF) (Yara Pilbara Pty Ltd) (Cwlth)	September 2011 (variations were approved under the EPBC Act in 2013, 2014 and 2017)	The Commonwealth Minister for the Environment determined the proposal for the construction of the TANPF was a controlled action under the EPBC Act for likely impacts to the National Heritage Place. The Commonwealth Minister for the Environment approved the proposed action, with conditions relating to the protection of the National Heritage Place, including: Δ contributing funds towards the implementation of the rock art monitoring program and reporting of results; Δ providing the Department of the Environment and Energy (DoEE) with a management plan in the event that accelerated changes in the rock art are detected; and Δ air-quality monitoring and emissions limits.
Murujuga National Park established (WA)	January 2013	Murujuga National Park, covering 4,913 hectares, is freehold land on Murujuga owned by the Murujuga Aboriginal Corporation (MAC) and leased back to the State Government. The granting of title to the non-industrial lands of the Burrup Peninsula was a result of the Burrup Agreement. Murujuga National Park is jointly managed by the Department of Biodiversity, Conservation and Attractions (DBCA) Parks and Wildlife Service and MAC through a partnership arrangement that operates under the provisions of the *Conservation and Land Management Act 1984* (CALM Act). Together, the CALM Act and the Conservation and Land Management Regulations 2002 provide for the formal protection of the park's values. Amendments to the CALM Act in 2012 allowed for: • joint management of Aboriginal land by DBCA • the addition of a management objective for DBCA-managed land to protect and conserve the value of the lands and waters to the culture and heritage of Aboriginal people • Aboriginal people to undertake certain customary activities on DBCA-managed lands and waters. The focus of the Murujuga National Park Management Plan (2013) is to ensure protection and awareness of the cultural and natural values of the area.
The Deep Gorge Joint Statement (DGJS) (Cwlth)	July 2017	The DGJS, signed by the Australian Government, Woodside and Rio Tinto, reaffirms the commitments made under each of the bilateral Conservation Agreements to support the ongoing protection, conservation and management of the National Heritage values of Murujuga and the wider Dampier Archipelago.

In September 2019, the EPA published Report 1648, which considered the protection of rock art within the context of a review of MS 870 (which regulates the TAN Plant). The EPA, in applying the precautionary principle, found that "*there is currently no compelling scientific evidence which indicates that there is an immediate material threat of serious or irreversible damage to rock art from cumulative industrial air emissions within the Murujuga airshed*", and further that "*there is sufficient time for the monitoring and evaluation activities associated with the Murujuga Rock Art Monitoring Program to be undertaken and for definitive information in regard to whether cumulative industrial air emissions within the Murujuga airshed are adversely affecting rock art to be obtained*".

1.2.3.1 Murujuga Rock Art Strategy

The Minister for Environment released the Murujuga Rock Art Strategy in February 2019 (DWER 2019). The strategy establishes the framework for the long-term management and monitoring of environmental quality to protect the rock art on Murujuga (the Dampier Archipelago and Burrup Peninsula) from the impacts of anthropogenic emissions that is consistent with the state government's responsibilities under the EP Act.

1.2.3.2 Environmental Quality Management Framework

An Environmental Quality Management Framework (EQMF) will be implemented as part of the Murujuga Rock Art Strategy to provide a transparent, risk-based, and adaptive framework for monitoring and managing environmental quality to protect the rock art on Murujuga from anthropogenic emissions.

The EQMF will establish a common and agreed Environmental Quality Objective and scientifically based limits of 'acceptable' change. The successful implementation of the EQMF will require:

- the application of Environmental Quality Criteria (EQC) that are based on sound scientific information
- a monitoring program that is appropriately designed and implemented to make the necessary measurements, to analyse the data and to report on the integrity or condition of the rock art and change in that condition
- a governance process that enables information to be assessed and appropriate management actions to be implemented.

There are currently no existing or default guideline 'trigger values' for protecting the rock art from anthropogenic emissions that could be used as EQC. The development of interim EQC, based on the best available scientific information at the time, will be informed by the monitoring studies undertaken to underpin the design of the Murujuga Rock Art Monitoring Program.

1.2.3.3 Murujuga Rock Art Stakeholder Reference Group

The Murujuga Rock Art Stakeholder Reference Group (MRASRG) was established by the Minister for Environment in September 2018 to facilitate engagement between the Murujuga Aboriginal Corporation (MAC) and key government, industry, and community representatives on the development and implementation of the Murujuga Rock Art Strategy.

The role of the MRASRG is to:

- contribute constructively to the monitoring and protection of rock art, being considerate of all stakeholder views and provide advice to the DWER and the Minister for Environment on the design, implementation and analysis of the scientific monitoring and analysis program
- consult, inform, and educate other stakeholders on matters referred by the DWER for input or comment, including further development of the strategy, implementation of the strategy, and five yearly reviews

- inform the government's broader consideration of other strategic issues relating to the protection of the rock art on Murujuga.

1.2.3.4 Murujuga Rock Art Monitoring Program

The DWER is partnering with the MAC to oversee the development and implementation of a rock art monitoring program to determine whether the rock art on Murujuga is being subject to accelerated change. The purpose of the Murujuga Rock Art Monitoring Program is to monitor, evaluate, and report on changes and trends in the integrity of the rock art, specifically to determine whether anthropogenic emissions are accelerating the natural weathering, alteration, or degradation of the rock art. This will enable timely and appropriate management responses by the state government, industry, and other stakeholders to emerging issues and risks.

The objectives of the Murujuga Rock Art Monitoring Program are to:

- obtain data for comparison against the EQC to ascertain whether the Environmental Quality Objective is being achieved and the environmental value (the rock art) protected
- provide the state government, the MAC, industry, and the community with robust, replicable and reliable information on changes and trends in the integrity or condition of the rock art on Murujuga
- ensure decisions regarding the protection of the rock art are based on the best available science
- inform the evaluation of the effectiveness of any measures taken to mitigate adverse effects on the rock art, including efforts to protect the rock art.

It is considered that the Murujuga Rock Art Monitoring Program (undertaken in accordance with the Murujuga Rock Art Strategy and EQMF) is an appropriate precautionary approach to managing the risk of impacts to rock art. Further, that the imposition of more restrictive emissions requirements in advance of the Murujuga Rock Art Monitoring Program is both unnecessary and inappropriate in terms of the legislative requirements of section 62(1) of the EP Act

If the Murujuga Rock Monitoring Program results identify (on an individual site or cumulative basis) the need for further regulatory controls, such an outcome can be facilitated through a licence amendment process under section 59 of the EP Act.

1.2.4 Contaminated sites

The Ammonia Plant (Lot 564) was classified as 'possibly contaminated – investigation required' under the *Contaminated Sites Act 2003* on 17 February 2016. This contamination classification relates to a spill of approximately 11 kilolitres of process condensate containing up to 37% of activated methyl diethanolamine (MDEA) in July 2015.

A targeted site investigation and an ecological and human health risk assessment have been completed for MDEA as part of the spill response and remedial works. The monitoring of any residual contamination occurs through ongoing groundwater monitoring (refer to Section 6.3.1).

1.2.5 Department of Mines, Industry Regulation and Safety (DMIRS)

The Ammonia Plant includes several infrastructure items used for the storage and processing of chemicals. The premises is considered a Major Hazard Facility and is subject to the requirements of the Dangerous Good Safety (Major Hazard Facilities) Regulations 2007. The appropriate dangerous goods licences have been obtained under the *Dangerous Goods Safety Act 2004* (refer to Table 1.2).

The Department of Mines, Industry Regulation and Safety (DMIRS) is the primary regulatory authority for regulating public health risks associated with the storage and handling of dangerous goods, including the risk of explosion.

The requirements of the *Dangerous Goods Safety Act* 2004 and Dangerous Goods Site Licence DSG021976 have been considered in the preparation of this application. It is not intended that the new licence duplicate these requirements, and this application has been prepared on that basis.

1.2.6 Approvals summary

Approvals relevant to the Ammonia Plant are listed in Table 1.2 below.

Table 1.2: Approvals

Legislation	Number	Approval holder	Approval
Environmental Protection Act 1986	Ministerial Statement Number 586 (MS 586)	Yara Pilbara Fertilisers Pty Ltd (formerly, Burrup Fertilisers Pty Ltd)	For construction and operation of an ammonia plant on the Burrup Peninsula. Granted 20 February 2002. Available from www.epa.wa.gov.au.
	Section 45C amendments		MS 586 was amended on 13 December 2005 and 11 September 2006. Amendments included alteration of Schedule 1 start-up steam generation and modifications to pipeline management. Schedule 1 of MS 586 was amended to authorise an increase in production capacity and associated emissions and discharges. Regulation of emissions and discharges were referred to Part V of the EP Act (WA). Granted on 5 August 2015. Available from www.epa.wa.gov.au.
	Ministerial Statement Number 594 (MS 594) & Previous ministerial Statement Number 567 (MS 567)	Water Corporation	To construct and operate a seawater supply and desalination system to service the requirements of industry on the Burrup Peninsula. Multi-User Brine Return Line (MUBRL) discharges to King Bay. Granted on 22 June 2001 and amended on 5 June 2002. Available from www.epa.wa.gov.au.
	L7997/2002/11	Yara Pilbara Fertilisers Pty Ltd and Yara Pilbara Nitrates Pty Ltd	Licence regarding emissions and discharges from the Ammonia Plant and TAN Plant. Available from www.dwer.wa.gov.au.
Dangerous Goods Safety Act 2004	DGS021976	Yara Pilbara Fertilisers Pty Ltd	Dangerous Goods Site Licence issued 31 August 2011. Expiry 1 September 2021.
	DPL001065		Dangerous Goods Pipeline Registration issued 22 May 2015. Expiry 1 June 2020.
Dangerous Goods Safety (Major Hazard Facilities) Regulations 2007	Approved Safety Report	Yara Pilbara Fertilisers Pty Ltd	Safety Report approved on 14 May 2015.

1.3 Integrated Management of Yara Pilbara Operations

Yara Australia Pty Ltd (Yara), which is a wholly owned subsidiary of Norwegian owned Yara International ASA, is the operator of both the Ammonia Plant and TAN Plant pursuant to the terms of an operations management deed. The Ammonia Plant is 100% owned by Yara Australia Pty Ltd. The TAN Plant is owned by YPN, which is an incorporated joint venture that is owned 50% by Orica Investments Pty Ltd (Orica Investments) (a subsidiary of Australian explosives manufacturer Orica Limited (Orica)) and 50% by Yara Australia Pty Ltd.

The company structure chart is shown in Figure 1.1.

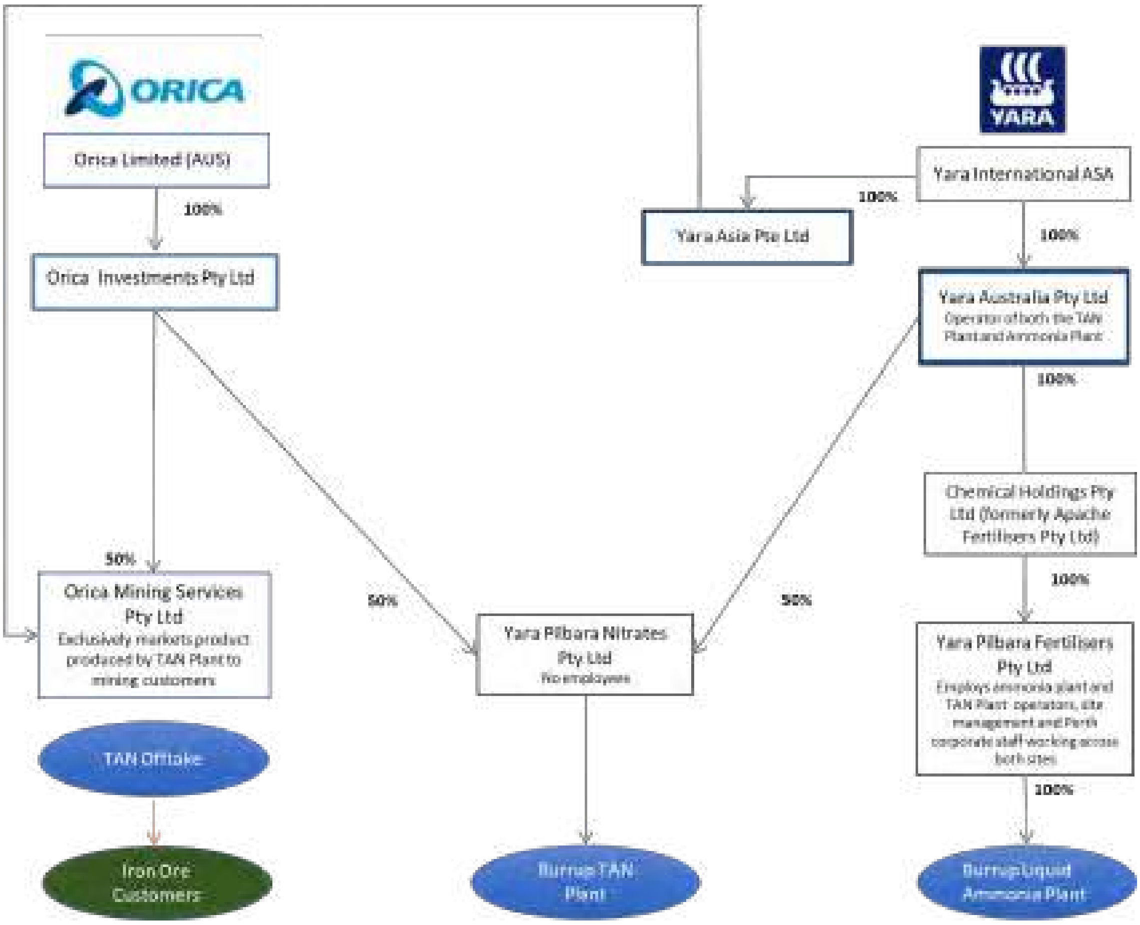


Figure 1.1: Company structure

The Ammonia Plant and TAN Plant are run as an integrated site and all employees are directly employed by YPF (a wholly owned subsidiary of Yara). This includes site management, Ammonia Plant and TAN Plant operators, maintenance staff and Perth based corporate staff.

The organisation structure for the Ammonia Plant and TAN Plant is illustrated in Figure 1.2.

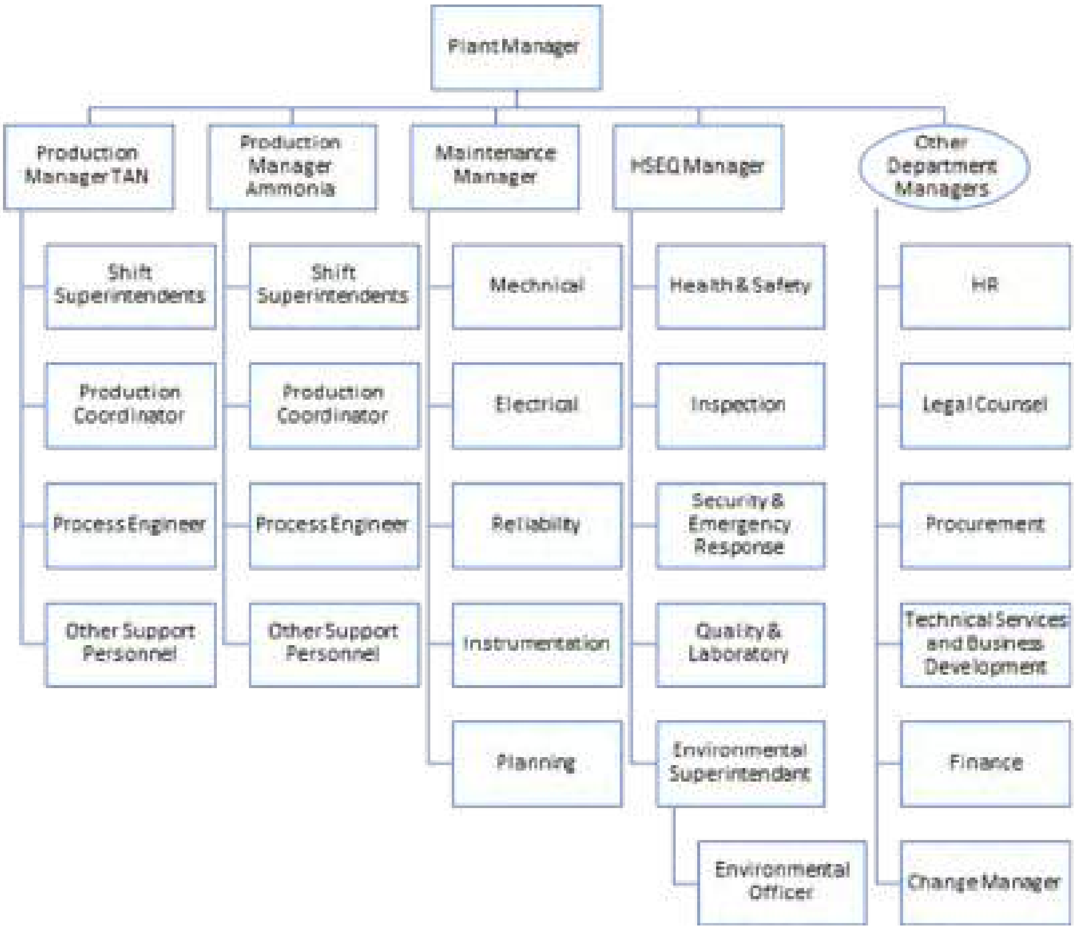


Figure 1.2: Yara Pilbara management structure as relevant to the Ammonia Plant operations

1.4 Purpose and scope

This document supports YPF's application for a new licence to operate the Ammonia Plant. The following categories of prescribed premises listed in Schedule 1 of the EP Regulations apply to the Ammonia Plant.

Table 1.3: Prescribed premises categories

Category number	Description of category	Production or design capacity threshold	Ammonia Plant production or design capacity
31	Chemical manufacturing: premises (other than premises within category 32) on which chemical products are manufactured by a chemical process	100 tonnes or more per year	950,000 tonnes per year
61	Liquid waste facility: premises on which liquid waste produced on other premises (other than sewerage waste) is stored, reprocessed, treated or irrigated	100 tonnes or more per year	3,500,000 tonnes [3500 ML] per year
85	Sewage facility: premises — a. on which sewage is treated (excluding septic tanks); or b. from which treated sewage is discharged onto land or into waters.	More than 20 but less than 100 m^3 per day	36 m^3 per day

Both prescribed premises categories 31 and 85 apply under the current licence.

Although there is no change in the operation of the Ammonia Plant, an additional prescribed premises category (i.e. category 61) is included in this licence application. This is a consequence of separate licences being sought for each of the Ammonia Plant and the TAN Plant.

Category 61 arises from the transfer of liquid waste from the TAN Plant to the MUBRL through the Ammonia Plant. This liquid waste is currently discharged through pipelines within the Ammonia Plant (including mixing with the Ammonia Plant liquid waste stream) before discharge into the MUBRL. Accordingly, while a new prescribed premises category is sought to be included within the new licence the subject of this application, no additional or different emissions or environmental impacts arise compared to those authorised under the current licence.

The document is structured to provide attachments required by DWER's *Application Form: Works Approval/Licence/Renewal/Amendment/Registration (February 2019, v 11*) (Application Form).

Table 1.4 provides an overview of the Application Form supporting attachments and the relevant sections of this document that address each of the information requirements.

Table 1.4: Supporting attachments

Application form attachments	Section in this document
Attachment 1A: Proof of occupier status	Section 2
Attachment 1B: ASIC company extract	Section 3
Attachment 2: Premises map/s	Section 4
Attachment 3A: Proposed activities	Section 5
Attachment 3B: Map for proposed area to be cleared	Not required
Attachment 4: Biodiversity surveys	Not required
Attachment 5: Other approvals and consultation documentation	Not required
Attachment 6A: Emissions and discharges	Section 6
Attachment 6B: Waste acceptance	Section 7
Attachment 7: Siting and location	Section 8
Attachment 8: Other relevant information	Not required
Attachment 9: Proposed fee calculation	Not required
Attachment 10: Request for exemption from publication	Not required

This application has been prepared in accordance with the regulatory framework described in Section 1.2 and with consideration of the principles of the EP Act, the requirements of MS 586 and other approvals, and the following guidance relevant to applications for licences under Part V of the EP Act:

- Guideline: Industry Regulation Guide to Licensing (DWER 2019a)
- Guideline: Decision Making (DWER 2019b)
- Guidance Statement: Risk Assessments (DER 2017)
- Guidance Statement: Environmental Siting (DER 2016).

4. Attachment 2: Premises maps

The Ammonia Plant is located on part of Lot 564 on Plan 31023, Village Road, BURRUP WA 6714. Yara Pilbara Fertilisers Pty Ltd hold the lease for Lot 564.

The prescribed premises boundary does not cover the entirety of Lot 564 but encompasses all plant, equipment and monitoring areas relevant to the Ammonia Plant. The prescribed premises boundary is consistent with the disturbance footprint described in MS 586.

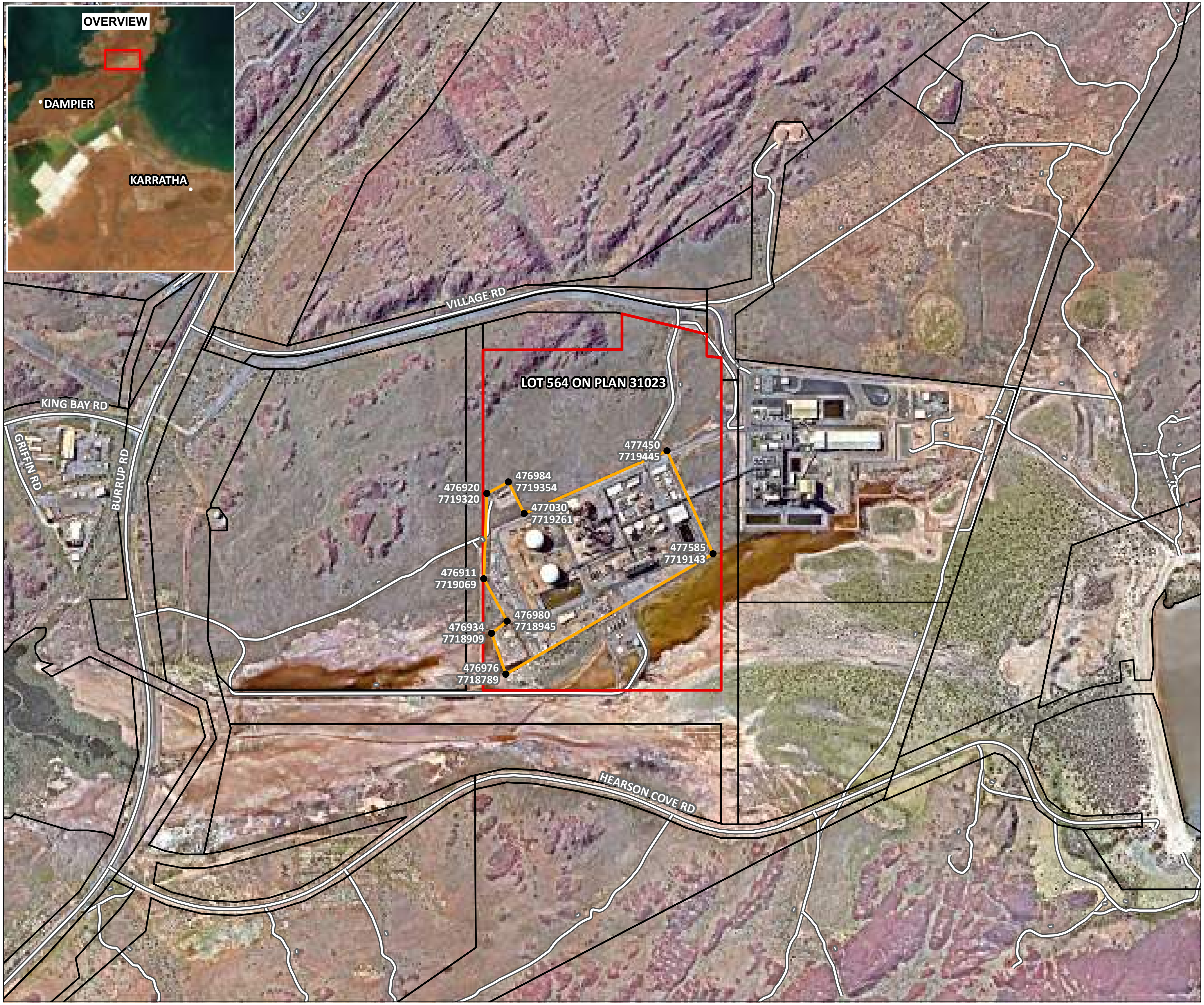
The coordinates of the prescribed premises boundary are show in Table 4.1 below and on the Premises Map.

Table 4.1: Premises coordinates (MGA 94, Zone 50)

	Easting	Northing
1	476920	7719320
2	476982	7718359
3	477030	7719261
4	477450	7719445
5	477585	7719143
6	476976	7718789
7	476934	7718909
8	476980	7718945
9	476911	7719069

The following maps are attached:

- Premises Map
- Infrastructure Map 1
- Infrastructure Map 2
- Map of Emission Points
- Map of Monitoring Locations.



Legend

- Lease boundary - Ammonia Plant
- Premises boundary - Ammonia Plant
- Cadastral boundary
- Roads
- Corner coordinates

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Job No: 56928

Client: Yara Pilbara Fertilisers

Version: A	Date 23/07/2019
Drawn By: cthatcher	Checked By: LT

Scale 1:15,000 at A4

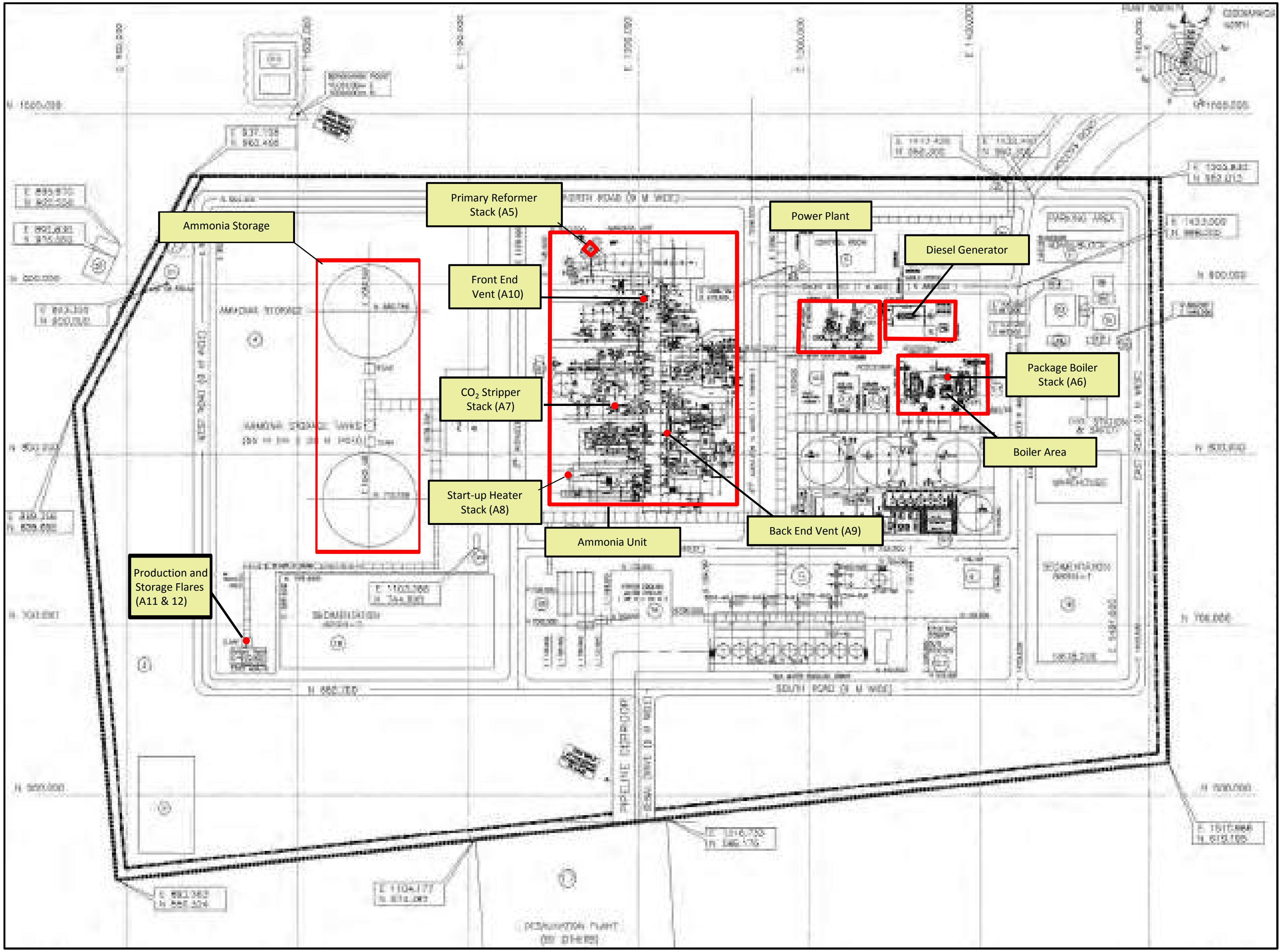
0 250 500
metres

Coord. Sys. GDA 1994 MGA Zone 50

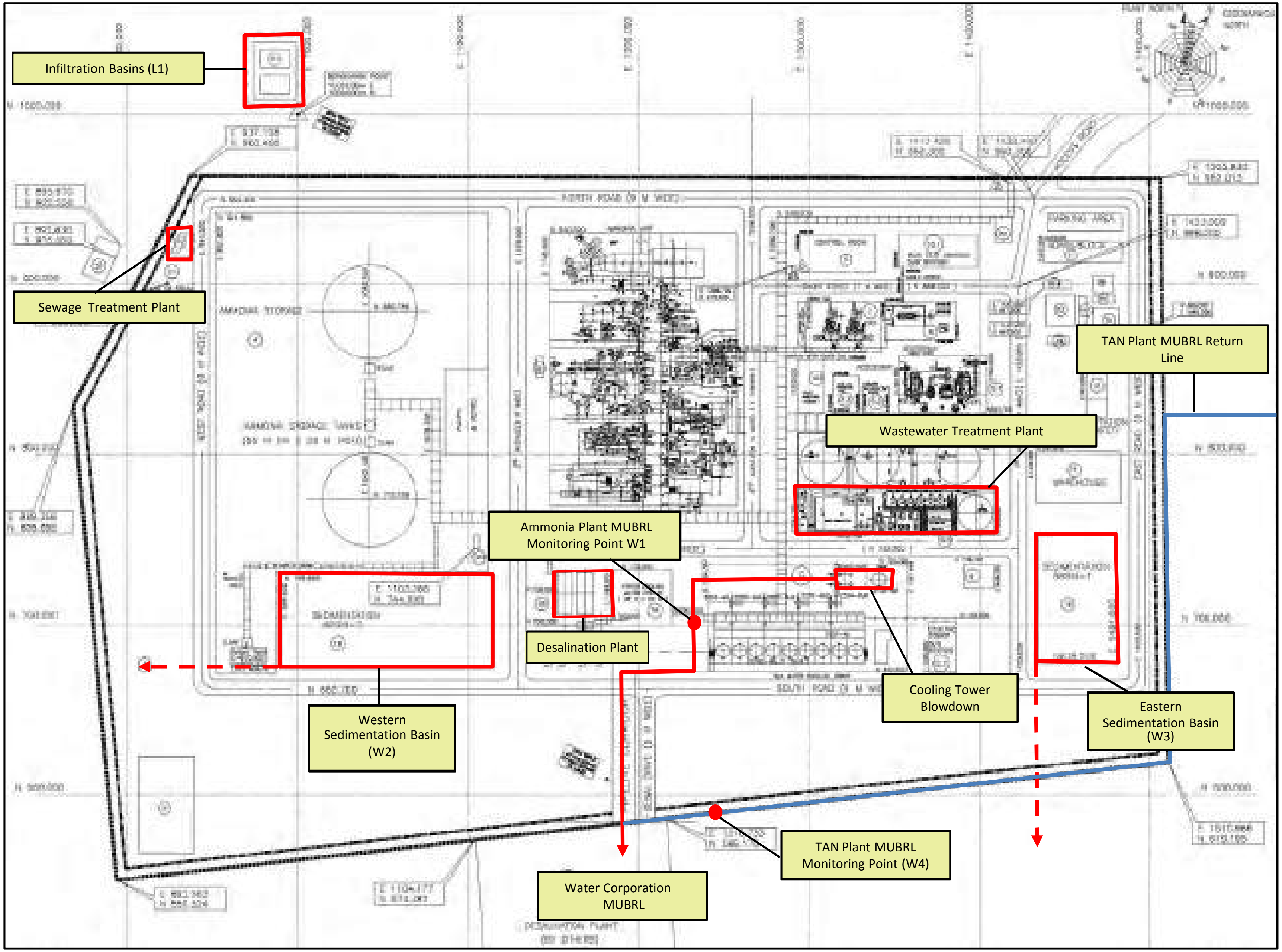
YARA PILBARA FERTILISERS AMMONIA PLANT

Premises map

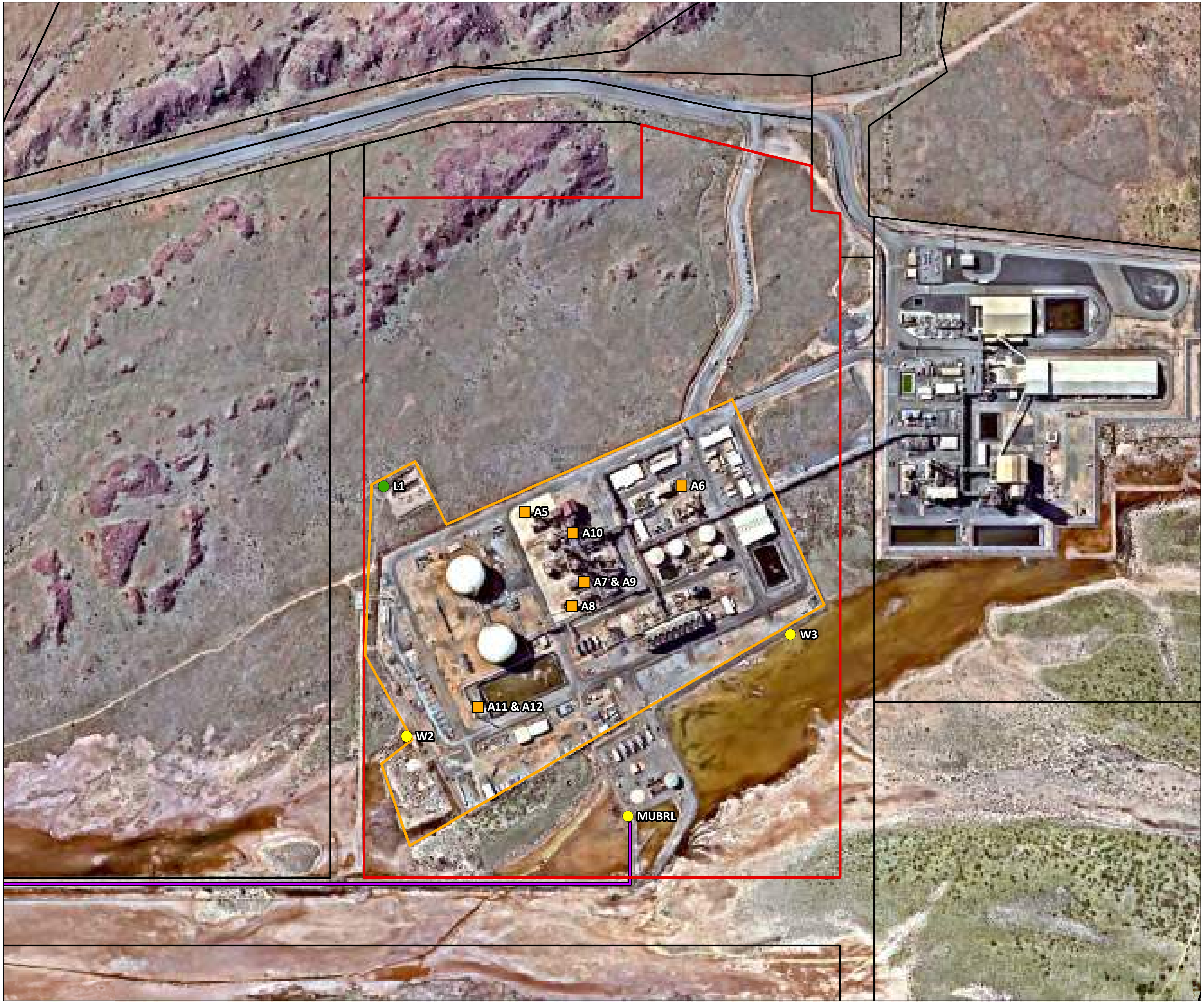
File Name: W:\Projects\1)Open\Yara Pilbara Nitrates\56928 Seperate licence applications\GIS\Maps\R001_Rev_A\56928_01_PremisesLocn.mxd
Reference: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Reference: Nearmap Imagery flown 04/2019.



Infrastructure Map 1



Infrastructure Map 2



Legend

- Lease boundary - Ammonia Plant
- Premises boundary - Ammonia Plant
- Cadastral boundary
- MUBRL
- Emission point to marine waters
- Emission point to air
- Emission point to land

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Job No: 56928	
Client: Yara Pilbara Fertilisers	
Version: A	Date 23/07/2019
Drawn By: cthatcher	Checked By: LT
Scale 1:7,500 at A4	

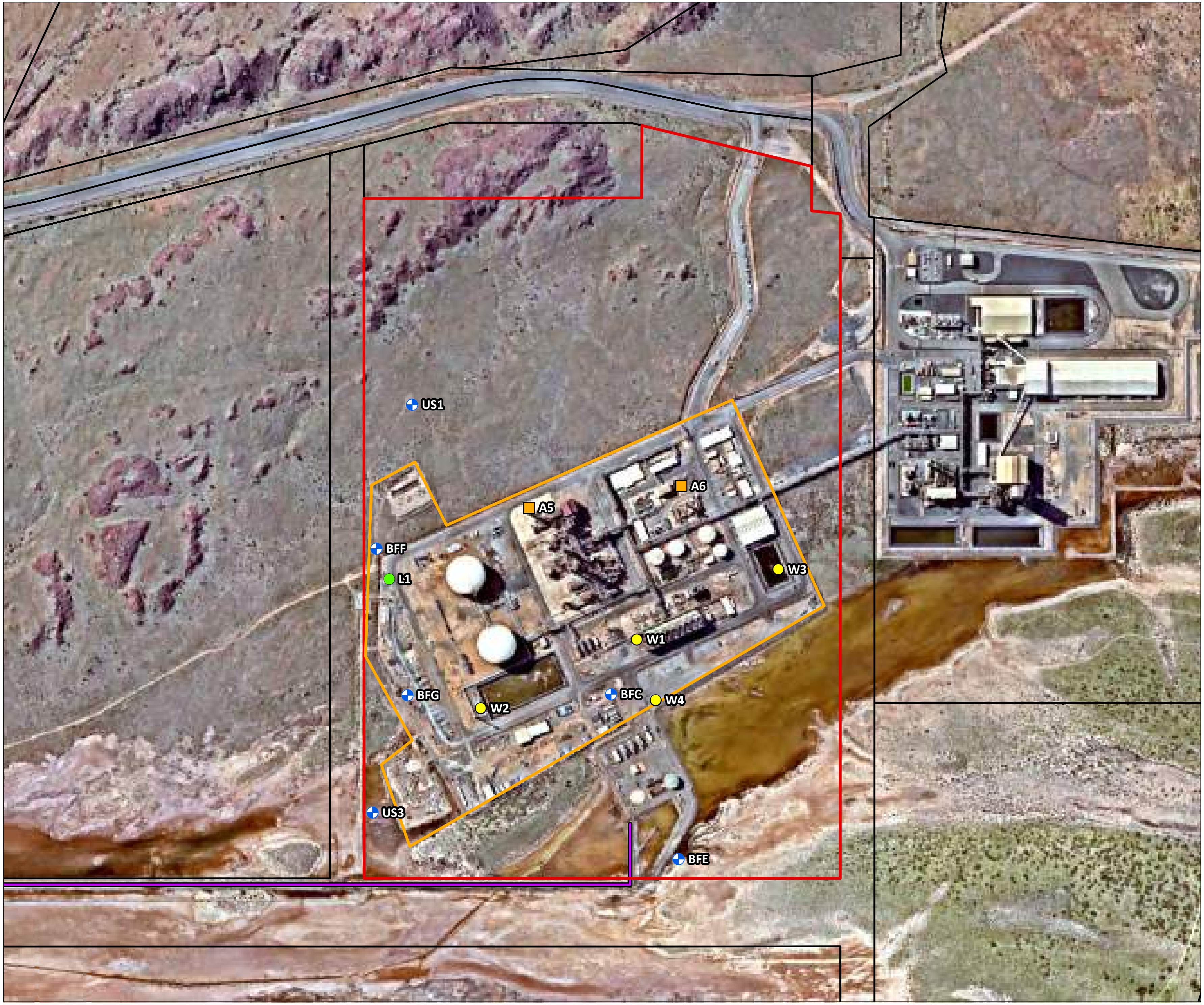
0 100 200
metres

Coord. Sys. GDA 1994 MGA Zone 50

YARA PILBARA FERTILISERS AMMONIA PLANT

Map of emission points

File Name: W:\Projects\1)Open\Yara Pilbara Nitrates\56928 Seperate licence applications\GIS\Maps\R001_Rev_A\56928_03_EmissionPts.mxd
Reference: Nearmap Imagery flown 04/2019.



Legend

- Lease boundary - Ammonia Plant
- Premises boundary - Ammonia Plant
- Cadastral boundary
- MUBRL
- Groundwater monitoring bores
- Monitoring of emissions to marine waters
- Monitoring of emissions to air
- Monitoring of emissions to land

strategen JBS&G

Job No: 56928	
Client: Yara Pilbara Fertilisers	
Version: A	Date 23/07/2019
Drawn By: cthatcher	Checked By: LT
Scale 1:7,500 at A4	

0 100 200
metres

Coord. Sys. GDA 1994 MGA Zone 50

YARA PILBARA FERTILISERS AMMONIA PLANT

Map of monitoring locations

File Name: W:\Projects\1)Open\Yara Pilbara Nitrates\56928 Seperate licence applications\GIS\Maps\R001_Rev_A\56928_02_MonitoringLocs.mxd
Reference: Nearmap Imagery flown 04/2019.

5. Attachment 3A: Activities

5.1 Process overview - prescribed premises category 31

The Ammonia Plant processes natural gas to produce liquid ammonia using the KBR Purifier Process (Category 31). The plant operates 24 hours a day, seven days a week and has a maximum production capacity of 950,000 tonnes of anhydrous liquid ammonia per year.

The Ammonia Plant process flow chart is shown in Figure 5.1. The main steps of the ammonia production process are as follows:

- feed gas desulphurisation
- primary reforming
- secondary reforming
- carbon monoxide shift conversion
- carbon dioxide removal
- methanation
- cryogenic purification
- ammonia synthesis
- ammonia refrigeration.

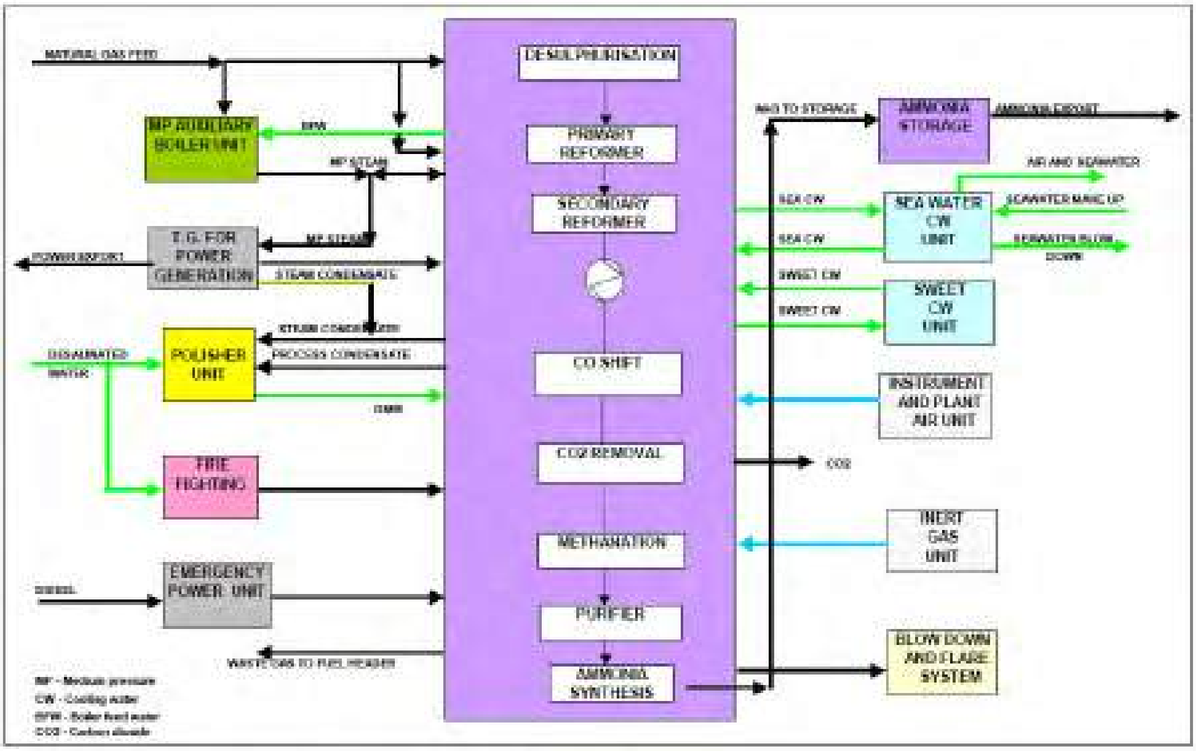


Figure 5.1: Process flow diagram (source: Sinclair Knight Mertz 2001)

5.1.1 Feed pre-treatment

Natural gas feed is directed to a feed gas knockout drum where liquids and solids are removed. Upon exiting the drum, the various fuel and feed streams are taken. Part of the natural gas is sent to the package boiler and primary reformer. The remainder is fed to the desulphurisation unit via the convection section of the primary reformer for heating.

The desulphurisation unit removes organic sulphur compounds from the heated gas by passing it over a catalyst bed of cobalt/molybdenum oxide. Organic sulphur compounds are hydrogenated to form hydrogen sulphide. This sulphide reacts with zinc oxide and is retained in the catalyst bed.

5.1.2 Primary reforming

The desulphurised feed is mixed with medium pressure steam and is preheated in the convection section of the primary reformer. The hot mixed feed is distributed to the primary reformer catalyst tubes, which are suspended in the radiant section of the furnace. The feed gas passes down the reforming catalyst and is reacted to form hydrogen, carbon monoxide and carbon dioxide. The combination of reactions are endothermic (i.e. requires and absorbs heat) with the duty supplied by fuel gas burners located between the rows of tubes.

5.1.3 Secondary reforming

The process gas leaving the primary reformer furnace contains about 52.3% hydrogen and 28% methane (dry volume basis). Air is injected in a special mixing and combustion chamber above a nickel catalyst bed to produce a 3:1 hydrogen to nitrogen synthesis gas.

The gas is directed to a secondary reformer waste heat boiler where high pressure steam is produced to partially cool the gas.

5.1.4 Shift conversion

Carbon monoxide is reacted with steam to produce carbon dioxide and additional hydrogen. This reaction is favoured by high temperatures, but the maximum conversion of CO to CO_2 (equilibrium) is favoured by low temperatures. Both high and low temperature conversions utilise different catalysts. The high temperature shift conversion utilises iron oxide and the low temperature shift conversion utilises a copper based catalyst.

Heat recovered from the low temperature shift conversion is used to preheat high pressure boiler feed water and deaerator feed water in the methanator, and to provide heat for the CO_2 removal process.

5.1.5 Carbon dioxide removal

Carbon dioxide contained in the shifted process gas is removed by absorption in a liquid absorbent, MDEA solution. The absorbent is stripped of CO_2 and regenerated for re-use. The recovered carbon dioxide is cooled and vented.

5.1.6 Methanation

This process occurs within the methanator feed/effluent exchanger where high temperature heat is recovered in the effluent by heat exchange against the feed gas. The gas then flows through the methanator where remaining carbon oxides combine with hydrogen over a nickel catalyst to form methane and water.

The methanator effluent is cooled by heat exchange with methanator feed and cooling water. The chilled gas flows to the synthesis gas driers containing solid desiccants. Exiting these driers, the water and CO and CO_2 content of the gas is reduced.

5.1.7 Cryogenic purification

Dried raw synthesis gas is cooled prior to entering the purifier rectifier column. This purifier column removes excess nitrogen, all of the methane and about 61% of the argon. The operation of the purifier is controlled by a hydrogen analyser on the synthesis gas to maintain the 3:1 hydrogen to nitrogen ratio. The only remaining contaminant in the make-up synthesis gas is about 0.27% argon. The synthesis gas is compressed to a suitable pressure required for the ammonia synthesis loop.

5.1.8 Ammonia synthesis

The synthesis gas is passed through the ammonia synthesis converter comprising of four beds of iron promoted conventional catalyst. The heat of reaction is recovered by the steam system in the ammonia converter effluent/steam generator and boiler feed water preheater. The converter effluent is cooled to condense most of the produced ammonia. The remaining synthesis gas is recycled to the converter, except for a small purge. The purge is recycled to the Purifier.

5.1.9 Refrigeration and storage

Ammonia is condensed from the converter effluent stream by chilling with ammonia refrigerant at four levels in the unitised chiller. The ammonia vapours are routed to the ammonia refrigeration compressor where the vapours are condensed. Cold liquid ammonia is used as a refrigerant. The refrigeration system is designed to deliver the ammonia product at minus 33 °C. Cold ammonia is then pumped to the cryogenic storage tanks.

Produced liquid ammonia is stored in two double-walled, double-integrity 40 000 tonne tanks. Above ground pipelines are used to transport the refrigerated liquid ammonia to the adjacent TAN Plant and the Dampier Bulk Liquids Berth at the Port of Dampier, where it is loaded into ships for export.

5.1.10 Utilities and ancillary plant

The Ammonia Plant has a flare system that provides the ability to combust gases should there be upset process conditions. A production flare is used to treat waste process gas and a storage flare to incinerate emissions of ammonia from the storage tank headspace.

Electrical power is supplied by a power plant with two 22 MW steam turbine generators. The two turbines are not required to operate at full load simultaneously, with one typically operating at 100% capacity and the other operating at 25% capacity.

One 150 tph package boiler is used to generate steam for operations and one 50 tph package boiler is used to generate steam for plant start-up. One 5 MW diesel generator is provided for start-up and emergency power.

Cooling is provided by seawater supplied by Water Corporation and desalinated water is supplied by an on-site desalination plant (three desalination trains with combined capacity of 1.4 GL per year).

Process effluent from the plant is discharged to the MUBRL operated by Water Corporation for disposal into marine waters at King Bay.

Stormwater and cooling tower blowdown water is directed to one of two sedimentation basins (the eastern sedimentation basin and western sedimentation basin). The basins have capacity to contain stormwater from a 1 in 100 average recurrence interval (ARI). The basins are lined with 1.5 mm thick high density polyethylene (HDPE). In the case of excess stormwater from extreme events, the basins discharge to the tidal flats of King Bay. Monitoring of the stormwater quality is conducted before a discharge event occurs.

The above processes are the same as is authorised under the current licence.

5.2 Process Overview - prescribed premises category 61

As previously noted, the Ammonia Plant also receives process effluent (seawater blowdown also containing cooling water blowdown, purified process condensate, chiller condensate and boiler blowdown) from the adjacent TAN Plant for discharge into the MUBRL (Category 61).

The Ammonia Plant accepts approximately 3,500 ML/year (3,500,000 tonnes/year) of wastewater from the TAN Plant, which exceeds the production design capacity of 100 tonnes/year specified for category 61 prescribed premises in Schedule 1 Part 1 of the EP Regulations.

The MUBRL is authorised by MS 594 to discharge up to 208 ML/day of brine and 0.8 ML/day of process wastewater. The Ammonia Plant (including TAN Plant) currently contributes approximately 55 ML/day of brine and process wastewater, well below the authorised volume.

The waste discharge quality requirements that are applicable to this prescribed premises category are addressed in Section 6.2.1 below. Waste discharge quality will be monitored at monitoring point W4.

5.3 Process Overview - prescribed premises category 85

A domestic sewage treatment plant (STP) services the Ammonia Plant. A STP was initially constructed in 2003 as part of the construction of the Ammonia Plant. A new rotating biological contactor (RBC) plant was commissioned in July 2016 through Works Approval W5920/2015/1. The STP discharges to two infiltration trenches with the approximate dimensions of 50 m x 10 m. The trenches are located to the north of the Ammonia Plant within a 70 m x 70 m area.

The STP has a capacity of 36 m^3/day, which exceeds the production design capacity of 20 m^3/day for category 85 sewage facilities as listed in Schedule 1 Part 2 of the EP Regulations. However, the capacity of the STP is lower than the 100 m^3/day production design capacity for higher risk category 54 sewage facilities as listed in Schedule 1 Part 1 of the EP Regulations.

This process is the same as is authorised under the current licence.

5.4 Key infrastructure

Key infrastructure for the Ammonia Plant as it relates to prescribed premises Categories 31, 61 and 85 is detailed in Table 5.1.

Table 5.1: Key infrastructure

Key infrastructure		Reference map
Category 31: Chemical manufacturing	**Production/design capacity: 950,000 tonnes per year**	
Approximately 81 TJ per day (Lower Heating Value (LHV)) of natural gas is received via pipeline and processed to produce up 950 000 tonnes of anhydrous ammonia per year.		
Ammonia unit		
1	Primary reformer	Infrastructure Map 1
2	Secondary reformer	
3	CO_2 stripper	
4	Vent system (front end vent and back end vent)	
5	Ammonia storage (2 x 40 000 tonne cryogenic, double-walled, double integrity tanks)	
6	Flare system (production flare and storage flare)	

Key infrastructure			Reference map
Utilities			
7	Power plant (2 x 22 MW steam turbine generators)		Infrastructure Map 1
8	Boiler area (Package boiler #1 - 150 tph)		
9	Boiler area (Package boiler #2 - 50 tph)		
10	Start-up heater		
11	Diesel generator (5 MW)		
12	Desalination plant (1.4 GL per year)		Infrastructure Map 2
13	Wastewater treatment plant		
14	Western sedimentation basin		
15	Eastern sedimentation basin		
Category 85: Sewage treatment		**Production/design capacity: 36 cubic metres per day**	
Treatment of domestic wastewater generated at the Ammonia Plant via a packaged Sewage Treatment Plant with treated wastewater disposed of via two infiltration beds.			
16	Sewage treatment plant (36 m^3 per day)		Infrastructure Map 2
17	Infiltration trenches (x 2)		
Category 61: Liquid waste facility		**Production/design capacity: 3500 ML/year**	
Receival of up to 3500 ML/year of process wastewater from the TAN Plant			
18	TAN Plant MUBRL return line		Infrastructure Map 2

6. Attachment 6A: Emissions and discharges

6.1 Emissions to air

Key emissions to air from the Ammonia Plant include point source emissions to air, comprising mainly oxides of nitrogen from the primary reformer and package boiler stacks. During start-up and shutdown of the plant, process gases comprising hydrogen, nitrogen, and argon are emitted from the back-end vent and emissions comprising of hydrogen, nitrogen, methane, carbon monoxide, carbon dioxide and water from the front-end vent. Discharge points to air are shown in Table 6.1.

Table 6.1: Emission points to air

Source	Emission type	Volume and frequency	Controls	Reference on Map of Emission Points and Infrastructure Map
Primary reformer	NOx, PM, CO	Continuous (normal operation)	Design features and operational practices including: • process controls for plant reliability • adoption of excess air process • installation of low NOx burners on primary reformer and start-up heater • use of low sulphur gas • minimal venting and flaring from the plant during normal operations	Primary reformer stack (A5)
Package boilers	NOx. CO, SO_2	Continuous (normal operation)		CO_2 stripper stack (A7)
CO_2 stripper	CO, CO_2	Continuous (normal operation)		Package boiler stack (A6)
Start-up heater	NOx, PM, SO_2	Intermittent (start-up)		Start-up heater stack (A8)
Back end vent	H_2, N_2, Ar	Intermittent (start-up/shutdown/plant trip)		Back-end vent (A9)
Front end vent	H_2, N_2, CH_4, CO, CO_2, H2O	Intermittent (start-up/shutdown/plant trip)		Front-end vent (A10)
Production flare	NOx, NH_3	Intermittent (plant trip)		Production flare (A11)
Storage flare	NOX, NH_3	Intermittent (plant trip)		Storage flare (A12)

6.1.1 Normal operation

The Ammonia Plant operates for 24 hours per day and 365 days per year with allowance for maintenance periods of around one week per year. The representative emissions profiles for normal operations are outlined in Table 6.2. Routine stack emissions monitoring show that the NOx emissions from the primary reformer stack and the package boiler stack are below the emissions to air limits specified in the current licence (180 mg/m^3 for the primary reformer stack and 300 mg/m^3 for the package boiler stack).

Table 6.2: Emissions to air (normal operation)

Location on Map of Emission Points	Source of emission or discharge	Stack height (m)	Stack diameter (m)	Exit velocity (m/s)	Temp (°C)	NOx (as NO_2) (mg/m^3)	S02 (mg/m^3)	CO (mg/m^3)
A5	Primary reformer stack	36	3.5	15	155	106	9.4	63.5
A6	Package boilers stack	30	3.0	6.0	148	140	<2.6	32
A7	CO_2 stripper stack	60	0.8	77	45	N/A	N/A	330

(1) Concentrations provided are maximum concentrations provided in Annual Environment Reports from 2014 to 2017.

Air emissions modelling for the Ammonia Plant was undertaken in August 2001 to support the Public Environmental Review (PER) formal assessment process under Part IV of the EP Act (Sinclair Knight Mertz 2001).

The 2001 modelling considered cumulative impacts from existing and proposed emission sources on the Burrup Peninsula and potential impacts on offsite receptors including recreation areas (Hearson Cove), residential areas (Dampier and Karratha) and nearby industrial workforces.

Ambient air quality criteria used in the assessment of emissions to air are shown in Table 6.3.

Table 6.3: Air quality criteria

Parameter	Criteria (µg/m³)	Average	Guideline
NOx	246	1 h	National Environmental Protection (Ambient Air Quality) Measure
	61	Annual	
SO_2	520	1 h	
	226	24 h	
	56	Annual	
CO	10300	8 h	
NH_3	330	1 h	
	180	Annual	
PM_{10}	90	24 h	
NH_3	330	1 h	Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (NSW 2005)
	180	Annual	

The modelling assessment concluded that, during normal operation of the Ammonia Plant, the ground level concentration (GLC) of NOx, SO_2 and PM would remain within the assessment criteria at receptors. The modelling also concluded that the GLC of NH_3 during normal operation would remain below the ambient assessment criteria.

Updated modelling was undertaken in 2015 to support the request to amend MS 586 under section 45C of the EP Act (Environ 2015). This model was updated using emissions data derived from process mass balance calculations as inputs to the model. The calculated emissions from the Ammonia Plant were supported by stack monitoring results (2015-2017) from the primary reformer stack (A5) and package boiler stack (A6). The calculated GLCs shown in Table 6.4 are derived from the 2015 updated modelling (using AERMOD and Karratha Airport meteorological data) scaled for use of Ammonia Plant meteorological data.

Table 6.4: Ammonia Plant emissions - modelled GLCs (normal operation)

Parameter	Criteria (µg/m³)	Average	Deep Gorge (µg/m³)	Dampier (µg/m³)	Karratha (µg/m³)	Hearson Cove (µg/m³)	Maximum of criteria (%)
NOx (as NO_2)	246	1 h	3.08	2.02	1.06	8.87	3.6
	61	Annual	0.22	0.063	0.019	0.70	1.1
SO_2	520	1 h	0.27	0.21	0.11	0.75	0.1
	226	24 h	0.018	0.0073	0.0036	0.054	0.02
	56	Annual	0.011	0.0034	0.0010	0.034	0.1
CO	10300	8 h	3.96	1.35	0.75	7.93	0.1
NH_3	330	1 h	0.000003	0.000002	0.000001	0.000012	3.54E-08
	180	Annual	0.00000021	0.00000006	0.00000002	0.0000007	3.77E-09
TSP	90	24 h	0.055	0.018	0.011	0.20	0.2
PM_{10}	50	24 h	0.027	0.0091	0.0055	0.10	0.2

The modelling predicted that, during normal operation of the Ammonia Plant, the GLCs of NOx, SO_2, CO, NH_3 and particulates (as PM_{10}) were below the assessment criteria at the receptors and at all locations in the modelling domain (see Table 6.4).

6.1.1.1 Cumulative assessment (Ammonia Plant and TAN Plant)

A conservative approach has been adopted to predict the cumulative impact of emissions from both the Ammonia Plant and the TAN Plant in support of this licence application by assuming the modelled maximum GLCs from each plant occur simultaneously at individual receptors. The predicted GLCs from both plants have been added together for assessment against the relevant criteria.

Emissions sources from each plant also separated by at least 390 m (Ammonia Plant package boiler stack (A6) to TAN Plant nitric acid plant stack), which means that when the wind blows along the axis of those stacks, the emissions from the stack nearest to the wind will already be significantly diluted before the emissions from the next stack interact with the plume. A similar situation would occur for the alignments of the other stacks with various wind directions.

Maximum predicted cumulative GLCs from normal operation of the Ammonia Plant and TAN Plant are shown in Table 6.5. The GLCs are derived from:

- the 2015 updated modelling of Ammonia Plant emissions (using AERMOD and Karratha Airport meteorological data) (Table 6.4) scaled for use of Ammonia Plant meteorological data
- the 2019 modelling of TAN Plant emissions (using AERMOD and site meteorological data) which includes updated emissions inventory data.

While the assessment cannot determine where each of the maximum GLCs will occur and under what meteorological conditions, the approach is considered conservative as the potential for maximum GLCs to occur from both sources at the same time and at the same location is extremely unlikely.

Table 6.5: Ammonia Plant and TAN Plant emission GLCs – normal operation

Parameter	Criteria (µg/m³)	Average	Deep Gorge (µg/m³)	Dampier (µg/m³)	Karratha (µg/m³)	Hearson Cove (µg/m³)	Maximum of criteria (%) excluding background	Background[1] (µg/m³)	Maximum of criteria (%) including background
NOx (as NO_2)	246	1 h	5.96	4.29	1.94	11.38	4.6	45	23
	61	Annual	0.47	0.22	0.057	1.16	1.9	6.3	12
SO_2	520	1 h	0.27	0.21	0.11	0.75	0.1	0.4	0.2
	226	24 h	0.018	0.0073	0.0036	0.054	0.02	0.3	0.2
	56	Annual	0.011	0.0034	0.0010	0.034	0.06	0.2	0.5
CO	10300	8 h	3.96	1.35	0.75	7.93	0.08	N/R	0.08
NH_3	330	1 h	34	8	3	11	10	0.9	10
	180	Annual	0.09	0.02	0.004	0.21	0.12	N/R	13
TSP	90	24 h	0.11	0.069	0.033	0.26	0.29	18.9	21
PM_{10}	50	24 h	0.055	0.035	0.016	0.13	0.26	23.8	48

(1) Background data from *Burrup Peninsula Technical Ammonium Nitrate Production Facility Air Quality Assessment Update* (ERM 2012).
(2) N/R = Not Reported.

The assessment concluded that, amongst the receptors considered, the highest 1-hr and annual GLCs of NO_2 are likely to occur at Hearson Cove (23% and 12% of the assessment criteria, respectively). These GLCs include consideration of background concentrations which were 18% of the 1-hr criterion and 10% of the annual criterion.

Ground level concentrations of SO_2 were calculated to be 0.2% of the assessment criteria (1-hr) (at Hearson Cove) during normal operations. The highest predicted GLC of CO from concurrent operation of the Ammonia Plant and TAN Plant was less than 1% of the 8-hr criterion. A background concentration of CO was not determined for the modelling assessments but is expected to be very low; the Pilbara Air Quality Monitoring Study (DEP 2002) found the highest CO concentration was less than 4% of the criterion.

Ground level concentrations of NH_3 were 10% of the adopted short term (1-hour) assessment criteria at Hearson Cove during normal operations.

6.1.2 Start-up, shutdown and plant trips

Two types of shutdown and associated start-up events occur as part of normal plant operations:

1. Minor shutdowns or plant trips which require cessation of natural gas feed to the reformer and isolation of other unit processes while the issue is resolved.
2. Major shutdowns (referred to as turn-arounds) that occur nominally every four to five years for refurbishment/replacement of catalysts.

A cold start-up occurs when the plant has been down for more than 24 hours.

Under start-up, the package boilers (A2) are fired on gas to produce the 170 tonnes or more per hour of steam needed before the ammonia production process is stabilised. Additionally, the start-up heater (A8) is operated to heat the gases. As steam generation within the ammonia process becomes available, the gas burners to the boiler are manipulated and the process optimised. Start-up is considered complete once the process is stabilised, ammonia is being produced, and the vent valve on the ammonia recovery unit is closed.

The Ammonia Plant, or parts within, can be shut down at various times in response to plant trips (upsets) and maintenance requirements. Major shutdowns are required every four to five years to replace catalysts in the various stages of the process.

Plant trips (partial and full plant shutdowns) occur when process conditions step outside safe limits and the process safety control system automatically activates a range of control measures to ensure plant safety is maintained. Venting of process gases occurs from the part of the plant which initiates the trip and will vent from the locations as required to stabilise the plant or take down the process safely. Typical start-ups, shutdowns and plant trips are shown in Table 6.6.

Table 6.6: Plant start-ups, shutdowns and trips

Event	Description
Full ISBL shutdown and cold start	Required for plant maintenance OSBL facilities remain on-line
Full ISBL shutdown and hot start	Restart begins within 24 hours
Full plant shutdown (ISBL & OSBL) and hot start	Restart begins within 24 hours
Full plant shutdown (ISBL & OSBL) and cold start	Entire plant shutdown Restart begins after a maintenance period
Backend trip and hot start	Plant (ISBL) trips anywhere from CO_2 removal onwards Restart begins within 24 hours
Backend trip and cold start	Plan (ISBL) trips anywhere from CO_2 removal onwards Restart begins after a maintenance period
Planned shutdown	Plant (ISBL and/or OSBL) is taken offline when planned (e.g. for major required maintenance or a turnaround period)
Backend trip with a hot start into a purifier bypass	Plant maintained with venting and increased boiler output

(3) ISBL = Inside Battery Limits.
(4) OSBL = Outside Battery Limits.

In addition to venting, NOx emissions occur from the package boiler (A6) and primary reformer (A5) stacks from natural gas combustion. Higher steam demand from the package boiler (A6) during start-up results in an increase of NOx emissions compared to normal operations. Lower NOx emissions occur from the primary reformer (A5) during shutdown as the burners are turned down or off. Emissions from the primary reformer (A5) recommence once the heating progresses during the start-up. NOx emissions are also generated from the start-up heater (A8).

Details of start-up, shutdown and plant trip events from January 2017 to May 2018, including information on frequency, duration and emission characteristics, are presented in Table 6.7.

Table 6.7: Recent Plant start-ups and shutdowns

Event	Maximum CO emission rate (g/s)	Duration of maximum CO emission rate (hours)	Maximum NOx emission rate (g/s) [1]	Duration of maximum NOx emission rate (hours)
Full plant shutdown and cold start	8974	7	47.4	10
Backend trip and hot start	879	1	50.1	9
Full ISBL shutdown and cold start	12235	7	50.7	10
Full ISBL shutdown and hot start	7963	6	52.6	14

(1) Maximum NOx emission is total of emissions from primary reformer, package boiler and start-up heater.

Potential impacts of emissions resulting from start-ups, shutdowns and plant trips have been assessed by calculating GLCs rather than by re-modelling, by using the application of dilution factors from the 2015 updated modelling (Environ 2015) which have been scaled for use of Yara site meteorological data rather than data from Karratha Airport.

This assessment method is considered conservative as it assumes constant emission rates for an entire modelling year rather than the few hours over which each event occurs. As such, actual GLC's are likely to be lower than those predicted. The assessment considered emissions from the primary reformer (A5), package boiler (A6), start-up heater (A8) and front end vent (A10).

The modelling showed that maximum GLCs of NO_2, SO_2 and PM_{10} were within relevant assessment criteria at receptors (see Table 6.8). Given the low frequency and short duration of these events, the emissions are unlikely to cause significant environmental or health impacts at receptors.

Table 6.8: Ammonia Plant emission GLCs – start-up

Parameter	Criteria (µg/m³)	Average	Deep Gorge (µg/m³)	Dampier (µg/m³)	Karratha (µg/m³)	Hearson Cove (µg/m³)	Maximum of criteria (%)
NOx (as NO_2)	246	1 h	10.1	4.144	6.6	7.3	4.11
	61	Annual	0.54	0.043	0.2	1.11	1.83
SO_2	520	1 h	0.49	0.104	0.4	0.21	0.09
	226	24 h	0.078	0.0078	0.03	0.053	0.03
	56	Annual	0.016	0.0011	0.0049	0.032	0.06
CO	10300	8 h	1669	329	567	2638	26
NH_3	330	1 h	2.52E-06	7.41E-07	1.38E-06	2.35E-06	7.63E-09
	180	Annual	8.12E-09	8.66E-09	2.41E-09	3.42E-07	1.90E-09
PM_{10}	50	24 h	0.13	0.36	0.04	0.36	0.73

6.1.3 Flaring

Emissions to air also occur from the production flare (A11) and storage flare (A12). These flares are components of the plant safety systems and are designed and operated to incinerate ammonia gas to N_2 and H_2O, with minimal NO_x formation.

The storage flare (A12) is dedicated to incineration of gaseous ammonia that may be emitted intermittently from the liquid ammonia storage tanks with changes in headspace pressure. Flaring of ammonia vapours from the storage tanks can occur in the event of refrigeration compressor failure which only occurs in a total blackout scenario. Built-in redundancy in the plant (power and refrigeration) makes this unlikely.

If flaring is required, boil-off gas from the storage tanks is directed to the flare and the ammonia is combusted, releasing combustion gases including water vapour, CO_2, N_2, NO_x and small amounts of unburnt ammonia.

The production flare (A11) incinerates waste process gas containing ammonia. Flaring of waste process gases from the production flare occurs as required during normal operations.

Based on the predicted low frequency of flaring, the high efficiency of the flares and destruction of ammonia, and the release of combustion by-products (water vapour, CO_2, N_2, NOx), emissions from the flares pose a low risk.

6.1.4 Monitoring of emissions to air

The primary sources of emissions to air are routinely monitored as described in Table 6.9. The current licence includes a requirement to install a continuous emission monitoring system (CEMS) for NO_x on the primary reformer (A1) and package boiler (A3) stacks by 30 September 2019. YPF is in the process of installing and commissioning the CEMS, but installation has been delayed due to delays in the factory acceptance testing (FAT) of the new units from the UK and Poland, as well as shipping and custom delays. Once installed, the CEMS will be operated, maintained and calibrated in accordance with the CEMS Code (DER 2016a).

Table 6.9: Monitoring of emissions to air

Source	Reference on Map of Monitoring Locations	Parameter	Frequency	Averaging period	Unit [1]	Method
Primary reformer stack [2]	A5	Flow rate	Continuous	60 minutes	m^3/s	CEMS
		NOx (as NO_2)			mg/m^3 g/s	
Package boiler stack [2]	A6	Flow rate	Continuous	60 minutes	m^3/s	CEMS
		NOx (as NO_2)			mg/m^3 g/s	

(2) All units are referenced to standard temperature and pressure, dry.
(3) Concentrations to be corrected to standard temperature and pressure at 15% oxygen on a dry basis.

Continuous ambient air quality monitoring for ammonia is carried out at locations in the plant and on the plant boundary. The monitors are used to detect ammonia released from venting or inefficient flaring. The location of ammonia ambient monitors is detailed on the Map of Monitoring Locations in Attachment 2. The monitors are alarmed when ammonia concentrations reach 35 ppm allowing YPF to investigate the cause and take appropriate action.

6.2 Discharges to marine waters

During normal operations, process effluent is discharged from the Ammonia Plant into the Water Corporation's MUBRL for final discharge into marine waters at King Bay. Process effluent is wastewater comprising of:

- cooling tower blowdown
- discharge from the desalination plant
- wastewater from air compressor intercoolers
- reformer jacket water blowdown
- reformer steam drum boiler blowdown
- package boiler blowdown.

The Ammonia Plant also receives process effluent from the TAN Plant, which discharges directly into to the Ammonia Plant process effluent pipework (i.e. process effluent from the TAN Plant is not stored on-site). The effluents are combined and discharged into the MUBRL via the Ammonia Plant.

Intermittent direct discharges of potentially contaminated stormwater and cooling tower blowdown water to King Bay tidal flats also occur from the western (W2) and eastern (W3) sedimentation basins when rainfall exceeds the containment capacity. These discharges typically occur two to three times per year for a duration of less than 24 hours.

Discharge points to marine waters are shown in Table 6.10 below.

Table 6.10: Discharge points to marine waters

Source	Discharge type	Volume and frequency	Controls	Reference on Map of Emission Points and Infrastructure Map
MUBRL	Process wastewater and brine: • cooling tower blowdown • discharge from the desalination plant (2 units @ 300 m³/hour each) • wastewater from air compressor intercoolers (4 m³/hour) • reformer jacket water blowdown (4 m³/hour but only when tripping on high conductivity) • reformer steam drum boiler blowdown (2.5 m³/hour) recycled into jacket water pit and recovered unless tripping on high conductivity • package boiler blowdown (2 m³/hour) recycled into jacket water pit and recovered unless tripping on high conductivity.	Continuous (normal operation) 1860 m³ per hour	Wastewater Treatment Plant: • chemical treatment and precipitation of the cooling tower blowdown with the aim to reduce chlorine, bromine and other biocides to non-detectable levels • steam stripping of process condensate and reformer jacket water blowdown, and recycle of polished water to prevent the discharge of ammonia and methanol • demineralisation and recycle of blowdowns from the Package Boilers and Primary Reformer.	Water Corporation MUBRL
	Wastewater from TAN Plant: • cooling tower blowdown • condensate • boiler blowdown.	Continuous (normal operation) 370 m³ per hour		
Western Sedimentation Basin	Stormwater and cooling tower blowdown	Intermittent	• Containment capacity for 1 in 100 ARI events • Lined with 1.5 mm thick HDPE (permeability less than 1 x 10⁻⁹ m/s) • Monitoring prior to discharge events.	Western Sedimentation Basin (W2)
Eastern Sedimentation Basin				Eastern Sedimentation Basin (W3)

6.2.1 Discharges to MUBRL

Process effluent is discharged via the Water Corporation's MUBRL which reports to the marine environment of King Bay. The MUBRL was approved by the Minister for Environment under MS 567 (June 2001) and MS 594 (June 2002). Wastewater entering the MUBRL from the Ammonia Plant (including discharges from the TAN Plant) is managed through a contract with the Water Corporation, which was executed on 20 March 2015.

As required by the Ministerial Statements, Water Corporation has developed an Operational Marine Environmental Management Plan (OMEMP) which outlines the approach for managing the discharge of combined effluent from the MUBRL to achieve specified environmental objectives using a program of in-field and field-based monitoring. The specified ecological and environmental objectives are based on the Environmental Protection Authority's (EPA) Pilbara Coastal Water Quality Consultation Outcomes (2006) report which recommended setting a high level of ecological protection for King Bay in areas outside of the MUBRL outfall mixing zone, and an area of low ecological protection within the mixing zone.

End-of-pipe trigger levels have been set through the OMEMP and act as initial indicators that the environmental objectives may not be met. The triggers were back calculated from the high protection trigger levels (99% level of protection) (ANZECC 2000) and take into consideration the predicted dilutions achieved at the outfall.

Although the Ministerial Statements and the OMEMP set a regulatory framework for managing the cumulative discharge from the MUBRL and specify water quality triggers for the combined effluent discharge, the OMEMP recommends that the management of discharges from each individual operator should be regulated under the respective EP Act licences or Ministerial Statements. As such, discharge limits are set in the current licence in accordance with the trigger values in the OMEMP as contained in Table 6.11.

Table 6.11: Discharge limits to marine waters (MUBRL)

Discharge point	Parameter	Limit (including units)	Averaging period
MUBRL	Temperature	Less than 5 °C above ambient seawater temperature	Daily
		Less than 2 °C above ambient seawater temperature 80% of the time	Daily (80th percentile)
	pH	6.9 – 8.3	Monthly
	Electrical conductivity	75 000 µs/cm	
	Ammonia as ammoniacal nitrogen (NH_3-N)	30 164 µg/L	Monthly rolling average
	Arsenic (III)	140 µg/L	
	Arsenic (V)	275 µg/L	
	Cadmium	36 µg/L	
	Chromium (III)	459 µg/L	
	Chromium (VI)	8.5 µg/L	
	Cobalt	61 µg/L	
	Copper	11µg/L	
	Lead	134 µg/L	
	Mercury	1.4 µg/L	
	Nickel	427 µg/L	
	Selenium	183 µg/L	
	Silver	49 µg/L	
	Vanadium	3050 µg/L	
	Zinc	419 µg/L	

6.2.2 Sedimentation basin discharges

The western and eastern sedimentation basins receive contaminated storm water and cooling tower blowdown. The basins are designed to withstand rainfall from a 1 in 100-year event and discharge into King Bay tidal flats via dedicated pipelines. Releases to King Bay tidal flat typically occur two to three times a year and are less than 24 hours in duration (see Table 6.12).

Wastewater discharged from sedimentation basins can have elevated concentrations of suspended solids, hydrocarbons and potentially MDEA from process leaks and spills. Monitoring of recent discharges shows that the discharged water is generally uncontaminated (see Table 6.12). A spill in August 2016 caused elevated concentrations of MDEA to be discharged (41 mg/L). The release of MDEA was deemed to have not caused environmental harm and was not considered a pollution event. The MDEA storage bund has since been sealed and rainwater is vacuumed out and disposed of to limit the potential risk of further MDEA contamination.

Table 6.12: Sedimentation basin discharge events

Date released	Emission point	Total suspended solids (mg/L)	pH	Total recoverable hydrocarbons (mg/L)	MDEA (mg/L)
17 Feb 2018	W3	65	8.6	<0.25	<0.1
6-12 Apr 2018	W2	26	8.5	<0.28	<0.1
21 Jun 2018	W3	22	8.9	<0.25	<0.1
21 Jun 2018	W2	9	8.8	<0.28	0.5
27 Nov 2018	W2	27	8.3	<0.28	<0.1
8 Feb 2017	W3	2	8.4	<0.25	<0.1
9-10 Feb 2017	W2	8	7.4	<0.25	<0.1
10 Feb 2017	W3	2	8.4	<0.25	<0.1
8-9 Mar 2017	W2	42	8.4	<0.28	<0.1
11 Sept 2017	W2	11	8.4	<0.28	<0.1
14-16 Sept 2017	W2	6	8.4	<0.28	<0.1
4-6 Oct 2017	W2	11	8.4	<0.28	<0.1
22 Dec 2017	W2	23	NA	<0.28	<0.1
6 Jul 2016	W3	12	8.9	<0.251	<0.1
11 Aug 2016	W2	7	8.4	<0.251	41
21 Aug 2016	W3	15	8.2	<0.251	<0.1
21 Aug 2015	W2	1	8.4	<0.25	ND
24 Oct 2015	W2	66	8.26	<0.25	ND
31 Dec 2015	W2	13	8.1	<0.25	ND
2 May 2014	W2	76	8.2	<0.25	ND
6 Oct 2014	W2	33	9.07	<0.25	ND
13 Feb 2013	W2	58	8.4	<0.25	ND
25 Jun 2013	W2	101	8.44	<0.25	ND
25 Jun 2013	W3	39	8.19	<0.25	ND

Water quality limits have been set for any discharge events from the sedimentation basins (Table 6.13). The limits (except MDEA) are based on the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (99% level of protection) and the ecological and environmental objectives from the Pilbara Coastal Water Quality Consultation Outcomes (DoE 2006).

The limit for MDEA has been revised from 1 mg/L to 5 mg/L to allow water sample analysis to be carried out by the on-site laboratory. This allows results to be provided quickly and in advance of potential discharge events. The on-site laboratory cannot achieve a limit of detection less than 2 mg/L and sending samples for analysis at an external laboratory to meet a detection threshold less than 1 mg/L takes up to two weeks to complete. Further, the current licence does not require testing for MDEA to be undertaken by a NATA Accredited laboratory. An increase of the limit to 5 mg/L is still considered to be highly protective. MDEA is generally not detected in discharged water (Table 6.12) and if discharged is highly soluble, readily biodegradable in sunlight and is considered to have a low to moderate risk of impacting marine aquatic ecosystems.

Table 6.13: Discharge limits to marine waters (sedimentation basins)

Discharge point	Parameter	Limit
W2 & W3	Total suspended solids	80 mg/L
	pH	6 – 9
	Total recoverable hydrocarbon	15 mg/L
	MDEA	5 mg/L

The discharge limits for total suspended solids, pH and total recoverable hydrocarbons are as per the current licence.

6.2.3 Monitoring of discharges to marine waters

Monitoring is carried out at two locations prior to the discharge point to the MUBRL from the Ammonia Plant to ensure that the discharge quality criteria are met. This monitoring is carried out a two locations representative of the Ammonia Plant (W1) and TAN Plant (W4) process effluent inputs, both of which must met the quality objectives specified in the current licence.

Monitoring of water quality in the sedimentation basins is carried out a maximum of 24 hours before a discharge event is expected to occur to provide enough time for the sample to be analysed, results obtained and any relevant management action to be taken prior to discharge. If required, further sampling of water quality during discharge can be carried out if the pre-discharge sampling shows any elevated levels of contaminants. To ensure this is achievable, analysis is undertaken by the site laboratory which is not NATA accredited for these analyses. A duplicate sample is collected for analysis of TSS and TRH in a laboratory which is NATA accredited so that the site laboratory results can be validated.

The monitoring program is described in Table 6.14.

Table 6.14: Monitoring of Ammonia Plant discharges to marine waters

Discharge point	Reference on Map of Monitoring Locations	Parameter [1]	Frequency	Averaging period	Unit	Sampling method	Analytical method
MUBRL	W1 and W4	Flow	Continuous	NA	m³/day	AS5667.1-1998 and AS5667.10-1998	Online analyser
		Temperature		Daily	⁰C		
		pH		Monthly	NA		
		Electrical conductivity		Monthly	µs/cm		
		Dissolved oxygen	Weekly	Spot sample	%		YPF laboratory
		Ammonia as ammoniacal nitrogen (NH_3-N)	Daily	Weekly composite of daily spot sample	µg/L		NATA accredited
		Total Phosphorous					
		Arsenic (III)					
		Arsenic (V)					
		Cadmium					
		Chromium (III)					
		Chromium (VI)					
		Cobalt					
		Copper					
		Lead					
		Mercury					
		Nickel					
		Selenium					
		Silver					
		Vanadium					
		Zinc					
	W1	MDEA					YPF laboratory
Western & Eastern Sedimentation Basins	W2 or W3	pH	Maximum of 24 hours before discharge	Spot sample	NA	AS5667.1-1998 and AS5667.10-1998	YPF laboratory [2]
		MDEA			mg/L		
		Total suspended solids					
		Total recoverable hydrocarbons					

(1) All metals analysed as total and filterable.
(2) NATA accredited analysis of duplicate sample for total suspended solids and total recoverable hydrocarbons.

6.3 Emissions to land

Emissions to land occur via the discharge of treated domestic wastewater from the STP.

A STP was initially constructed in 2003 as part of the construction of the Ammonia Plant. A new rotating biological contactor (RBC) plant was commissioned in July 2016 through Works Approval W5920/2015/1, which has a design capacity of 36 m^3/day. The design specification for the STP was a treated water quality of:

- < 8 mg/L total phosphorus (TP)
- < 20 mg/L total nitrogen (TN).

The STP discharges to two infiltration trenches with the approximate dimensions of 50 m x 10 m. The trenches are located to the north of the Ammonia Plant within a 70 m x 70 m area. The depth to groundwater in the area is estimated to be about 8.0 m.

Table 6.15: Discharge points to land

Source	Emission type	Volume and frequency	Controls	Reference on Map of Emission Points and Infrastructure Map
Sewage treatment plant infiltration basins	Treated domestic wastewater	Continuous (normal operation) 36 m^3/day	Rotating biological contactor (RBC) treatment plant	Infiltration basins (L1)

Between 3 August 2016 and 3 August 2018, an average of 9 m^3/day of wastewater was treated and infiltrated. Based on testing over this period, the treated wastewater contained an average:

- 10.3 mg/L TP
- 74.8 mg/L TN
- 57.4 mg/L nitrate as N (NO_3-N)
- 1 mg/L nitrite as N (NO_2-N)
- 8.8 mg/L ammonia as N (NH_3-N).

As the STP has not been able to achieve the design criteria for TN and TP, an improvement program was initiated through the current licence. As part of the improvement program, chemical dosing trials were carried out in January 2019 to improve the quality of the effluent discharged from the STP. The dosing trials have been successful at sustaining the treated water quality below 30 mg/L TN and 8 mg/L TP.

As part of the improvement program, a risk assessment of the discharge was completed (Strategen 2019). The risk assessment concluded that:

- the nutrient-rich water from the STP discharge from 2003 is likely to result in TN levels exceeding the site-specific trigger level of 5.06 mg/L at the supratidal flats by around 2033 (30 years); as such, the removal of the source is not possible
- the pathway to the flats is via groundwater and its expression at surface. The pathway to King Bay is via groundwater flow (submarine groundwater discharge) beneath the tidal flats or surface flow during tidal and rainfall events
- there is evidence that extensive denitrification takes place at the supratidal flats due to:
    - the repeated drying and rewetting of supratidal sediments promotes volatilisation of N-species gases
    - the continual flushing and dilution from tidal process and occasional heavy rain
    - the high levels of heat and wind that drive increased volatilisation of N-species gases

- o the continual source of alkalinity from seawater that promotes denitrification processes

- these processes result in an incomplete source-pathway-receptor linkage. This can be confirmed by continuing the monitoring of groundwater and tidal flat surface water.

Based on the current performance of the STP and the assessment work completed to date, limits have been set on the discharge from the STP to the infiltration trenches as described in Table 6.16.

Table 6.16: Discharge limits to land

Discharge point	Parameter	Limit
Infiltration basins (L1)	Total nitrogen	30 mg/L
	Total phosphorus	8 mg/L
	Biochemical oxygen demand	20 mg/L
	pH	6.5 – 8.5
	Total suspended solids	30 mg/L
	E.coli	10,000 cfu/100mL

Discharge limits for biochemical oxygen demand, pH, total suspended solids and *E.coli* are as per the current licence. Monitoring of the STP discharge will continue in accordance with the program in Table 6.17 to ensure that the improvements in treated water quality are maintained.

Table 6.17: Monitoring of emissions to land

<table>
<tr><th>Discharge point</th><th>Reference of Map of Monitoring Locations</th><th>Parameter</th><th>Frequency</th><th>Averaging period</th><th>Unit</th><th>Sampling method</th><th>Analytical method</th></tr>
<tr><td rowspan="7">Infiltration basins (L1)</td><td rowspan="7">L1</td><td>Flow</td><td>Continuous</td><td>NA</td><td>m³/day</td><td rowspan="7">AS5667.1:1998 and AS5667.10:1998 and AS/NZS 2031:2001</td><td>NA</td></tr>
<tr><td>pH</td><td rowspan="6">Monthly</td><td rowspan="6">Spot sample</td><td>NA</td><td rowspan="6">NATA accredited</td></tr>
<tr><td>Total nitrogen</td><td rowspan="4">µg/L or mg/L</td></tr>
<tr><td>Total phosphorus</td></tr>
<tr><td>Biochemical oxygen demand</td></tr>
<tr><td>Total suspended solids</td></tr>
<tr><td>E.coli</td><td>cfu/100mL</td></tr>
</table>

6.3.1 Groundwater monitoring

Ongoing groundwater monitoring is required to track the movement of the groundwater nitrogen plume from the STP infiltration trenches. The current monitoring regime is considered adequate for plume monitoring as:

- the parameters currently being monitored in groundwater (water level, TN, TP, oxidised nitrogen (NOx-N), ammonia, Kjeldahl nitrogen, pH and total dissolved salts) are sufficient to delineate the plume

- the quarterly frequency is adequate to track plume movement

- an additional bore (BFG) has been installed approximately half way between the bore closest to the STP infiltration trenches (BFF) and the premises boundary. BFG has been installed to replace BFB which has been decommissioned due to safety and access concerns

- the monitoring of sites US1 (background concentrations), BFF, US3 and BFG will assist in tracking the plume.

The groundwater monitoring will also provide surveillance for any potential impacts (leaks, spills, seepage) from the storage of hazardous materials (e.g. MDEA, hydrocarbons) and the containment of potentially contaminated water in the sedimentation basins. The monitoring regime is described in Table 6.18.

The current licence requires analysis of MDEA derivatives. It is understood that MDEA derivatives were added to the groundwater monitoring program after the spill of MDEA in July 2015. To date, no MDEA derivatives have been detected in any groundwater samples and MDEA is only rarely detected and at very low concentrations suggesting no ongoing environmental impact. Therefore, monitoring of MDEA in groundwater is considered sufficient to monitor for any potential impact to groundwater from operations.

Table 6.18: Groundwater monitoring

<table>
<tr><th>Parameter</th><th>Reference on Map of Monitoring Locations</th><th>Unit</th><th>Frequency</th><th>Averaging Period</th><th>Sampling method [1]</th><th>Analytical method</th></tr>
<tr><td>pH</td><td rowspan="25">US1
US3
BFC
BFE
BFF
BFG</td><td>NA</td><td rowspan="25">Quarterly</td><td rowspan="25">Spot sample</td><td rowspan="25">AS/NZS 5667.11</td><td rowspan="5">In-field or YPF laboratory</td></tr>
<tr><td>Electrical conductivity</td><td>µS/cm</td></tr>
<tr><td>Redox potential</td><td>mV</td></tr>
<tr><td>Temperature</td><td>ºC</td></tr>
<tr><td>Dissolved Oxygen</td><td>%</td></tr>
<tr><td>MDEA [3]</td><td rowspan="20">µg/L
or
mg/L</td><td>YPF laboratory</td></tr>
<tr><td>Ammonia as ammoniacal nitrogen (NH_3-N)</td><td rowspan="19">NATA accredited [2]</td></tr>
<tr><td>Nitrate and nitrite</td></tr>
<tr><td>Aluminium</td></tr>
<tr><td>Cadmium</td></tr>
<tr><td>Chromium (III)</td></tr>
<tr><td>Chromium (VI)</td></tr>
<tr><td>Copper</td></tr>
<tr><td>Nickel</td></tr>
<tr><td>Lead</td></tr>
<tr><td>Sulfate</td></tr>
<tr><td>Total dissolved solids</td></tr>
<tr><td>Total Kjeldal nitrogen</td></tr>
<tr><td>Total nitrogen as N and total oxidised</td></tr>
<tr><td>Total recoverable hydrocarbons</td></tr>
<tr><td>Total phosphorus as P</td></tr>
<tr><td>Total organic carbon</td></tr>
<tr><td>Total alkalinity</td></tr>
<tr><td>Major cations (K^+, Na^+, Ca^{2+}, Mg^{2+})</td></tr>
<tr><td>Zinc</td></tr>
</table>

(1) Samples measured and collected in a flow-through cell.
(2) Metal samples filtered for analysis.
(3) Non-NATA accredited laboratory analysis.

6.4 Noise emissions

Noise emissions from the Ammonia Plant are generated across the plant with the loudest noise from air compressors and air machines. Noise mitigation measures implemented at the plant include:

- equipment such as compressors and pumps are located within enclosures, cases, blankets or are situated in a building as required
- silencers installed on vents
- pipework with acoustic cladding
- relief system for flow/ acoustically induced vibration and fatigue
- repairing, modifying or replacing high noise generating items
- selecting machinery with minimum noise levels.

During its assessment of the current licence, DWER concluded that cumulative noise levels at the nearest sensitive receptor (Hearson Cove) could be minimised by ensuring that all industrial facilities located in proximity incorporated noise attenuation measures on all identified significant noise sources to reduce noise levels, as practicable, at their respective plant boundaries to below the 65 dB(A) specified noise level in the Environment Protection (Noise) Regulations 1997 (Noise Regulations).

Noise monitoring during commissioning of the TAN Plant provided monitoring data reflective of cumulative noise emission levels at receptors. The noise monitoring was completed between 30 May 2016 and 17 May 2017 and involved:

- daily attended 'spot' measurements at Hearson Cove and the TAN Plant boundary
- attended measurements at Hearson Cove conducted during TAN Plant performance testing that included 1/3 octave band analysis
- continuous monitoring on the south-eastern boundary of the TAN Plant and at Deep Gorge between 27 April and 4 May 2017.

Review of the noise monitoring data indicated that ambient noise levels at Hearson Cove during the TAN Plant commissioning were below the 65 dB(A) level, except for a few occasions. Noise levels measured at the south-eastern boundary of the TAN Plant exceeded the 65 dB(A) level on one occasion (19 October 2016); however, the noise level at Hearson Cove for that day was 48 dB(A). On other occasions when the noise levels at Hearson Cove exceeded 65 dB(A), measured noise levels at the Premises boundary were below 65 dB(A), indicating that ambient noise levels at Hearson Cove were influenced by other sources.

Noise monitoring was carried out at four locations on the Ammonia Plant and TAN Plant boundaries between October 2018 and June 2019 to check compliance with the Noise Regulations of combined noise emissions from both plants. The monitoring locations are shown in Figure 6.1.

Figure 6.1: Noise monitoring locations (N1 to N4)

Due to operational downtime of the Ammonia Plant and TAN Plant since the issue of the current licence, limited data is available at times when both plants are operating. However, the results of the monitoring show little variation in results regardless of whether only one plant or both plants are operating and demonstrate compliance with the 65 dBA criteria. The results of the monitoring and operational status of both plants is shown in Table 6.19 below.

Table 6.19: Noise monitoring October 2018 to June 2019

Date	Wind	Operational status	Average LA10 (dB)			
			N1	N2	N3	N4
16/10/18	Northeast Light breeze	TAN Plant not operating Ammonia Plant operating	58.7	52.8	45.8	37.5
20/12/18	Northwest Moderate	TAN Plant not operating Ammonia Plant operating	58	55.7	57.9	50.4
8/3/19	West Light-moderate	TAN Plant not operating Ammonia Plant operating	57.9	53.8	54.7	46.2
7/6/19	East Moderate	Ammonia Plant utilities only running TAN Plant operating	55.1	51.9	47.5	44.8
1/7/19	Northeast Moderate	Both plants operating	58.8	54.4	53.8	49.8

Given the Ammonia Plant's demonstrated compliance with the 65 dB LA_{10} assessment criteria, no further control is considered necessary outside of regulation under the Noise Regulations.

6.5 Risk assessment

The identified emissions and discharges have been assessed in accordance with DWER's Guidance Statement: Risk Assessments (DER 2017). A summary of the risk assessment is presented in Table 6.20.

Table 6.20: Risk assessment summary

Source	Activity	Emission	Receptor	Pathway	Potential impact	Controls	Consequence	Likelihood	Risk
Primary reformer (A5) Package Boiler (A6) CO_2 stripper (A7)	Normal operation	NOx, CO, SO_2, PM_{10}	Hearson Cove (beach recreation) Residential areas at Dampier and Karratha Workforce at King Bay Industrial Estate, Pilbara Port Authority and Woodside Facilities	Air/wind dispersion	Human health impacts Loss of amenity	• process controls for plant reliability • adoption of excess air process • installation of low NOx burners on primary reformer and start-up heater • use of low sulphur gas • minimal venting and flaring from the plant during normal operations • quarterly stack emission monitoring (until CEMS is commissioned) • CEMS monitoring once installed and commissioned.	Minor	Possible	Medium[1]
Primary reformer (A5) Package Boiler (A6) CO_2 stripper (A7) Front end vent (A10) Back end vent (A9) Start-up heater (A8)	Start-up/shutdown/ plant trip	NOx, CO, SO_2, PM_{10} H_2, N_2, CH_4					Minor	Unlikely	Medium
Production flare (A11) Storage flare (A12)	Refrigeration plant failure; plant trip	NOx, N_2, NH_3				• power and refrigeration plant back up and redundancy • ambient air quality monitors for NH_3.	Slight	Unlikely	Low
MUBRL	Normal operation	Ammonia Plant [and TAN Plant] process effluent	King Bay marine ecosystem	Direct discharge	Degradation of marine water quality Ecological impacts	• chemical treatment and precipitation of the cooling tower blowdown with the aim to reduce chlorine, bromine and other biocides to non-detectable levels • steam stripping of process condensate and reformer jacket water blowdown, and recycle of polished water to prevent the discharge of ammonia and methanol • demineralisation and recycle of blowdowns from the package boilers and primary reformer • routine water quality monitoring • end-of-pipe discharge to King Bay managed by Water Corporation through implementation of OMEMP.	Regulated under MS 567 and MS 594 and managed by Water Corporation through implementation of OMEMP		

Source	Activity	Emission	Receptor	Pathway	Potential impact	Controls	Consequence	Likelihood	Risk
Western & Eastern Sedimentation Basins	Planned discharge (high rainfall events)	Potentially contaminated stormwater	King Bay tidal flats and marine ecosystem	Direct discharge	Degradation of marine water quality Ecological impacts	• containment capacity for 1 in 100 ARI events • lined with 1.5 mm thick HDPE (permeability less than 1 x 10^{-9} m/s) • monitoring prior to discharge events.	Moderate	Unlikely	Medium
	Containment		Groundwater	Seepage		• lined with 1.5 mm thick HDPE (permeability less than 1 x 10^{-9} m/s) • quarterly groundwater monitoring.	Moderate	Unlikely	Medium
			King Bay tidal flats and marine ecosystem	Discharge/ expression of groundwater					
Sewage Treatment Plant	Discharge of treated wastewater	Treated wastewater	Groundwater	Infiltration	Degradation of groundwater quality	• rotating biological contactor (RBC) treatment plant • chemical dosing • monthly discharge quality monitoring and continuous flow monitoring • quarterly groundwater monitoring.	Minor	Likely	Medium
			King Bay tidal flats and marine ecosystem	Discharge/ expression of groundwater Surface flow during rainfall/tidal events	Degradation marine water quality Ecological impacts		Moderate	Possible	Medium
Ammonia Plant and equipment	Normal operation	Noise	Hearson Cove (beach recreation)	Air/wind dispersion	Loss of amenity	• equipment such as compressors and pumps are located within enclosures, cases, blankets or are situated in a building as required • silencers installed on vents • pipework with acoustic cladding • relief system for flow/ acoustically induced vibration and fatigue • repairing, modifying or replacing high noise generating items • selecting machinery with minimum noise levels.	Minor	Rare	Low

(1) Risk assessment based on NOx emissions. PM assessed as Medium risk (Minor consequence; Unlikely); CO and SO_2 Low risk (Slight consequence; Rare).

7. Attachment 6B: Waste acceptance

As described in Section 1.4 and Section 5.2, the Ammonia Plant receives process effluent from the TAN Plant for discharge into the MUBRL. The TAN Plant MUBRL return line connects to the Ammonia Plant where the effluent streams are combined before discharge to the MUBRL.

This waste process presently occurs under the current licence.

Table 7.1: Waste acceptance table

Source	Waste type	Quantity	Storage infrastructure	Monitoring	Location (on Premises map)
TAN Plant	Process effluent	3500 ML per year	N/A	As Table 7.2	W4

The discharge from the TAN Plant to the MUBRL is subject to the same limits as the Ammonia Plant as applied by the contract with the Water Corporation (see Table 6.11). Monitoring of the TAN Plant discharge is carried out in accordance with the monitoring program detailed in Table 7.2. This is the same monitoring suite as for the discharge from the Ammonia Plant to the MUBRL with the exclusion of MDEA which is not stored or used at the TAN Plant.

Table 7.2: Monitoring of TAN Plant discharges to marine waters

Discharge point	Monitoring location	Parameter [1]	Frequency	Averaging period	Unit	Sampling method	Analytical method
MUBRL	W4	Flow	Continuous	N/A	m^3/day	AS5667.1-1998 and AS5667.10-1998	Online analyser
		Temperature		Daily	^{0}C		
		pH		Monthly	NA		
		Electrical conductivity		Monthly	µs/cm		
		Dissolved oxygen	Weekly	Spot sample	%		YPF laboratory
		Ammonia as ammoniacal nitrogen (NH_3-N)	Daily	Weekly composite of daily spot sample	µg/L		NATA accredited
		Total Phosphorous					
		Arsenic (III)					
		Arsenic (V)					
		Cadmium					
		Chromium (III)					
		Chromium (VI)					
		Cobalt					
		Copper					
		Lead					
		Mercury					
		Nickel					
		Selenium					
		Silver					
		Vanadium					
		Zinc					

(1) All metals analysed as total and filterable.

8. Attachment 7: Siting and location

The Ammonia Plant is located on the Burrup Peninsula, 11 km northwest of Karratha. The plant is in the Burrup Strategic Industrial Area; a well established strategic heavy industrial estate. Non-industrial land to the north and south of the plant form part of the Murujuga National Park, which is recognised for its cultural significance and ecological and biological diversity.

The TAN Plant is located adjacent to the premises to the east northeast.

8.1 Residential and sensitive premises

The distances to residential and sensitive receptors are shown in Table 8.1 and Figure 8.1.

Table 8.1: Receptors and distance from prescribed activity

Residential and sensitive premises	Distance from Ammonia Plant (measured from boundary)
Hearson Cove beach (zoned conservation recreation and natural/landscapes City of Karratha Planning Scheme No.8)	1530 m south
Deep Gorge (recreational area) (zoned conservation recreation and natural/landscapes City of Karratha Planning Scheme No.8)	1000 m south
Industrial receptor - Pilbara Port Authority lease area (multiple users) including ammonia loading facilities (zoned strategic industry City of Karratha Planning Scheme No.8)	1.2 km west
Industrial receptor - Pluto LNG Project (zoned strategic industry City of Karratha Planning Scheme No.8)	1.6 km northeast
Industrial receptor - Karratha Gas Plant (zoned strategic industry City of Karratha Planning Scheme No.8)	3.3 km north
Industrial receptor - Parker Point Iron Ore Port (zoned strategic industry City of Karratha Planning Scheme No.8)	4.5 km southwest
Residential Premises - Dampier townsite	7.3 km south west
Residential Premises - Karratha townsite	11.5 km south southeast

8.2 Specified ecosystems

Specified ecosystems are areas of high conservation value and special significance that may be impacted because of activities at or emissions and discharges from the Ammonia Plant. Specified ecosystems have been identified in accordance with DWER Guidance Statement on Environmental Siting (DER 2016). The distances to specified ecosystems and other relevant ecosystem values are shown in Table 8.2.

Table 8.2: Environmental values

Specified Ecosystem	Distance from the Premises
Parks and Wildlife Managed Waters	Murujuga National Park - Borders Lot 3017 to the east, 500 m from the boundary of the Ammonia Plant to the north and 900 m to the south. Deep Gorge, a popular site frequented by tourists containing rock art, is located 1000 m south
Threatened Ecological Communities and Priority Ecological Communities	Several priority ecological communities have been identified approximately 1.2 km and 2.6 km west of the Ammonia Plant. Priority 1 ecological communities exist within 5,000 m of the Ammonia Plant including the Burrup Peninsula rock pool and rock piles communities. The Burrup Peninsula rock pile communities consist of short-range endemic land snails.
Threatened / Priority Flora	No threatened or priority flora have been identified on the Premises.

Specified Ecosystem	Distance from the Premises
Threatened / Priority Fauna	State and Commonwealth listed threatened species of fauna have been identified within a 10 km radius of the Ammonia Plant. Twenty four (24) migratory species have also been identified. Most threatened species within the area include marine animals which may use areas off Hearson Cove for feeding, breeding, nesting or resting.
King Bay - mangroves and marine ecosystem	Supratidal flat located directly adjacent to the Ammonia Plant boundary to the southeast. Mangrove community located 1,000 m east of Lot 564. The waters of King Bay are afforded a high level of ecological protection except for a one-hectare area surrounding the outfall, where industry discharges occur in King Bay and the surrounding Mermaid Sound. These areas have been afforded a low level of ecological protection and moderate level of ecological protection respectively.
Hearson Cove - marine tidal ecosystem	1530 m to the east southeast
National Heritage Listed place - Dampier Archipelago (including the Burrup Peninsula) (ID 105727)	The Dampier Archipelago including the Burrup Peninsula is listed on the National Heritage List due to the presence of rock engravings and other Aboriginal heritage sites such as stone arrangements. Nearest rock art to the Ammonia Plant is 400 m.

8.3 Climate

The Ammonia Plant is located on the Burrup Peninsula within the Pilbara region of WA which has a tropical-arid climate with two distinct seasons; hot summers with periodic heavy rains (October-April) and mild winters with occasional rainfall (May-September). According to the Bureau of Meteorology (BoM, 2015) climate statistics for the nearest weather station at Dampier Salt (site no. 5061) show that mean maximum daily temperatures vary from 36.2 ^{o}C in March to 26.2 ^{o}C in July, and mean minimum daily temperatures vary from 26.5 ^{o}C in February to 13.4 ^{o}C in July. Average annual rainfall is approximately 273 mm and is predominantly associated with tropical cyclones or thunderstorms, while average evapotranspiration for the area generally exceeds 3000 mm.

8.4 Topography and landform

The Ammonia Plant is located at the base of a high scree range cut by steeply inclined valleys, which occur along fault lines and minor drainage lines. The supratidal flat (i.e. tidal flats above the spring high tide line, flushed during storm surge or other events) forms an east to west trending valley at approximately 4 mAHD to the south of the plant. The major landform features found on and adjacent to the Ammonia Plant, from north to south, include:

- a small area of high scree slope on the northern border of the lease
- uplands and upper hill slopes associated with the upper scree slopes
- gentle, low, undulating hill slopes with occasional small rock outcrops and shallow drainage gullies
- supratidal flat (SKM 2001).

The supratidal flat ranges between approximately 2 to 4 mAHD (Golder 2018).

8.5 Hydrology

The hydrology of the site and its surrounds are described as follows:

- fresh water flows are highly variable, characterised by short periods of very high flow that coincide with major rainfall events usually associated with tropical cyclone activity
- these periods of high flow are followed by dry periods sometimes lasting years

- topographical features suggest that surface water has historically flowed in a south southeast direction through the land now occupied by the Ammonia Plant and TAN Plant to the supratidal flat between King Bay and Hearson Cove (ERM 2012a)
- the soils of the lower slopes and tidal flat are highly permeable (ERM 2012a). Surface runoff that is not infiltrated concentrates in trapped low points within the supratidal flat or flows towards King Bay (Golder 2018).

The distances to water sources are shown in Table 8.3.

Table 8.3: Surface water receptors

Surface water receptors	Distance from Ammonia Plant	Environmental value
Surface water (supra-tidal flat between King Bay and Hearson Cove)	The supra-tidal flat between King Bay and Hearson Cove is subject to flooding from storm surge events. A 1:100-year storm is expected to result in a storm surge of 5 mAHD	Supra-tidal flats which connect to King Bay. Mangrove community located 1,000 m east of the boundary of the Ammonia Plant

8.6 Geology and soils

The Burrup Peninsula is composed largely of an intrusive Proterozoic igneous rock outcrop known as the Gidley Granophyre. The base of the intrusion consists of a differentiated coarse-grained gabbro and the main body is a fine-grained granophyre.

The general geological profile of the area was summarised by ERM (2012) based on geotechnical investigations carried out for the TAN Plant. The soil stratigraphy is described as:

- silty or clayey sand: red brown, fine to medium grained, sub angular sand, poorly sorted with gravel being more frequent in the northern area of the Site and occasional cobbles being present, extending from between 0.5 m and 4.0 m
- granophyre: pale grey, generally weathered with rock becoming fresher and less fractured with depth extending to the maximum depth of 5.0 m with dolerite intrusions.

Golder (2001) noted that the granophyre consisted of pale grey and dark grey, fine to medium sized crystals which was distinctly weathered and generally becoming fresher with depth. The bedrock was locally fractured along thin iron-stained quartz seams, generally of high to extreme high strength, extending to a maximum depth of 15 m. Golder (2011) also noted dolerite in one borehole.

The tidal mudflat located in the southern portion of the site are comprised largely of sandy silts to silty sands generally brown to grey in colour with occasional variations of green, yellow and red mottling. The sediments are typically organically rich and often contain a thin veneer of shelly lenses. Soils in the area are generally alkaline due to high carbonate content originating from marine sands and underlying calcrete bedrock (SKM 2001).

The Ammonia Plant itself has been constructed on made ground described by Western Environmental (2015) as:

Approximately 0.5 – 1 m thick and consisting of brown/orange loamy/clay with abundant gravels and cobbles of lithic/mafic origin overlying a red/brown to grey sandy clay material. These materials appear to derive from the colluvial soil and rock in the area.

8.7 Hydrogeology and groundwater

The modelled hydrogeology is based on the following:

- groundwater is predominantly located in fractured rock aquifers where it is stored in the fractures, joints, bedding planes and cavities of the rock mass
- the Hydrogeological Atlas (DoW website) indicates that the upper aquifer in this region is the low permeability, unconfined Pilbara Fractured Rock Aquifer
- groundwater recharge to this aquifer is directly related to rainfall events where water infiltrates the fractures of the surface rock or infiltrates from surface water flows
- these fractured rock aquifers are localised systems with little regional flow
- hyper-saline groundwater typically occurs beneath supratidal flat
- the shallow aquifer in this region is categorised as a Level 1 aquifer which indicates it is shallow and present within superficial deposits which are likely to be unconfined.
- groundwater is generally shallow and follows the surface topography at a depth of between approximately 0.5 and 8 m below ground level; depth to groundwater decreases towards the tidal flat and is anticipated to be higher during spring tides and following significant rainfall events.

A groundwater monitoring network was initially installed in 2003, including bores to the north (up gradient) of the STP infiltration trenches and to the south of the Ammonia Plant in the tidal flat. Groundwater monitoring locations are shown in the Map of Monitoring Locations in Attachment 2.

Over 2017/18, groundwater levels peaked in December 2017 with levels ranging from 4.55 mAHD at bore US1 to 1.87 mAHD at DS1 in the south. Minimum levels occurred in June 2017 and varied from 4.21 mAHD at US1 in the north to 2.08 mAHD at DS1 in the south. The magnitude of the seasonal variation was limited and was greater in the northern bores.

An analysis of groundwater level variations within the TAN Plant indicated that the groundwater levels were not generally influenced by tidal fluctuations (Strategen 2017). Groundwater levels were measured at all locations at high tide and low tide and the differences in tide and groundwater levels were compared. On average, groundwater levels varied by 0.03 m and by no more than 0.1 m; average tidal variation was 2.6 m with a maximum of 3.2 m (Strategen 2017).

Groundwater flow is in a southerly to east south easterly direction towards the supratidal flats and on to King Bay. At levels higher than 2 mAHD, groundwater will daylight in the supratidal flats to the southeast of the Ammonia Plant.

The distances to groundwater are shown in Table 8.4.

Table 8.4: Groundwater receptors

Receptor	Distance from Ammonia Plant	Environmental value
Groundwater	Depth to groundwater at the Ammonia Plant ranges from a maximum of 11 mbgl in the northern, more elevated areas to a minimum of 0.2mbgl in the southern part of the Premises near the supra-tidal flat area). Variation is driven by tidal variation and rainfall. The Ammonia Plant is located within the Pilbara Groundwater Area and Pilbara Surface Water Area (proclaimed under the *Rights in Water Irrigation Act 1914*).	Water is not used for potable or industrial use. Groundwater flows to the southeast, towards the supra-tidal flats which connect to King Bay. Mangrove community located 1,000 m east of the boundary of the Ammonia Plant.

Legend

- Sensitive receptors
- Premises boundary - Ammonia Plant

strategen JBS&G

Job No: 56928

Client: Yara Pilbara Nitrates

Version: A	Date 23/09/2019
Drawn By: cthatcher	Checked By: JB

Scale 1:105,000 at A4

0 1 2
Kilometers

Coord. Sys. GDA 1994 MGA Zone 50

YARA PILBARA FERTILISERS AMMONIA PLANT

SENSITIVE RECEPTORS

Figure 8.1

File Name: W:\Projects\1)Open\Yara Pilbara Nitrates\56928 Seperate licence applications\GIS\Maps\R002_Rev_A\56928_08_1_SensitiveReceptors.mxd
Reference: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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