Rio Tinto

Hamersley Iron Pty Ltd

Dampier Seawater Desalination Plant

Referral Supporting Document

October 2022

RTIO-0213979

Hamersley Iron Pty Limited

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Disclaimer and Limitation

This report has been prepared by Rio Tinto's Iron Ore Group (Rio Tinto), on behalf of Hamersley Iron Pty Limited (the Proponent), specifically for the Dampier Seawater Desalination Plant. Neither the report nor its contents may be referred to without the express approval of Rio Tinto, unless the report has been released for referral and assessment of Proposals.

Document Status					
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Introduction

The purpose of the Referral Supplementary Information (RSI) is to support the referral of a proposal by Hamersley Iron Pty Limited (the Proponent) to develop the Dampier Seawater Desalination Plant (DSDP) with a production capacity of up to 8 GL/a of potable water at Parker Point in the Pilbara region of Western Australia (WA) (Figure ES 1).

The Proposal is a proponent-led mitigation measure to provide an alternative water supply to reduce drawdown on the Bungaroo groundwater aquifer at the Proponent's Pilbara Coastal Water Supply Borefield (which currently conveys water to the Water Corporation's West Pilbara Water Supply Scheme). Once implemented the Proposal will provide a potable water supply for the Proponent's Dampier operations (including Parker Point and East Intercourse Island Ports), the town of Dampier and a connection into the West Pilbara Water Supply Scheme (WPWSS) is proposed. The WPWSS is the primary supply for all towns and ports in the West Pilbara.

This proponent-led mitigation measure clearly demonstrates the Proponent's corporate sustainability values and a commitment to align with both State and Federal Government climate change policy initiatives in a meaningful manner, in particular the WA Climate Change Policy (DWER, 2020). Noting the State Government's concerns about a drying climate, the Proponent has responded with significant investment in identifying climate resilient water sources, in this case desalination, enhancing water security and certainty for water users throughout the Pilbara region.

Assessment process

The *Environmental Protection Act 1986* (EP Act) is the primary legislative instrument for environmental assessment in Western Australia (WA). It specifies procedures for assessment and appeal processes, including responsibilities and functions of the WA Minister for the Environment and the Environmental Protection Authority (EPA). Under Part IV of the EP Act, the EPA is responsible for providing advice to the Minister for significant proposals assessed under Part IV of the EP Act.

The EPA lists several environmental factors that need to be considered in the Environmental Impact Assessment (EIA) process. The Proponent is of the view that the key environmental factors relevant for this Proposal include:

- Marine Environmental Quality
- Social Surroundings.

Other environmental factors considered in the assessment process include:

- Terrestrial Flora and Vegetation
- Terrestrial Fauna
- Marine Fauna
- Benthic Communities and Habitats.

The Proponent notes that a limited section of the development envelope intersects the Dampier Archipelago (including Burrup Peninsula) National Heritage Place (0.9 ha, or 0.002%). This section is within the existing disturbed corridor that contains the Water Corporation water transfer pipelines north and south of the existing Kangaroo Hill tanks (approximately 900 m of water pipelines).

Consultation

The Proponent has undertaken proactive engagement with the local community, government agencies and Traditional Owners regarding the Proposal. The Proponent acknowledges the traditional custodians of Murujuga, which comprise members of five traditional Aboriginal language groups, including the

Ngarluma, Yindjibarndi, Yaburara, Mardudhunera and Wong-Goo-Tt-Oo People, collectively referred to as *Ngurra-ra Ngarli* (alt.*Ngarda-ngarli*). All of these groups were involved with three overlapping native title claims which were historically in place over the Dampier Archipelago, and adjacent mainland.

The Proponent is committed to ongoing consultation with the *Ngurra-ra Ngarli* people, through their representative body, Murujuga Aboriginal Corporation (MAC). The Proposal is also located within the contractual agreement area covered by the *Rio Tinto Ngarluma Indigenous Land Use Agreement (ILUA),* 2011, and the Proponent has undertaken consultation with the Ngarluma people, through their prescribed body corporate, Ngarluma Aboriginal Corporation RNTBC (NAC).

The Proponent's awareness of social and cultural heritage values within the Parker Point area is based on a number of cultural heritage surveys and consultation with Traditional Owners, with the most recent surveys of the Proposal development area being carried out in 2021. The Proponent acknowledges that MAC has been involved in these surveys since 2006 after it became the approved representative body for implementation of the Burrup and Maitland Industrial Estates Agreement (BMIEA).

The Proposal has been carefully designed to avoid impacts to cultural heritage values through restricting the majority of the works to previously disturbed ground, aligning within existing water pipeline corridors and through the implementation of mitigation strategies during construction. Consultation with Traditional Owners has informed the development of the Proposal to ensure it will not have impacts to cultural heritage values, and ongoing consultation with the Traditional Owner groups will occur throughout the construction and operations of this Proposal. The Proponent is committed to supporting each group to achieve the right consultation and engagement balance in accordance with the wishes of Traditional Owners and understands the need for continuous review and engagement with Traditional Owners.

Overview of the proposal

The Proposal's key characteristics are outlined in Table ES-1. The Proposal's summary of the environmental review is provided in Table ES-2. A conceptual visualisation of the desalination plant is shown in

Table ES 1 General description of the Proposal

General Proposal description	
Proposal title	Dampier Seawater Desalination Plant
Proponent name	Hamersley Iron Pty Limited
Short description	Construction and operation of the Dampier Seawater Desalination Plant (DSDP) at Parker Point, located approximately 2.5 km north-east of Dampier township within the Proponent's existing Dampier Port industrial area (Figure 1). The DSDP will have a maximum production capacity of potable water of 8 GL/a and may be delivered in stages to meet water demands. The Proposal includes but is not limited to the following: • Seawater desalination plant • Seawater intake • Outfall to ocean • Water transfer pipelines connecting the plant to potable water tanks and the existing West Pilbara Water Supply Scheme • Other associated supporting infrastructure and services.

Table ES 2 Proposal elements

Proposal elements	Location / description	Maximum extent, capacity or range
Physical elements		
Marine		
Seawater intake	Figure ES 2	Within existing disturbed footprint of seawater intake pond
Outfall to ocean	Figure ES 2	Outfall pipeline attached along wharf Diffuser/s arrangement attached to wharf pile above the seabed
Terrestrial		
Desalination plant, pipelines and other associated infrastructure and services (e.g. power and fibre optic cables, pump/metering station/s, borrow pit/s)	Figure ES 2	Clearing of up to 13.5 ha (0.3 ha within the National Heritage Place) of native vegetation and up to 44 ha of ground disturbance (of already previously cleared land) within a development envelope of 57.5 ha.
Construction elements		
Seawater intake	Figure ES 2	Refurbishment of an existing seawater intake pond Intake pump station structure to be constructed within the seawater intake pond
Outfall to ocean	Figure ES 2	Diffuser/s tethered to Parker Point wharf pile
Desalination plant	Figure ES 2	Import of fill for pad construction Construction of desalination plant
Trenching – terrestrial	Figure ES 2	Open trenching for construction of pipelines (as required)
Operational elements		
Seawater intake	Figure ES 2	Up to 22 GL/a
Outfall	Figure ES 2	Up to 13 GL/a including brine discharge
Desalination plant production capacity	Figure ES 2	Up to 8 GL/a of potable water production
Desalinisation plant design capacity (i.e accept, hold, process etc)	Figure ES 2	Up to 22 GL/a
Greenhouse gas emissions		
Construction elements		
Scope 1	Up to 8,300 t CO_2 e per annum	
Operation elements		
Scope 1	Up to 180 t CO_2 e per annum	
Scope 2	Up to 37,300 t CO_2 e per annum	

Proposal elements	Location / description	Maximum extent, capacity or range
Commissioning		
Desalination plant **Water sourced from ocean and discharged to ocean via diffuser.** ***Process pipelines*** **Pressure testing and disinfection of construction works.** **Reuse of water where practical, sourced from potable supply.** **Water neutralised and discharged to the environment**		
Rehabilitation and Decommissioning		
All areas of native vegetation that are temporarily cleared for construction and commissioning purposes and are not required for operations, will be rehabilitated as soon as practicable after construction. **Removal of all above surface infrastructure.** **Buried pipelines to a depth of 1 m to be decommissioned and removed.**		
Other elements which affect extent of effects on environment		
Proposal time	Maximum project life	Approximately 50 years
	Construction and commissioning phase	Approximately 18 months
	Operation phase	Up to 365 operational days per year

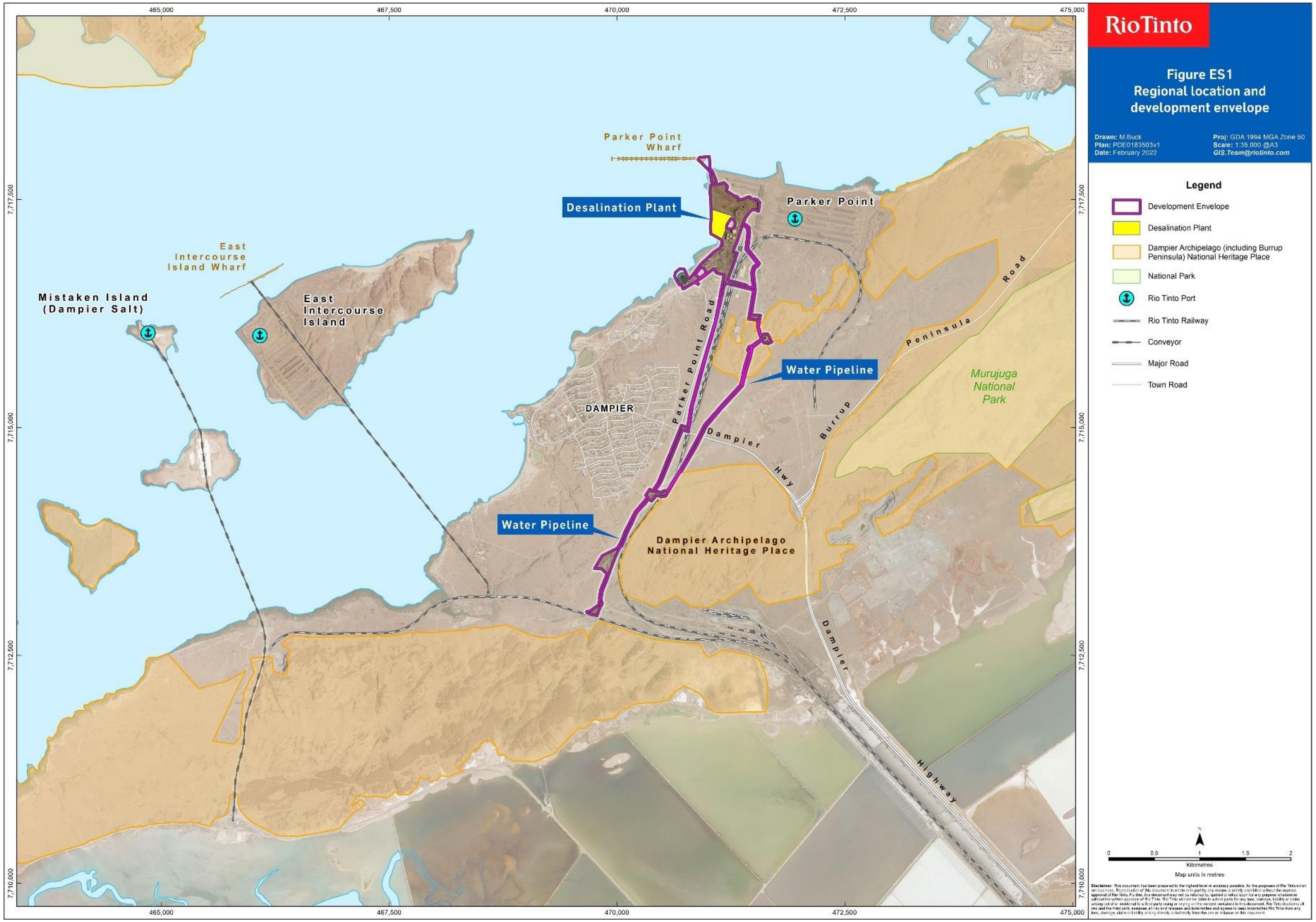

Figure ES 1 Regional location and development envelope

Figure ES 2 Development envelope and indicative footprint

Table ES3: Summary of potential impacts, proposed mitigation and proposed environmental outcomes

Preliminary Environmental Factors	
Marine Environmental Quality	
Potential impacts	**Direct impacts** • Localised changes to the physio-chemical properties affecting water quality as a result of brine discharge to the marine environment. • Potential hydrocarbon release into the marine environment during construction activities, including vessel spills. **Indirect impacts** • Temporary and localised decline in water quality (i.e. increased total suspended solids (turbidity)) during refurbishment of the intake pond.
Mitigation hierarchy	**Avoid** • During construction of the intake pond the systems culverts will be plugged disconnecting the pond's internal basin area from the surrounding marine environment. • Construction activities associated with developing the intake infrastructure have been designed to occur inside the existing intake pond to avoid the release of sediment, contaminants and underwater noise emissions entering the surrounding marine environment. **Minimise** • Dispose of sediments removed from the seawater intake pond to a licenced onshore waste management facility. • All construction activities (vessels and construction plant) will have approved hydrocarbon spill response procedures in place as part of the Proposal Construction Environmental Management Plan (CEMP) (RioTinto, 2022a; Appendix A). • Brine diffuser design will be optimised to maximise dilution with the receiving waters. • The chemicals proposed to be used during the operational phase of the Proposal are considered standard for similar operating Australian desalinisation plants and will either be neutralised or negligible in residual active chemical concentrations. • Water treatment chemicals that do not include aluminium-based chemicals have been selected to avoid known toxicity. • The Operational Environmental Management Plan (EMP) (Rio Tinto, 2022b; Appendix B) presents a robust Environmental Quality Management Framework (EQMF) to confirm the predicted performance of the diffuser. The EQMF will aim to protect a range of environmental values in the area, including ecosystem integrity and cultural and spiritual values. • The EQMF will spatially allocate levels of ecological protection areas (LEPA) surrounding the brine outfall based on ultra-conservative dilution values of 1:222 to determine the location of the HEPA and 1:59 to determine the location of the MEPA. • Modelling of ultra conservative dilution ratios, chosen as a worst-case scenario, have demonstrated that the required ratios can be achieved within the LEPA to achieve a High level of ecological protection (LEP) at the Low/High LEP boundary.
Residual impacts, including assessment of significance	The Proposal will result in a localised change in seawater quality associated with the brine discharge. Given the type and concentration of residual chemical compounds anticipated to be within the brine discharge and rapid dilution of the plume within close proximity of the outfall location, it is not expected to exceed the relevant EQCs. The Proposal is likely to meet the Environmental Quality Objectives set out by the EQMF and is unlikely to compromise the environmental values of the *Dampier Archipelago (including Burrup Peninsula)* marine environment.
Proposed environmental outcomes	The environmental outcomes for MEQ are: *"To meet the Environmental Quality Criteria defined in the Environmental Management Plan (Rio Tinto, 2022b) for a Moderate Level of Ecological*

	Protection inside of the boundary of the revised Low Level of Ecological Protection area as defined in Figure 7-15." And *"To meet the Environmental Quality Criteria defined in the Environmental Management Plan (Rio Tinto, 2022b) for a High Level of Ecological Protection inside of the boundary of the revised Moderate Level of Ecological Protection area as defined in Figure 7-15."*
Assessment of offsets (if relevant)	The Proponent considers the potential impacts to MEQ can be managed such that the Proposal is unlikely to have a significant residual impact on MEQ, and therefore offsets for MEQ are not proposed.
Social Surroundings	
Potential impacts	**Direct impacts** • Disturbance of sites and places of cultural significance, including from pipeline refurbishment work within the Dampier Archipelago (including Burrup Peninsula) National Heritage Place (NHP). • Impacts associated with noise, light emissions and visual amenity **Indirect impacts** • Degradation of sites and places of cultural significance from dust deposition. • Changes to dust deposition for Dampier residents during construction.
Mitigation hierarchy	**Avoid** • The Proposal's infrastructure has been designed and located within areas of existing disturbance where possible. • Realignment of pipeline corridor to avoid identified heritage sites (specifically to the north and south of existing Kangaroo Hill water tanks in the NHP). • Pre-clearance survey work with MAC Rangers prior to ground disturbance to identify unknown sites and ensure the appropriate site delineation, signage and exclusion zones have been applied. **Minimise** • A project specific DSDP Cultural Heritage Management Plan (CHMP) (RioTinto, 2022c; Appendix C) has been prepared, in consultation with MAC, to provide robust management provisions and controls for construction activities associated with implementing the Proposal. The DSDP CHMP is informed by objective-based provisions that clearly define management objectives, supported by management targets, management actions, adaptive management and reporting protocols. • A summary of the mitigation measures provided in the DSDP CHMP (2022) for protection of heritage areas inside the development envelope are provided below. For further specific management targets, actions and reporting protocols, refer to Table 4 in the DSDP CHMP (RioTinto, 2022c). Key management actions include: 1. Conservation zones are to be identified around known heritage sites and petroglyphs that include the immediate visual setting of the particular feature as well as the feature itself and to a minimum distance of 10m from the features recorded boundary as per the Proponents internal site recording processes. 2. Complete pre-clearance monitoring inspections documenting pre-construction site condition. 3. Install site delineation and signage for all heritage sites within 50m of construction activities per the Proponent's Heritage Delineation Procedure (RioTinto, 2021). 4. Cultural heritage inductions are completed with all project personnel. 5. Apply RTIO's internal process Ground Disturbance Approval Request procedure to advise approved work areas and follow, as a minimum, the detailed ground disturbance strategies.

	6. No development is to occur in undisturbed land areas that have not been subject to cultural heritage surveys and assessments. 7. Any major changes to the project footprint or infrastructure layout are to be discussed and agreed with MAC prior to implementation. • Preparation of a Construction Environmental Management Plan (CEMP), which contains specific management measures to minimise indirect impacts (i.e. dust deposition) across the development envelope. • A hard copy of the DSDP CHMP and the CEMP will be kept onsite for reference at all times. **Rehabilitate** No rehabilitation of heritage sites is expected to be required as there is no anticipated disturbance to heritage sites. Regular monitoring will occur during construction in line with the Proponent's Heritage Delineation Procedure (RioTinto, 2021), DSDP CHMP and CEMP. The Proponent is committed to working in partnership with MAC to ensure preservation of the significant Indigenous rock art of the Dampier Archipelago (including Burrup Peninsula) NHP.
Residual impacts, including assessment of significance	**Cultural heritage** Mitigation measures have been built into the Proposal design to mitigate potential impacts to cultural heritage values. The Proposal will not have direct or indirect impacts on any heritage and cultural sites and/or values. A small section of the development envelope intersects the boundary of the Dampier Archipelago (including Burrup Peninsula) National Heritage Place (0.9 ha). The existing water pipeline infrastructure was constructed in 1970-71, before the Dampier Archipelago (including Burrup Peninsula) was listed as a National Heritage Place in 2007, and the boundary was delineated to include this existing water infrastructure. The existing restricted corridor will be used for the installation and replacement of the pipelines for the Proposal. Cultural and heritage values have been identified adjacent to this corridor through previous surveys and more recent site walks with MAC representatives. Key management processes to ensure the Proposal will not have direct or indirect impacts on heritage and cultural sites and values include implementing the project specific DSDP CHMP (2022), which has been prepared in consultation with MAC, in conjunction with the Proposal's CEMP. **Noise, dust, artificial light and visual amenity impacts** Impacts from noise, dust, artificial light and visual impacts are not expected to significantly affect nearby communities, including the town of Dampier, as the project is situated within the operational port facilities of Parker Point and due to the additional mitigation measures proposed.
Proposed environmental outcomes	The Proposal will be implemented to meet the following objectives for social surroundings: *"Avoid, where possible, and minimise direct and project attributable indirect impacts to:* • *social, cultural, heritage and archaeological values within and surrounding the development envelope* • *visual and amenity impacts to social and cultural places and activities* • *potential loss of access to traditional lands".* The Proposal will be implemented to meet the following outcome: "*No direct or indirect impacts to cultural, heritage, and archaeological values within the project area and no direct or indirect impacts to National Heritage Values within the Dampier Archipelago (including Burrup Peninsula) National Heritage Place"*
Assessment of offsets (if relevant)	The Proponent considers the Proposal is unlikely to have a significant residual impact on social surroundings and therefore offsets for social surroundings are not proposed.

Other Environmental Factors	
Benthic Communities and Habitat (BCH)	
Potential impacts	**Indirect** • Indirect impacts on BCH due to changes in water quality from construction of the intake pond and operational brine discharge.
Mitigation hierarchy	**Avoid** • Construction activities associated with developing the intake infrastructure have been designed to occur inside the existing intake pond (which will be plugged to disconnect the pond from the marine environment) to avoid release of sediment and contaminants entering the surrounding marine environment. **Minimise** • The Operational Environmental Management Plan (EMP) (Rio Tinto, 2022b) presents a robust Environmental Quality Management Framework (EQMF) to confirm the predicted performance of the diffuser, that align with the Pilbara EQMF specifically changes to the ones within Mermaid Sound. The EQMF will aim to protect a range of environmental values in the area, including ecosystem integrity and cultural and spiritual values. • The EQMF will spatially allocate environmental values, environmental quality objectives consistent with State Guidelines and Technical Guidance documentation. A LEPA is proposed to be designated as a 70 m buffer surrounding the final outfall location. Modelling has demonstrated that the required dilutions can be achieved within the LEPA to achieve a High level of ecological protection (LEP) at the Low/High LEP boundary. **Rehabilitate** Not applicable.
Residual impacts, including assessment of significance	The Proposal's brine discharge has the potential to impact approximately 1 ha of low quality sparse mixed assemblage (corals, sponges, macroalgae, and zoanthids) benthic habitat. The restricted patch of mixed assemblage habitat is considered to be located in a highly altered and disturbed environment, which has experienced significant port development activities at Parker Point since the 1960's. Considering the localised and negligible scale (approx. 1 ha) of potential benthic habitat at risk of being impacted, the Proponent is of the view that if implemented in accordance with the management measures, it is highly unlikely to present a significant impact to BCH and the EPA's objective for BCH can be met.
Proposed environmental outcomes	As the predicted impacts to BCH are not significant, no environmental conditions or monitoring/management are required, other than those outlined for the MEQ factor. The Proponent will ensure the environmental quality criteria (EQC) are met at the boundaries of the LEP to ensure the environmental outcome for MEQ is achieved.
Assessment of offsets (if relevant)	The Proponent considers the potential impacts to BCH can be managed such that the Proposal is unlikely to have a significant residual impact on BCH, and therefore offsets for BCH are not proposed.
Flora and Vegetation	
Potential impacts	**Direct impacts** • Clearing of conservation significant flora located within the development envelope. • Clearing and degradation of vegetation through clearing and ground disturbance. **Indirect impacts** • Degradation of vegetation due to altered fire regimes during construction and operations. • Degradation of vegetation from increased dust deposition during construction. • Degradation of vegetation due to ingress of weeds and disease during construction.

Mitigation hierarchy	**Avoid**
	• To avoid impacts, the development envelope has been located on highly disturbed, reclaimed land within an established industrial area.
	• Demarcation of exclusion zones surrounding Priority flora records where practicable.
	Minimise
	• Controls related to clearing include:
	  o Clearing of vegetation has been minimised through the design process and will not exceed 13.5 ha.
	  o Ground disturbance and clearing will be undertaken in accordance with the Rio Tinto Projects – Iron Ore: Land Clearing and Disturbance Procedure.
	  o Demarcation of 50 m exclusion zones surrounding records of *Eragrostis surreyana* (Priority 3), where practicable, within the burrow it area of the development envelope.
	• All spark-generating activities will be managed through a hot works permitting system, which manages designated hot works areas and assesses risk to minimise the risk of a fire occurring.
	• The Rio Tinto Projects – Iron Ore: Weed Control Procedure and Equipment Hygiene Inspection Certificate will be used for all vehicles associated with construction of the Proposal, with records retained on a Vehicle Hygiene Register.
	• Weekly weed inspections will be undertaken, with results recorded.
	Rehabilitate
	• All areas that have been cleared for construction and commissioning purposes and which are not required for operations will be rehabilitated as soon as practicable after construction.

Residual impacts, including assessment of significance	No significant impacts are predicted. This is on the basis the development envelope has been located generally within areas that have been previously disturbed with large areas of existing cleared areas (43.2 ha or 75%). The vegetation within the development envelope does not provide significant ecological linkages to the surrounding areas and no species listed as Threatened under the Western Australia (WA) *Biodiversity Conservation Act 2016* or *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) were identified within the development envelope. One P3 species, E. surreyana, was recorded in the development area and up to 751 individuals may be impacted during clearing for burrow material, which represents 5% of records of this species in the Pilbara bioregion. The species was recorded in the 'Disturbed – Artificial Ephemeral Wetland' that was in degraded condition. Given the presence of this species in recently cleared and degraded habitats, it is likely that it will exist in similar habitats elsewhere outside of the study area. The Proponent is committed to carrying out further surveys in similar, suitable habitats, to further understand the distribution of this poorly known species. The Proponent is of the view that further targeted survey work (proposed for 2023) will find additional records of the species across the Burrup Peninsula, further demonstrating that the species local viability has not been impacts by clearing relating to the Proposal.
Proposed environmental outcomes	Based on the implementation of the mitigation hierarchy and management measures proposed, the residual impact of the Proposal to flora and vegetation is the clearing of 13.5 ha of native vegetation within the development envelope. Of the native vegetation, approximately 2.5 ha is in good to very good condition (approximately 20%). None of native vegetation comprises conservation-listed ecological communities and there are no listed Threatened flora present. Given the flora and vegetation communities are well represented regionally, this impact is not considered to be significant and no environmental outcome is proposed.
Assessment of offsets (if relevant)	The Proponent considers the Proposal is unlikely to have a significant residual impact on flora and vegetation; therefore, offsets for flora and vegetation are not proposed.

Terrestrial Fauna	
Potential impacts	**Direct impacts** • Reduction and degradation of fauna habitat. • Loss of or injury to conservation significant fauna individuals. • Impact to fauna from artificial light, noise and fauna-human interactions. **Indirect impacts** Not applicable. **Cumulative impacts** There will not be significant cumulative impacts from the Proposal. This is on the basis the development envelope has been located within an area that has been previously disturbed with large areas of existing cleared areas. The development envelope does not contain any habitats that are considered 'core habitat' for conservation-significant fauna species and none of the recorded fauna habitats are restricted to the development envelope and occur throughout the Dampier area. The habitats are considered to be widespread and common throughout the surrounding area.
Mitigation hierarchy	**Avoid** The desalination plant has been located on highly disturbed, reclaimed land within an established industrial area. The design of the development envelope has specifically avoided areas of higher ecological value, such as higher-quality vegetation and fauna habitat. **Minimise** • Clearing of vegetation has been minimised through the design process and will not exceed 13.5 ha. • Ground disturbance and clearing will be undertaken in accordance with the Rio Tinto Projects – Iron Ore: Land Clearing and Disturbance Procedure. • An appropriately trained Fauna Spotter will be present during the clearing of any native vegetation. • All interactions with fauna will be reported and maintained in a Fauna Register during construction, commissioning and operations. • Vehicle speeds will be limited on all construction roads within the development envelope. • Relevant controls will be included in site induction (as required). • Excavations will be backfilled as soon as possible. • Injured fauna will be managed by appropriately qualified personnel in accordance with the Iron Ore (WA) Wildlife Interaction Guidelines.
Residual impacts, including assessment of significance	As the Proposal avoids impacts to habitat critical to the survival of the species and does not result in fragmentation of key movement corridors, the impacts of habitat removal to the Northern Quoll are not expected to be significant. Although some habitat is considered 'suitable' or 'marginal' for conservation-significant fauna that may occur in the development envelope, AECOM (2021) concluded these habitats are widespread on the Burrup Peninsula and no fauna species are likely to be restricted to or reliant on the habitats present. Furthermore, the majority of the development envelope is already cleared or highly disturbed from existing port and water infrastructure (43.2 ha or 75%) and therefore is unlikely to provide important habitat linkages.
Proposed environmental outcomes	Based on the implementation of the mitigation hierarchy and management measures proposed, the residual impact of the Proposal to terrestrial fauna is the clearing of 13.5 ha of native vegetation within the development envelope. Of the native vegetation, approximately 2.5 ha is in good to very good condition (approx. 20%). There is no important or critical habitat for listed fauna species within the development envelope. Given the fauna habitats are well represented regionally, this impact is not considered to be significant and no environmental outcomes are proposed.
Assessment of offsets (if relevant)	The Proponent considers the Proposal is unlikely to have a significant residual impact on terrestrial fauna and therefore offsets for terrestrial fauna are not proposed.

<table>
<tr><th colspan="2">Marine Fauna</th></tr>
<tr><td>Potential impacts</td><td>Direct impacts
Mortality as a result of interaction with construction vessels.
Behavioural changes due to artificial light spill and underwater noise (from piling activities).
Injury or fatality from impingement and entrainment of marine fauna within the intake pond.
Indirect impacts
Introduction of non-native invasive marine species.
Localised reduction in marine water quality adjacent to the brine outfall.</td></tr>
<tr><td>Mitigation hierarchy</td><td>Avoid
Piling activities will occur within the plugged intake pond and only during daylight hours (i.e. 6am – 6pm) to avoid interacting with nocturnal sawfish species, as well as provide adequate visibility for the Marine Fauna Observers (MFOs) to monitor for marine fauna species within a 100 m exclusion zone surrounding the intake pond.
Implementation of shut-down and soft start procedures.
Vessels will only be used for construction of the outfall pipeline where land-based methods are not fit for purpose. No ballast water exchange will occur during vessel operations to avoid introduction of invasive marine species (IMS) from ballast water.
Screened culverts will prevent marine fauna larger than 150 mm from entering the seawater intake pond. Intake velocity at culverts, located 100 m from intake pipes, will be managed to maintain 0.1 – 0.15 m/s.
Minimise
The following controls will be used to minimise potential impacts associated with lighting:
During construction, all lights will be switched off when not in use.
During operations, lights that do not require to be continually lit will be switched off or activated by motion sensors. The lighting design for the desalination plant will follow the principles of Best Practice Lighting Design outlined in the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia, 2020)
Vessels will travel at less than 8 knots when within 45 m of the Preston Point wharf, as per the Port of Dampier Handbook. Vessels will also adhere to requirements under the Australian National Guidelines for Whale and Dolphin Watching 2017.
On-going monitoring of the intake pond for trapped and/or injured fauna shall be managed by appropriately qualified personnel in accordance with the Iron Ore (WA) Wildlife Interaction Guidelines.</td></tr>
<tr><td>Residual impacts, including assessment of significance</td><td>The Proposal involves activities in that include construction and operation of intake infrastructure and discharge of brine. Both of these key activities have the potential to impact on marine fauna. Considering the construction of the intake pond will be undertaken when the pond is plugged and disconnected from the marine environment, minimising underwater emissions entering the marine environment.

Considering the EQMF management of impacts to marine environmental quality, any impacts to marine fauna are likely to be minor, temporary and / or localised to within the proposed LEPA. Therefore, in relation to the Proposal, the Proponent considers that the EPA’s objective for Marine Fauna has been met.</td></tr>
<tr><td>Proposed environmental outcomes</td><td>Based on the implementation of the mitigation hierarchy and management measures proposed, the Proposal will not have significant residual impacts to marine fauna so no environmental outcomes are proposed.</td></tr>
<tr><td>Assessment of offsets (if relevant)</td><td>The Proponent considers the Proposal is unlikely to have a significant residual impact on marine fauna and therefore offsets for marine fauna are not proposed.</td></tr>
</table>

Other statutory decision-making processes

The Proponent understands that amendments to the EP Act in 2020 provided additional considerations for the EPA, or the Minister for Environment, to take account of other statutory decision-making processes which can mitigate the potential impacts of a proposal on the environment.

In accordance with section 38G(4) of the EP Act, the Proponent is of the view that the EPA would be reasonable in examining and considering to what extent Part V of the EP Act provides adequate regulation of the Proposal. The Proponent notes that the capacity of the Desalinisation Plant has been designed to accept, hold and process up to 22 GL/a, resulting in emission to the environment of up to 13 GL/a of brine discharge and the production of 8 GL/a of potable water. This being the case, the design capacity of the facility meets the Prescribed Premise Criteria of being above 10 GL/a.

Furthermore, the regulatory conditions provided for by Part V Works Approvals and Licencing requirements are considered adequate to regulate and manage the implementation of the Proposal in accordance with the referral documentation and management plans that commit project specific management and mitigation measures to be implemented.

1 INTRODUCTION

Hamersley Iron Pty Limited (the Proponent) is proposing to design, construct, commission and operate a seawater reverse osmosis desalination plant with a capacity of up to 8 GL/a (the Proposal, or the Dampier Seawater Desalination Plant) at Parker Point in the Pilbara region of Western Australia.

The Proposal will establish a reliable potable water supply for the Proponent's Parker Point and East Intercourse Island Dampier port operations, for the township of Dampier and the broader Burrup Peninsula via Water Corporation's existing network.

The key driver for the Proposal is to reduce the groundwater volumes currently abstracted from the inland Pilbara Bungaroo borefield (which currently supplies Water Corporation's West Pilbara Water Supply Scheme) to reduce potential environmental impacts to the Bungaroo aquifer and associated ecosystems.

1.1 Purpose and scope

The purpose of this Referral Supporting Document is to provide a detailed description of the Proposal to inform an Environmental Impact Assessment (EIA) under:

- Section 38 (Part IV) of the *Environmental Protection Act 1986* (EP Act)
- The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

This Supporting Document should be read in conjunction with the EP Act Referral Form and the EPBC Act Referral Form prepared for the Proposal.

In accordance with Environmental Protection Authority's (EPA) *Instructions on how to prepare an Environmental Review Document* (EPA, 2021a), the scope of the document includes a:

- Description of the Proposal (Section 2), including alternatives and justification (Section 2.3)
- Summary of stakeholder engagement undertaken to support the Proposal (Section 4)
- Description of the potential environmental impacts (Section 7 to Section 13)
- Description of the mitigation measures to avoid, minimise or reduce impacts as a result of the Proposal (Section 2.3 and Section 7 to Section 13)
- Description and assessment of the significance of residual environmental impacts of the Proposal on identified environmental principles and factors (Section 7 to Section 13)
- Holistic assessment of potential impacts of the Proposal on the whole environment (Section 15).

1.2 Proponent

The Proponent details are provided in Table 1-1.

Table 1-1: Proponent details

Item	Detail
Company	Hamersley Iron Pty Limited
ACN	0409 092 152
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2 PROPOSAL

This section describes the Proposal and is consistent with the Proposal Content Document. A detailed description of the Proposal is provided to enable the potential environmental impacts to the relevant environmental factors to be identified.

2.1 Proposal content

2.1.1 Proposal description

This Proposal is for the construction and operation of the desalination plant at Parker Point, located approximately 2.5 km north-east of Dampier township within the Proponent’s existing Dampier port industrial area (Figure 2-1).

This Proposal will establish a reliable potable water supply for the Proponent’s Dampier port operation (including Parker Point and East Intercourse Island), Dampier town and connection into Water Corporation’s West Pilbara Water Supply Scheme (WPWSS). The desalination plant may be delivered in stages up to a maximum production capacity of 8 GL/a of potable water to meet future water demands.

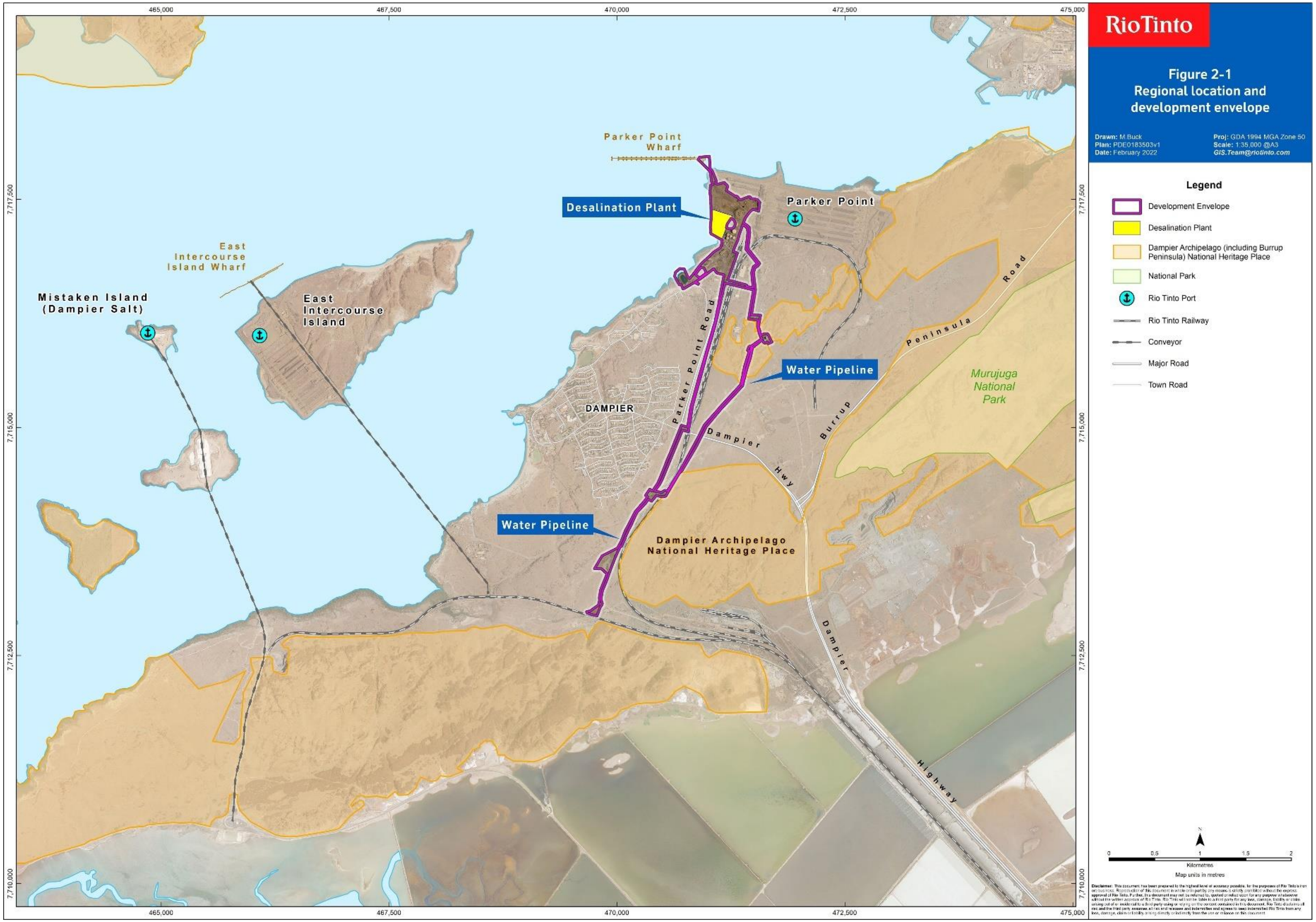


Figure 2-1: Location of the proposed desalination plant

Table 2-1: General Proposal description

General Proposal description	
Proposal title	Dampier Seawater Desalination Plant
Proponent name	Hamersley Iron Pty Limited
Short description	Construction and operation of the Dampier Seawater Desalination Plant (DSDP) at Parker Point, located approximately 2.5 km north-east of Dampier township within the Proponent's existing Dampier Port industrial area (Figure 1). The DSDP will have a maximum production capacity of 8 GL/a of potable water and may be delivered in stages to meet water demands. The Proposal includes but is not limited to the following: • Seawater desalination plant • Seawater intake (approx. 22 GL/a) • Outfall to ocean (approx. 13 GL/a) • Water transfer pipelines connecting the plant to potable water tanks and the existing West Pilbara Water Supply Scheme • Other associated supporting infrastructure and services.

Seawater desalination plant, seawater intake and outfall

To reduce the potential for environmental impacts from native vegetation clearing, the desalination plant will be constructed on a disturbed area of land reclaimed by historic dredge deposition activities, south of the Parker Point wharf. Seawater intake of 22 GL/a will be located within the existing intake pond to the south-west of the desalination plant (previously used as a cooling-water pond for the decommissioned power station), to minimise the Proposal's impact to the marine environment. The desalination plant brine stream of 13 GL/a will be discharged to the ocean via an outfall located along the existing Parker Point wharf. In short, from the intake of 22 GL/a and discharge of 13 GL/a, 8 GL/a of potable water will be produced.

Delivery

The preferred delivery location for all produced water is via Water Corporation's existing Kangaroo Hill tanks. To support this, the Proponent is in the process of finalising an amendment to its existing Water Transfer Agreement with Water Corporation. An alternative delivery location has been included in this Proposal to allow for an independent pathway. This involves delivering water to a proposed new tank that would be located near Kangaroo Hill (Figure 2-2).

Water transfer pipelines

The water transfer pipelines that have been included in this Proposal to connect the desalination plant with the existing potable water networks are:

- Pipeline from the desalination plant to Water Corporation's existing Kangaroo Hill tanks (or the existing tank near Kangaroo Hill).
- Pipeline from the existing Kangaroo Hill tanks to Dampier town and the existing East Intercourse Island (EII) water supply main.

Water transfer to all other locations will be through existing Rio Tinto or Water Corporation pipeline infrastructure.

The Proposal may be developed in multiple stages up to a maximum production capacity of potable water of 8 GL/a.

2.1.2 Proposal elements

2.1.2.1 Development envelope and indicative footprint

The Proposal development envelope and indicative footprint are shown in Figure 2-2.

The development envelope covers a total area of 57.5 ha and comprises the:

- Seawater intake – located within an existing intake pond
- Outfall – located along the Parker Point wharf
- Desalination plant site – within an existing disturbed and cleared area
- Pipelines and other associated infrastructure and services, including:
    - Process pipelines between seawater intake/outfall and the desalination plant
    - Water transfer pipelines – connecting the desalination plant with the existing potable water networks, largely aligned along existing disturbed corridors and including a contingency corridor
    - Borrow pits – borrow material potentially sourced from existing disturbed borrow areas within the Proponent's lease
    - Supporting infrastructure and services (e.g., power and fibre optic cables, booster/meter pump stations and switch room, offices, etc).

The contingency corridor has been included, should the preferred delivery location for all produced water via Water Corporation's existing Kangaroo Hill tanks not progress. An alternative delivery location has been included in this Proposal to allow for an independent pathway, which involves delivering water to a proposed new tank that would be located near Kangaroo Hill.

The development envelope contains all the Proposal's construction and operational activities; the indicative footprint will be refined within the development envelope based on the final design. Disturbance has been calculated as 57.5 ha for the entire development envelope, noting that 75% of the development envelope is already pre-cleared or disturbed.

A small section of the development envelope (approximately 0.9 ha, or 0.002% of the total National Heritage Place area) intersects the Dampier Archipelago (including Burrup Peninsula) National Heritage Place. This section is within the existing disturbed corridor that contains the Water Corporation water transfer pipelines north and south of the existing Kangaroo Hill tanks (approximately 900 m of water pipelines). Within the intersection of 0.9 ha of NHP, 0.3 ha of native vegetation will be removed and the remaining is already disturbed.

Figure 2-2: Development envelope and indicative footprint (Map 1-3)

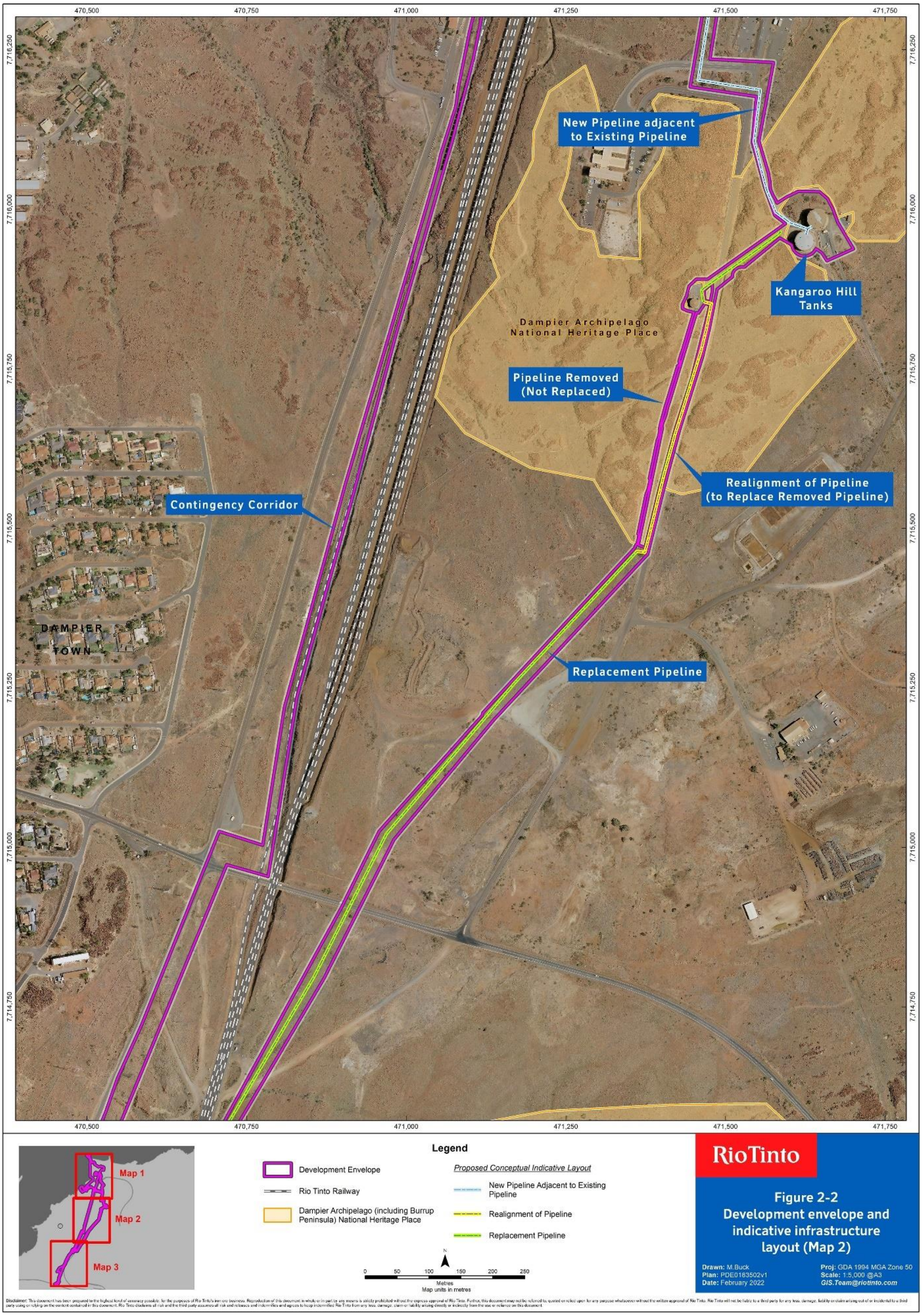


Figure 2-2
Development envelope and indicative infrastructure layout (Map 2)

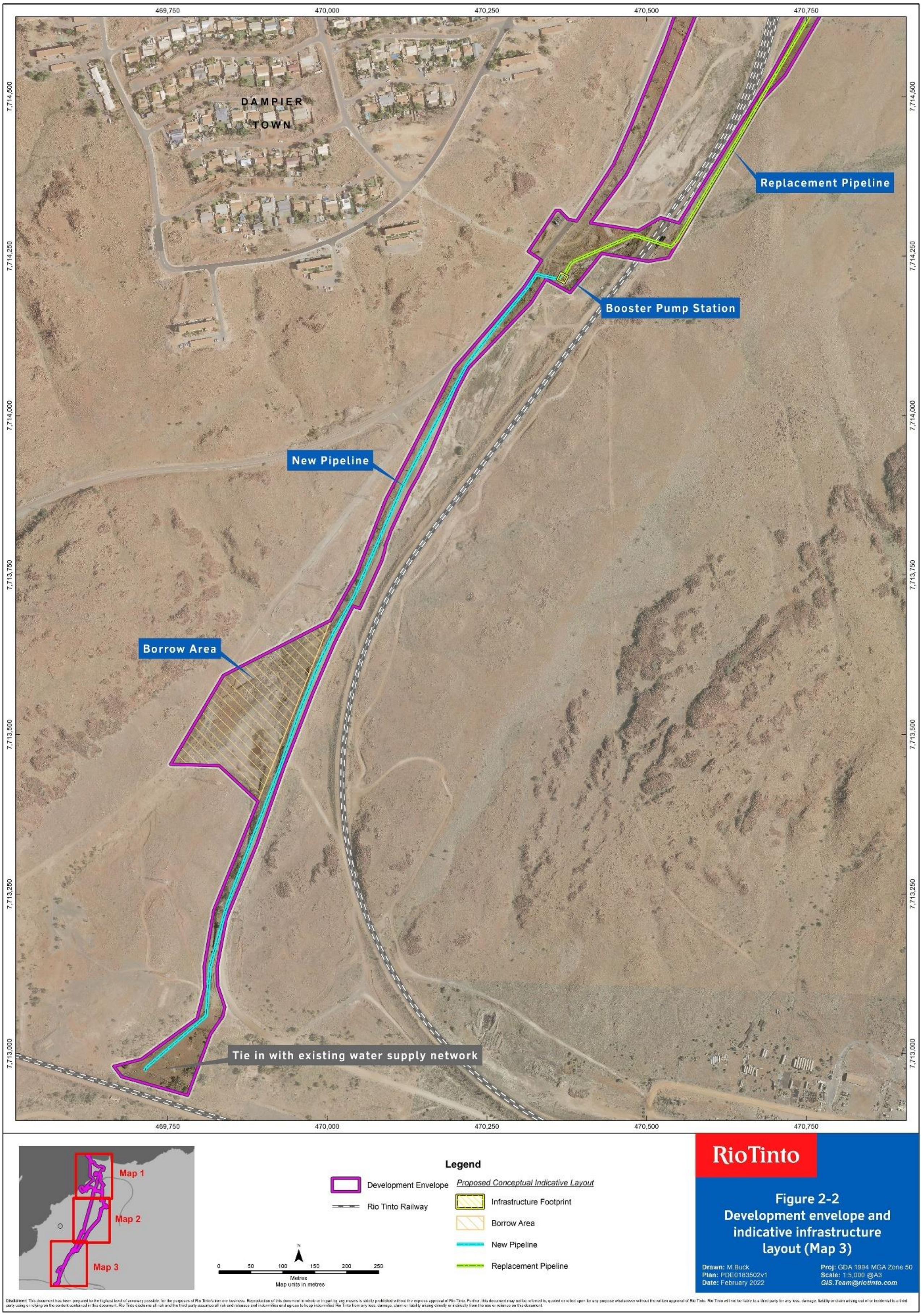


Figure 2-2
Development envelope and indicative infrastructure layout (Map 3)

2.1.2.2 Key Proposal elements

The key Proposal elements are outlined in Table 2-2. Maximum plant capacities associated with the Proposal have been provided by the Proponent or assumed for the purpose of the Supporting Document and EIA.

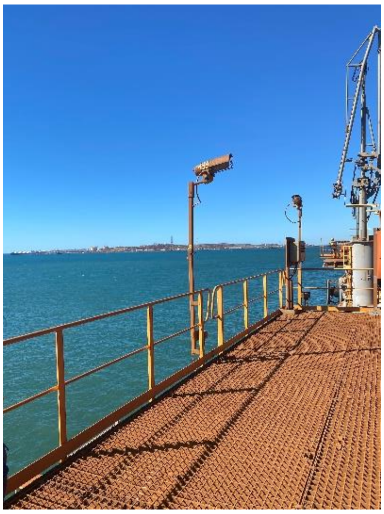
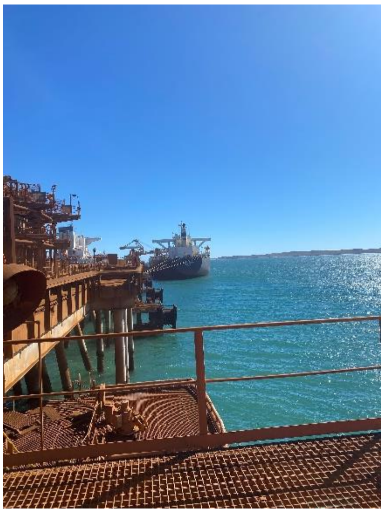
Photos of the existing environment for the Proposal elements are shown in Table 2-3.

Table 2-2: Proposal content elements

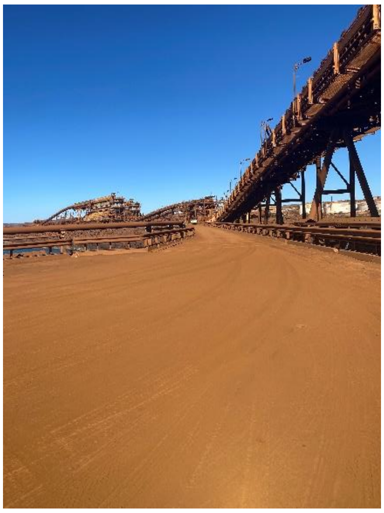
Proposal elements	Location / description	Maximum extent, capacity or range
Physical elements		
Marine		
Seawater intake	Figure ES 2	Within existing disturbed footprint of seawater intake pond
Outfall to ocean	Figure ES 2	Outfall pipeline attached along wharf Diffuser/s arrangement attached to wharf pile above the seabed
Terrestrial		
Desalination plant, pipelines and other associated infrastructure and services (e.g. power and fibre optic cables, pump/metering station/s, borrow pit/s)	Figure ES 2	The development envelope covers an area of 57.5 ha, within which up to 13.5 ha of native vegetation will be cleared. Of the 13.5 ha of native vegetation to be cleared, 0.3 ha is in the National Heritage Place.
Construction elements		
Seawater intake	Figure ES 2	Refurbishment of an existing seawater intake pond Intake pump station structure to be constructed within the seawater intake pond
Outfall to ocean	Figure ES 2	Diffuser secured to Parker Point wharf pile
Desalination plant	Figure ES 2	Import of fill for pad construction Construction of desalination plant
Trenching – terrestrial	Figure ES 2	Open trenching for construction of pipelines (as required)
Operational elements		
Seawater intake	Figure ES 2	Up to 22 GL/a
Outfall	Figure ES 2	Up to 13 GL/a including brine discharge
Desalination plant production capacity	Figure ES 2	Up to 8 GL/a of potable water production
Desalinisation plant design capacity (i.e accept, hold, process etc)		Up to 22 GL/a
Greenhouse gas emissions		
Construction elements		
Scope 1	Up to 8,300 t CO_2 e per annum	
Operation elements		
Scope 1	Up to 180 t CO2 e per annum	
Scope 2	Up to 37,300 t CO2 e per annum	

Proposal elements	Location / description	Maximum extent, capacity or range
Commissioning		
Desalination plant **Water sourced from ocean and discharged to ocean via diffuser.** ***Process pipelines*** **Pressure testing and disinfection of construction works.** **Reuse of water where practical, sourced from potable supply.** **Water neutralised and discharged to the environment**		
Rehabilitation and Decommissioning		
All areas of native vegetation temporarily cleared for construction and commissioning purposes which are not required for operations will be rehabilitated as soon as practicable after construction. **Removal of all above surface infrastructure.** **Buried pipelines to a depth of 1 m to be decommissioned and removed.**		
Other elements which affect extent of effects on environment		
Proposal time	Maximum project life	Approximately 50 years
	Construction and commissioning phase	Approximately 18 months
	Operation phase	Up to 365 operational days per year

Table 2-3: Photos of the existing environment for the Proposal elements

 Proposed seawater intake pond	 Proposed seawater intake pond
 Proposed outfall infrastructure location	 Proposed outfall infrastructure location
 Proposed desalination plant location	

Proposed intake pipeline from intake pumps to desalination plant



Proposed outfall pipeline location from the desalination plant to outfall

Proposed pipeline location from the desalination plant to the existing Kangaroo Hill tanks

Proposed pipeline location from existing Kangaroo Hill tanks to a connection point with the existing pipeline to EII

2.1.2.3 Desalination process overview

A schematic of the desalination process is shown in Figure 2-3. The desalination process involves:

- Pre-treatment:
  - Physical screens remove coarse particulates
  - Water is dosed with hypochlorite to prevent fouling through the desalination process.
  - Ultra-filtration membranes to remove fine particles.
- Removal of dissolved salts:
  - Seawater reverse osmosis (SWRO) via passing pressurised seawater through semi-permeable membranes to separate out dissolved salts and ions.
  - A second pass of the brackish water through semi-permeable membranes to further exclude dissolved salts and ions.

- Treatment of the output water:
    - Treatment of output water (permeate) to achieve potable drinking water quality via remineralisation, pH correction, chlorination and fluoridation.

The desalinisation process and chemical use proposed is typical of current operating plants across the State and Nationally.

Backwash wastewater from the pre-treatment stage and the brine generated from the reverse osmosis process will only be discharged back to the ocean through the outfall once the material is treated to ensure it is suitable for discharge to the environment.

A Dissolved Air Flotation (DAF) unit has been designed to form part of the system and come online when extreme weather events (i.e. cyclonic activities) create elevated levels of suspended solids that require filtration and management. It is important to note that when the DAF unit is using iron-based coagulants or organic flocculants to enhance its performance, the generated waste will be collected and disposed at an appropriate offsite waste disposal facility, rather than returned to the outfall, to prevent these chemicals entering the marine environment.

More details on the desalination process can be found in section 3.2 of Appendix D.

2.1.2.4 Capacity staging

The desalination plant may be delivered in the stages shown in Table 2-4 to meet future water demand.

Table 2-4: Possible stages of construction

Stage	Plant capacity	Construction of intake and outfall works	Delivery of drinking water
1	4 GL/a	Majority of construction for an 8 GL/a intake and outfall infrastructure completed in Stage 1	4 GL/a to existing Kangaroo Hill storage tanks
2	8 GL/a	Majority of construction completed in Stage 1	8 GL/a to existing Kangaroo Hill storage tanks
[1] Delivery location requires a service agreement with Water Corporation and may be subject to change. Alternative delivery locations will remain within the proposed development envelope and within the proposed capacity of 8 GL/a.			

The timing of each stage will be based on the region's water demands and, if required, Stages 1 and 2 will be merged. To facilitate effective staging, bulk earthworks for the Proposal may be completed to facilitate both stages during Stage 1 construction. Environmental impacts considered in this Supporting Document have been assessed based on the development of Stage 1 and 2.

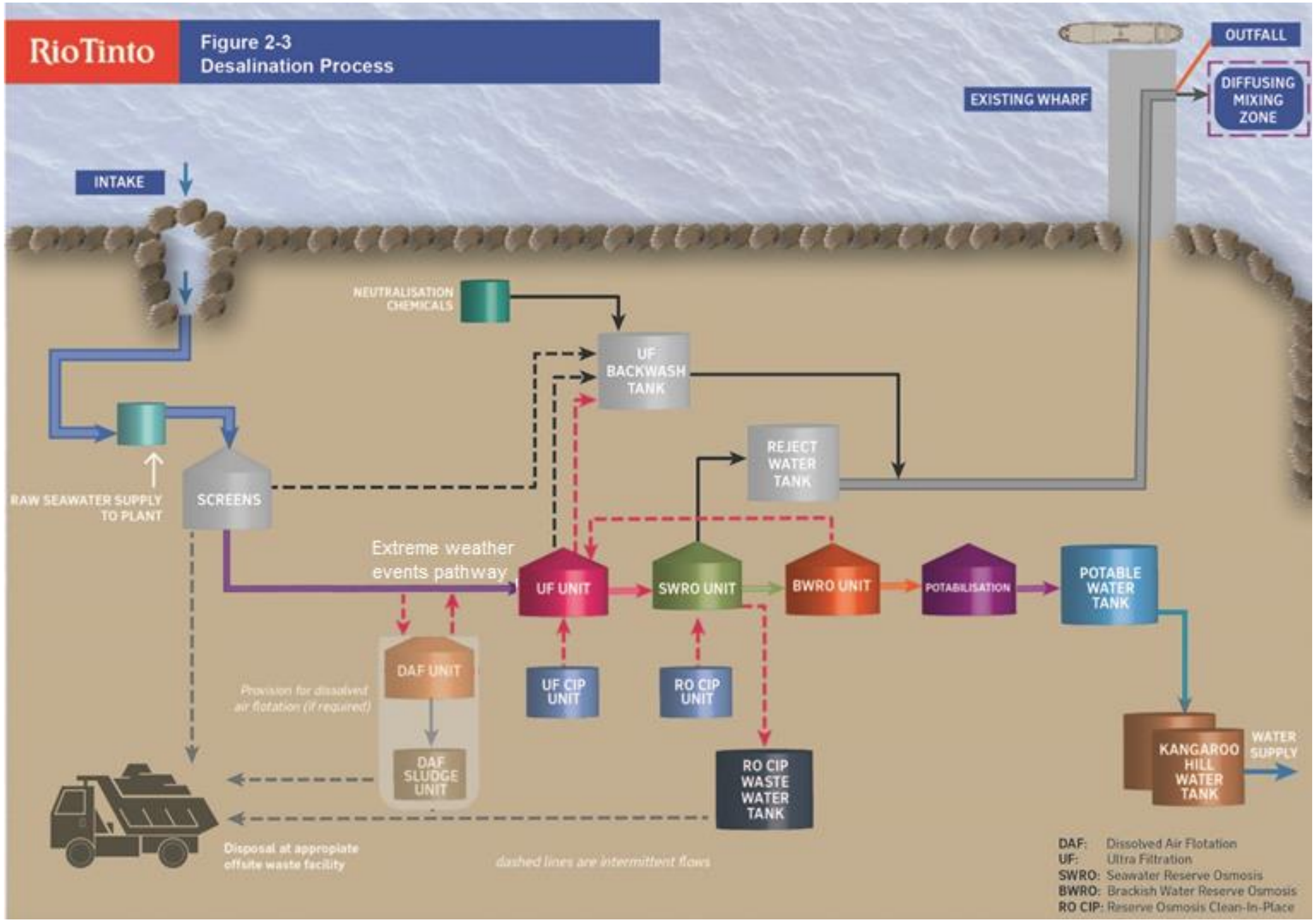


Figure 2-3: Seawater reverse osmosis desalination process

2.2 Project life cycle

This section provides a summary of construction, commissioning and operational activities relevant for EIA of key proposal elements. The most likely methods used for each stage are provided, however methods may be further refined following more detailed engineering work. Any refinements will still ensure activities remain low risk to key proposal elements.

Further details on engineering design and the desalination process are provided in Appendix D.

2.2.1 Construction activities

2.2.1.1 Existing intake pond

The existing intake pond at Parker Point has been selected as the proposed location for the seawater intake pond (Figure 2-4). This site has been chosen to minimise impacts to the marine environment. Use of the existing pond avoids the need to construct an entirely new seawater intake site, which would require significant construction works in the marine environment.

Figure 2-4: Existing intake pond

2.2.1.2 Intake construction

The initial construction activities around the existing intake pond will involve refurbishment of the artificial pond and culverts which link the pond to the ocean. Some sparse (less than 10% cover) turf algae, microalgae and corals are present on the rocks and rubble surrounding the seawater intake, but no restricted or locally significant benthic communities or habitat were identified (MScience, 2021a).

Culvert refurbishment

The existing bar screens in front of the culverts (on the ocean side) will be replaced with new 150 mm aperture screens and a small volume of material will be excavated from in front of the culverts (Figure 2-5). The inside of the culverts will be cleaned to remove any biological and sediment build-up. This work is likely to be done using underwater jetting or vacuuming, with dislodged material directed towards the seawater intake pond.

Figure 2-5: Culvert bar screens

Removal of existing built-up sediment from the seawater intake pond

The culverts will be completely blocked on the intake side and sediment will then be removed from the base of the seawater intake pond to return it to originally constructed levels. During construction, a silt curtain will be set up on the ocean side of the culverts to minimise sediment dispersion beyond the existing intake pond during these works. This work will be done by a long-reach excavator or other suitable equipment. A dedicated area will be established adjacent to the seawater intake pond where the excavated material will be temporarily stockpiled (Figure 2-7). Further details on construction methods of the intake pond can be found in section 1 of Appendix D.

A dedicated management area will be established adjacent to the seawater intake pond where the excavated material from the intake pond will be temporarily stockpiled and dewatered as required. This management area (shown in Figure x-x) will be engineered to ensure the containment of the slurry material within a lined and bunded cell, which allows for settling and separation of the material to occur. The dewater that is separated from the slurry matrix, which will also consist of captured stormwater runoff, will be directed back into the intake pond and the solid material will be transported to a licenced waste management facility.

Construction of the intake structure

The temporary causeway (if required) will remain in place to provide access for the drill-based piling activities which are required to construct the seawater intake structure (Figure 2-6).

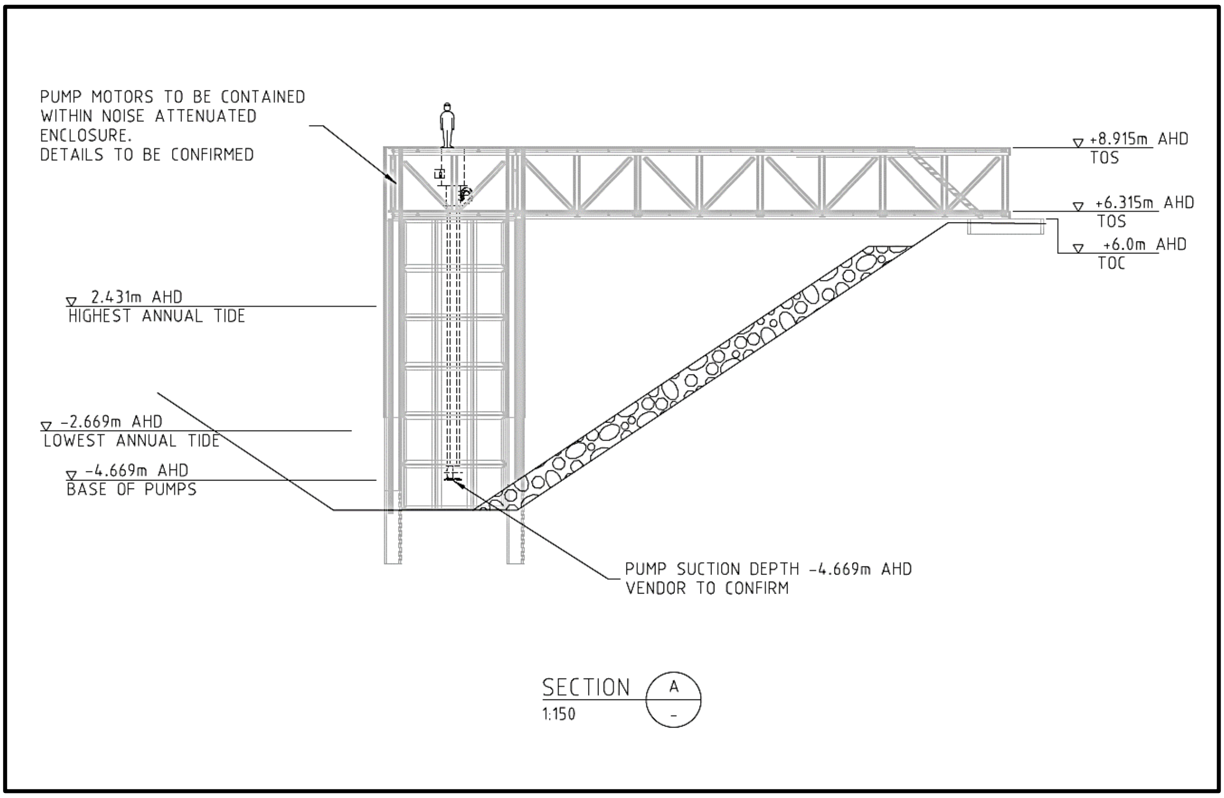


Figure 2-6: Indicative cross-section design of seawater intake

Up to six piles will be installed using drilling methods to minimise noise and vibration associated with the works to both the marine environment and to the community of Dampier. A mesh screen will be installed around the intake pumps to avoid entrapment of debris and marine life.

Figure 2-7: Drainage diversion at the seawater intake pond

2.2.1.3 Service corridors

Service corridors will be established within the development envelope between the existing intake pond and the desalination plant and between the desalination plant and tie-in locations to existing services, including potable water, power and fibre optics. The establishment of service corridors will include:

- Land disturbance within corridors ranging from 8 to 20 m wide
- Earthworks to achieve the required surface levels
- Construction of drainage along the corridor, including v-drains and culverts where required
- Excavation of open trenches to bury pipelines, power and fibre optics.

The requirements for trenching will vary depending on the ground conditions. The water table is not expected to be intercepted during trenching. Trenches will be backfilled either by using the material originally excavated, if suitable, or clean imported material.

2.2.1.4 Plant

The desalination plant site will be constructed on an area of land reclaimed by historic dredge spoil deposition activities (Figure 2-8). Depending on ground condition, ground improvement may be required to mitigate the risk of settlement. The preferred method is to remove the existing material and replace it in compacted layers. Any required fill will be sourced from nominated existing borrow pits or purchased from existing local commercial quarries.

Site drainage will be directed to the existing open drainage channel along the eastern side of the desalination plant site via a new v-drain around the plant perimeter.

Figure 2-8: Plant site location

A conceptual visualisation of the desalination plant is shown in Figure 2-9.

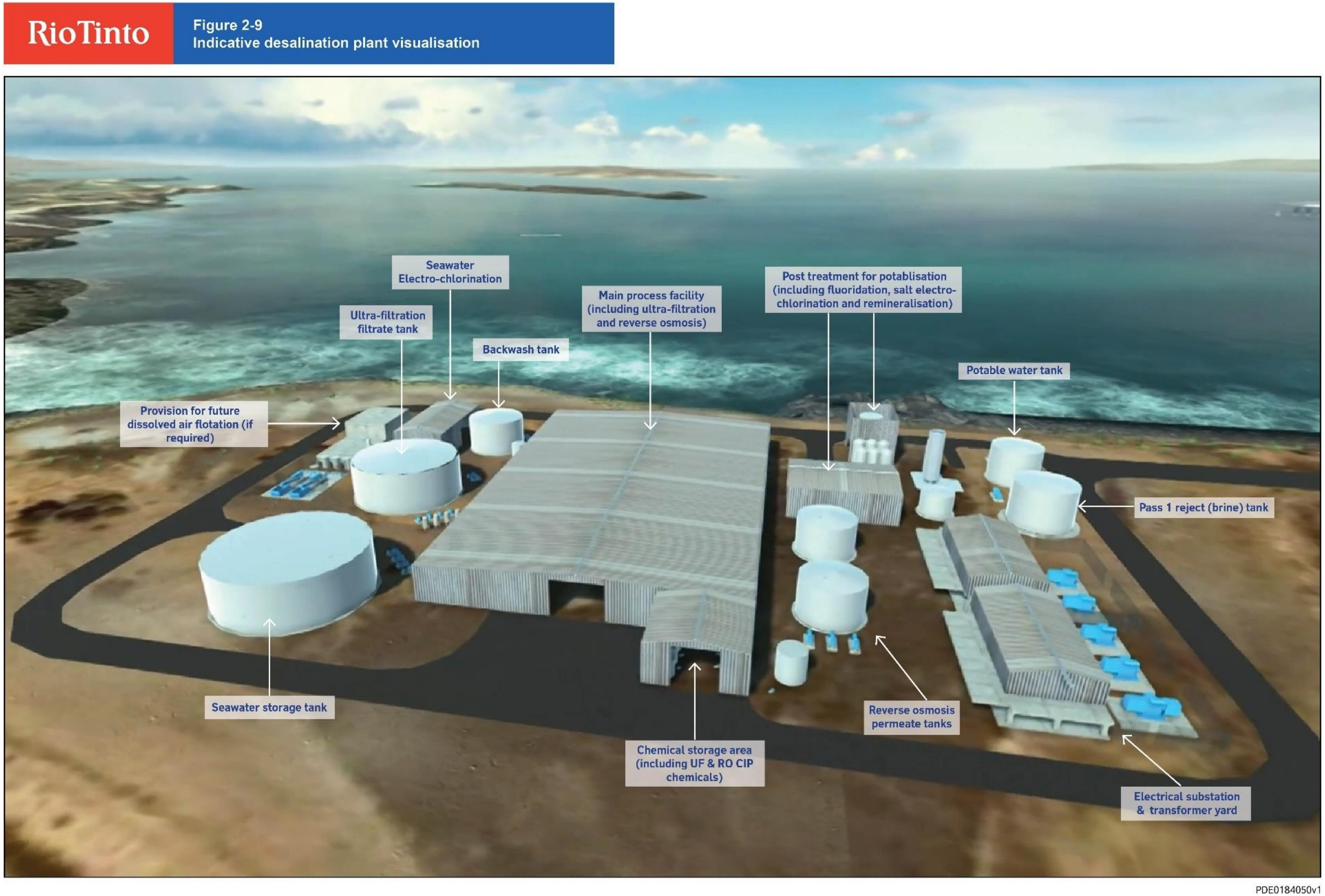


Figure 2-9: Indicative desalination plant visualisation

2.2.1.5 Outfall

Brine, ultra-filtration backwash and treated clean-in-place (CIP) wastewater from the desalination plant will be conveyed via a pipeline to the diffuser location along the Parker Point wharf. The pipeline will be buried overland from the desalination plant to the start of the Parker Point wharf to minimise heat transfer from higher ambient air temperatures. A services corridor between the desalination plant and the start of the wharf will be established for the outfall pipelines, including:

- Land disturbance within a corridor no greater than 15 m wide
- Excavation of open trenches to bury the services
- Backfilling of trenches by using the material originally excavated, if suitable, or imported material.

The pipeline along the wharf will be installed from the shore and/or off the wharf where feasible; however, it is likely construction vessels will be required to support the construction activities. Construction vessels may anchor alongside the wharf.

The diffuser design is expected to comprise a single arrangement fitted to a single wharf pile submerged below sea level. The indicative location of the diffuser is shown in Figure 2-10.

Figure 2-10: Indicative location of diffuser

One outfall diffuser will be installed initially for Stage 1, with a further diffuser installed to meet the discharge requirements of Stage 2. The diffusers will be sized to achieve an exit velocity of 3 to 6 m/s (Table 2-5). The diffuser pieces will either be lifted in place from the wharf or from a construction barge and fixed to the wharf piles using divers. An example diffuser design arrangement is shown in Figure 2-11.

Table 2-5: Outfall specifications

Item	Unit
Number of outlets	Two diffuser arrangements (one for each stage)
Outlet depth	Outlets will be oriented to discharged upwards at an angle of 45 degrees
Outlet diameter	Each outlet 250 mm
Outlet velocity	3 to 6 m/s for each port

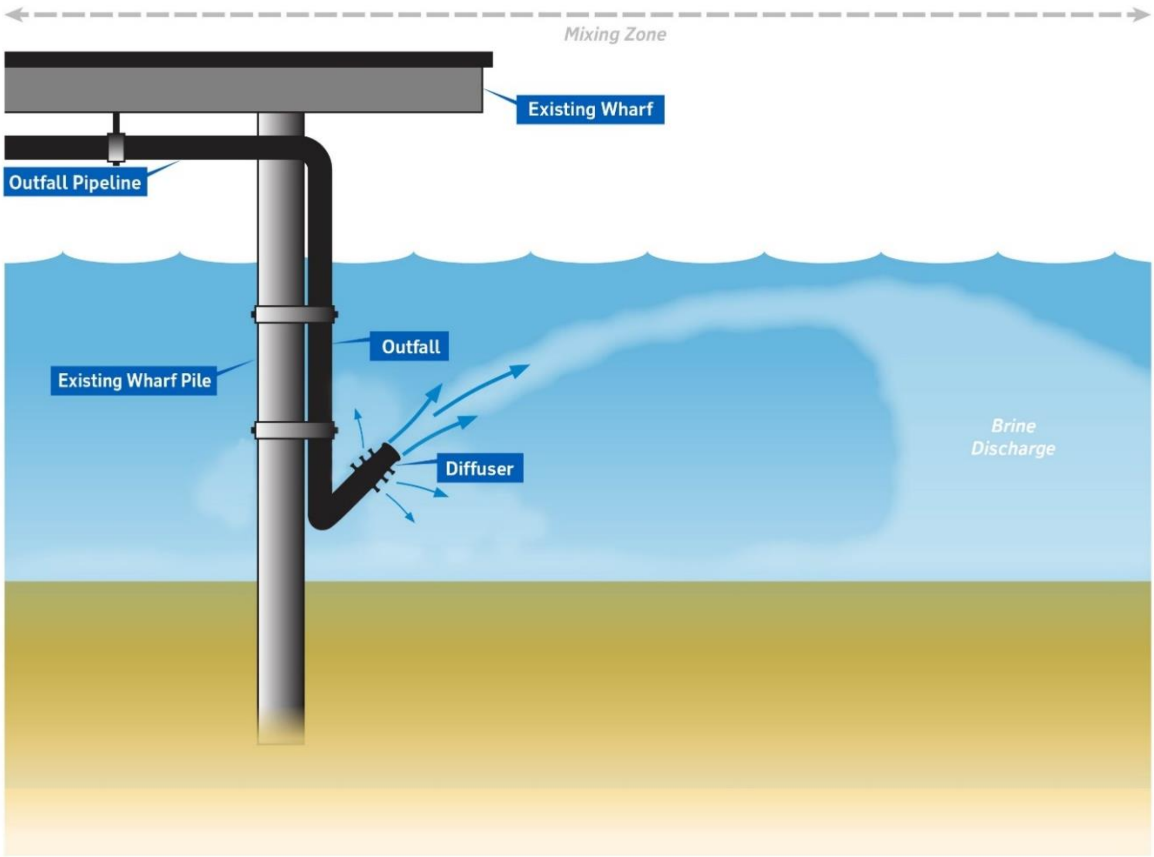


Figure 2-11: Indicative diffuser arrangement

2.2.1.6 Water transfer pipelines

The construction of the water transfer pipelines includes:

- New pipeline installed from the desalination plant to the existing pipeline corridor and to the existing Kangaroo Hill tanks. This pipeline will be 350 to 450 mm in diameter, largely above ground, and will follow existing pipelines for the majority of its alignment. In the NHP near the existing Kangaroo Hill tanks, the new pipeline will be constructed immediately adjacent to an existing pipeline and has been designed to have no impact on the national heritage values within the NHP.
- New pipeline from the booster pump station to existing pipeline to East Intercourse Island.
- Removal of existing pipeline and realignment along the existing road corridor (private road) south of existing Kangaroo Hill tanks within the NHP (approximately 400 m).
- Replacement of existing pipeline south of the NHP to the booster pump station.

These water transfer pipelines are shown in Figure 2-2, and the existing water pipelines through the NHP are shown in Figure 2-12.

The water transfer pipelines will generally be constructed above-ground to avoid excavation of hard rock (bedrock) and to allow easy access for maintenance. Above-ground pipelines will be held in place with pipe supports and anchorage where required. Some excavation may be needed to bury the bases of the pipe supports.

Below-ground installation will be adopted where above-ground installation is not feasible, such as road and railway crossings. Most below-ground piping will be installed using open trenching methods. Trenching requirements will vary, depending on specific ground conditions.

Railway crossings will be installed using trenchless methods, which will involve tunnel boring, pipe jacking or horizontal directional drilling.

The water transfer pipelines' construction will involve:

- land disturbance within a corridor up to approximately 15 m wide[1]; where feasible, construction of the pipeline route will be limited to already cleared areas and follow existing roads to minimise disturbance
- excavation of open trenches to bury the services
- backfilling of trenches, as soon as practicable, either by using the material originally excavated, if suitable, or imported material.

The existing water transfer pipelines north and south of the existing Kangaroo Hill tanks intersect the Dampier Archipelago (including Burrup Peninsula) NHP. The existing restricted corridor will be used for installation of the pipeline within and near the boundary of the NHP.

Photos of the existing water pipelines through the NHP are shown in Figure 2-13. The approximately 400 m section of pipeline south of the existing Kangaroo Hill tanks is close to rocky outcrops; therefore, to avoid potential impacts to nearby heritage values, the pipeline will not be replaced. Instead, this section of pipeline will be realigned to follow along the existing road corridor (private road) to the east (Figure 2-12).

[1] With the exception of launch and receive pits required at the trenchless crossings beneath railways which may require up to a 20 m x 20 m area

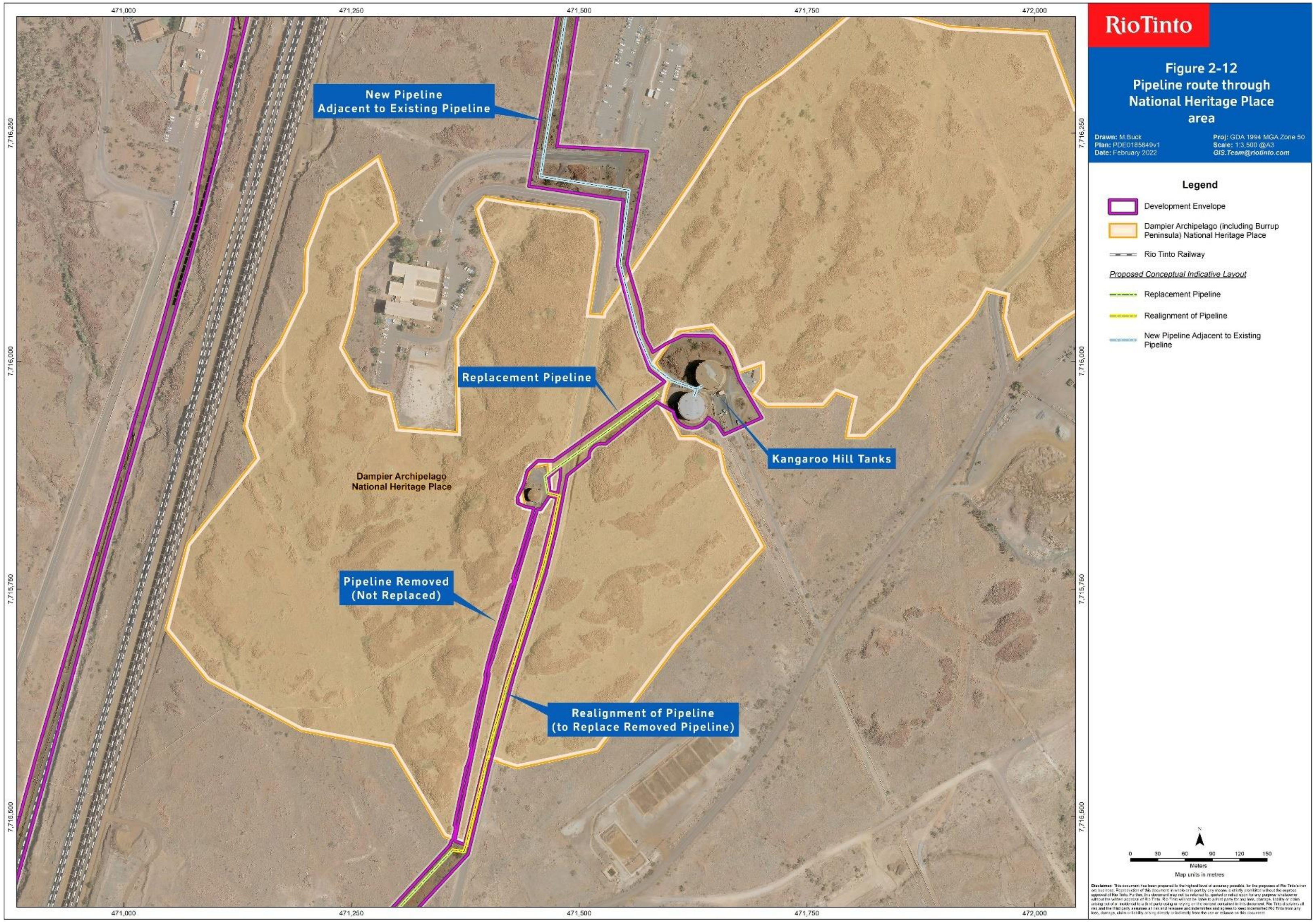


Figure 2-12: Pipeline route through the National Heritage Place

Figure 2-13: Existing environment along pipeline alignment through National Heritage Place

2.2.1.7 Additional construction activities

During construction, the following activities will also occur within the development envelope:

- Construction areas will have artificial lighting to provide safe working conditions. Areas will be lit to the minimum extent for safe working conditions and only areas where works are being performed, or which are critical to safe movements around the site, will be lit.
- Construction vehicles will move heavy machinery and equipment. Light vehicles will transport the construction workforce to and around the site. It is expected the construction vehicles will enter the site through one main entrance. However, where required, additional temporary entrances may be needed. These will be closed following construction activities. Where possible, entrances will be limited to avoid multiple interactions with the adjoining public roads.
- Hot works, such as welding, will be required throughout operations. These will be performed in accordance with established Rio Tinto hot works procedures.
- Amenities will be provided onsite for the construction workforce, including crib huts, meeting rooms and temporary office spaces and ablution facilities. No accommodation will be provided onsite.
- Temporary stormwater control will be installed where required and will be designed to prevent water egress to construction areas and minimise sediment runoff outside the development envelope.
- All solid and liquid waste will be managed onsite and collected for disposal at appropriate offsite facilities.
- Chemical storage areas will be established to comply with relevant Australian standards. These will include bunded, lined areas that will be rehabilitated before operations begin.
- Laydown areas will be set up as required. When they are no longer in use, they will be rehabilitated as soon as practicable, and before operations begin.
- Topsoil and vegetation will be removed from the permanent infrastructure footprint, as well as the areas needed for temporary construction activities. It will be temporarily stockpiled during construction and be used to rehabilitate temporary construction areas before operations begin.

2.2.2 Commissioning

Testing and commissioning will take three to six months and will be managed via a Commissioning Plan and dedicated Manager and team. Commissioning will involve flushing all components of the desalination plant with either seawater or potable water (depending on the area being flushed). Discharge points will be controlled under the requirements of a Part V licence. All commissioning water will be treated (removal of debris with screens, neutralisation of chlorine, etc) before discharge to either the outfall diffuser or terrestrial environment. The discharge points will be located away from key identified environmental and cultural heritage receptors and not within the NHP.

Further engineering details on the commissioning stage of a desalination plant are provided in section 3 of Appendix D.

2.2.3 Operations

This section provides an overview of operational activities relevant to EIA. Further engineering details on the operation of a desalination plant are provided in section 3 of Appendix D.

2.2.3.1 Intake

Up to 22 GL/a of sea water will be extracted from within the intake pond, which fills naturally through tidal inflows and inundation. The intake pipe has been designed to be located at the far side of the pond, approximately 100 m from the screened entrance. The location and meshed screen covering the intake turbine pipes provides an additional barrier to the movement of marine fauna and potential entrapment within the system. The design of the intake pump to avoid potential impacts is discussed further in section 2.1.2.3.

To enable maintenance of the existing intake pond infrastructure, when sediment has built up over time in the existing intake pond, it will require desilting. This would involve similar activities to the initial intake pond excavation described in Section 2.2.1.1.

2.2.3.1.1 Chemical use in desalination treatment processes

The chemicals to be used in the desalination plant treatment and maintenance process are typical of most approved and operating Plants located across the State and Nationally (Table 2-6). Chemical storage and outlet discharge is described below and further details on chemical processes involved in desalination are provided in Appendix D.

Table 2-6: Diluted chemicals used in desalination plant treatment and maintenance

Chemical	Application
Continual discharge to outfall	
Anti-scalant (proprietary)	SWRO system
SBS	Screen backwash neutralisation and SWRO system
Intermittent discharge to outfall	
Neutralised citric acid	Ultra-filtration CIP neutralisation
Neutralised chlorine	Ultra-filtration CIP neutralisation
Neutralised sodium hydroxide	Ultra-filtration CIP neutralisation
Rare discharge to outfall (e.g., commissioning, equipment failure)	
Coagulant (ferric sulfate/chloride)	Residual from DAF unit in clear water to ultra-filtration
Flocculant (organic)	Residual from DAF unit in clear water to ultra-filtration
Rare discharge to existing drainage channel (e.g., commissioning, equipment failure)	
Coagulant (ferric sulfate/chloride)	DAF unit overflow
Flocculant (organic)	DAF unit overflow
Chlorine	Seawater tank overflows (screened seawater and ultra-filtration filtrate)

Storage

Concentrated chemicals used at the desalination plant will be stored within bunded storage facilities in compliance with all relevant Australian Standards. No concentrated chemicals will be discharged beyond their designated bunded areas.

Chemicals, including bulk chemicals and post-treatment chemicals, will be stored in two primary areas located inside appropriately designed and secure buildings at the desalination plant. All dosing lines will be double contained to prevent leakage to ground. Chemicals may be diluted within the chemical storage facility before pumping to the dosing point to minimise the impact of any spillage.

Outlet discharge

The backwash wastewater from the pre-treatment stage will be neutralised prior to discharge back to the marine environment via the outfall blended with the brine stream. Where a chemical cannot be neutralised or its chemical nature verified in documentation from vendors, it will be collected and discharged at an appropriate offsite waste disposal facility.

For the discharge to ocean, there are only six chemicals which need to be considered, and all of these become neutralised to benign products before they reach the marine environment:

- **Antiscalant** – pre-treatment additive that gets injected into the feedwater that flows through the RO membrane, preventing the membrane from scaling.
- **Chlorine -** used on the seawater for disinfection and cleaning the UF membranes. Chlorine is easily neutralised to benign chloride with the sulphite. (note: Seawater contains organic compounds that most chlorine will be consumed.)
- **Sulphite –** Sulphite in the form of "sodium bisulphite" is a "reducing agent" that neutralises oxidising agents such as chlorine and contains no heavy metals or phosphorus. In the neutralisation of chlorine, the sulphite is itself neutralised to benign sulphate. Any residual sulphite (<1 mg/L) is then neutralised back to sulphate once it reaches the ocean.
- **Citric acid** - Citric acid is a weak 'organic' acid commonly found in citrus fruit, and contain no heavy metals or phosphorus. Citric acid is used for intermittent cleaning of the UF membranes and is neutralised by sodium hydroxide. It will neutralise and/or bio-degrade to benign compounds containing oxygen and hydrogen only.
- **Sulphuric Acid and Sodium hydroxide (NaOH) -** These chemicals are only required for neutralisation of other chemicals. NaOH is mainly used to neutralise citric acid. It is itself neutralised to benign sodium citrate and water. Sulphuric acid is used to neutralise alkaline CIP chemicals and will report to land-side wastewater disposal facility. It is itself neutralised to benign sodium sulphate and water

2.2.3.2 Outfall

The wastewater generated from desalination will consist of brine stream from the reverse osmosis process, as well as neutralised wastewater from pre-treatment backwash and cleaning processes. Both streams will be blended and discharged continuously via the outfall while the desalination plant is in operation. If a portion of the desalination plant is operating, the flows will be in proportion to the operating unit's rating.

A bypass line has been provided around certain process units to allow them to be redirected to the outfall. This is to maintain the desalination plant's overall reliability and availability in the event of minor process unit upsets. Any discharges would be rare and may include neutralised seawater filtrate, reverse osmosis permeate and neutralised potable water. Table 2-7 presents the expected discharge characteristics.

Table 2-7: Expected discharge characteristics

Parameter	Final discharge
Flow rate[1]	Up to 13 GL/a
Salinity	Approximately 65.9ppt (Summer) and 64.4ppt (Winter)
Temperature[2]	<2°C above ambient seawater temperatures
Dissolved oxygen	At saturation of the prevailing seawater value (i.e., 100%, or about 6 to 8 mg/L)
pH	Same as per seawater at about pH 8.0 to 8.3
Total suspended solids	TSS is based on approximately 1.8 times the prevailing seawater value: if seawater is 10 mg/L, discharge will be around 20 mg/l

[1] Discharge flow rates will be greater if certain process units are required to be bypassed for maintenance. These would be rare discharges and would produce a diluted water quality compared with discharge during normal operations.

[2] Outfall pipelines will mostly be buried up until the wharf to minimise heat transfer in the pipeline from higher ambient air temperatures (the treatment process does not add heat).

2.2.3.2.1 *Maintenance activities*

During maintenance activities, the desalination plant and pipelines may need to be flushed and emptied for works to be performed. Where possible, water from the pipelines and desalination plant will be captured and recycled after maintenance activities. If this is not possible, water from the desalination plant will be directed into the stormwater drainage system for discharge via the existing stormwater network at the port or discharged via the outfall. For onshore pipelines, water will be discharged to land at established discharge points.

2.3 Proposal alternatives

2.3.1 Justification for the Proposal

Rio Tinto's Coastal Water Supply Project (CWSP) is located approximately 230 km southeast of Karratha and 35 km southeast of Pannawonica Town in the Pilbara region of Western Australia and operates to supply potable water to supplement Water Corporation's West Pilbara Water Supply Scheme (the Scheme).

Due to increased water demand at the coastal operations, including rail, Dampier and Cape Lambert ports, and coastal communities, combined with sustainable capacity limitations from the Millstream Aquifer, Rio Tinto sought approval for a new water supply borefield at Bungaroo. The CWSP was referred under section 38 of the WA EP Act in 2011 and determined not to require formal assessment under Part IV of the EP Act (Not Assessed), on the basis the water supply was determined to provide a sustainable abstraction volume, and therefore unlikely to significantly impact on the aquifer and associated groundwater-dependent environmental receptors.

Construction of the Bungaroo borefield and 87 km of transmission pipeline (CWSP) was completed in 2014 and enabled abstraction of water from the Bungaroo aquifer and supply, under contract, to Water Corporation's Millstream facility for transfer to the Pilbara coast via the Scheme. The CWSP borefield is licenced under GWL171733 to abstract 10 GL/a of water from the Bungaroo aquifer to supply water to:

- Rio Tinto's Dampier and Cape Lambert Ports
- coastal rail operations
- the coastal communities of Dampier and Wickham.

Annual production from the Bungaroo aquifer is around 7 GL/a, which meets demand from Rio Tinto's coastal operations, including potable water for the townships.

Since the Bungaroo borefield began operating, aquifer recharge via significant rainfall events has occurred less frequently than anticipated and groundwater levels have dropped to levels nearing licence abstraction limits. Groundwater levels are expected to continue to drop without major consecutive rainfall recharge events (generally via cyclonic events) and a reduction in groundwater abstraction. The Bungaroo aquifer is classified as a Priority 1 Ecological Community (*Stygofaunal community of the Bungaroo aquifer*) and contains several known and locally restricted Threatened species, comprising stygobiotic fauna and a stygobiotic fish known as the Blind Cave Eel (*Ophisternon candidum*).

The Robe River Kuruma (RRK) traditional owners have a strong cultural association with the region. During regular consultations, the RRK people have expressed their desire for a solution to reduce the abstraction from the Bungaroo aquifer.

Based on modelling of a future dry climate scenario to assess the risk of sustainable yield, it was identified that abstraction from the Bungaroo aquifer would need to be reduced in the order of 5 GL/a and achieved by 2027, assuming no significant cyclonic recharge events.

Rio Tinto initiated a study of water saving and water management initiatives, and alternative and supplementary water sources, to develop an expedited long-term and sustainable water supply solution for reducing drawdown of the Bungaroo aquifer.

2.3.2 Consideration of alternatives

A number of Proposal options and alternatives to reduce the abstraction demand on the Bungaroo aquifer were assessed during the Prefeasibility Study (PFS) project phase. The key criteria required to be met in order to assess and prioritise these options included:

- Sustainable abstraction, taking into consideration climate predictions
- Sufficient volume of water
- Surety of long-term supply
- Avoidance/limited impacts to cultural heritage and environmental values
- Minimal impact on other stakeholders
- Short implementation timeframe.

The broad high-level options considered at the PFS stage included:

- Desalination plants in a number of alternate locations
- Use of the Proponent’s Pilbara mines’ surplus dewatering volumes
- Supply from local Pilbara aquifers (e.g., new borefield).

The process for assessing proposal options and alternatives is summarised in Figure 2-14. An assessment of Proposal options and alternatives against the key criteria listed above is provided in Table 2-8 .

Once the Parker Point location was selected, several engineering options were evaluated to further avoid or minimise potential environmental impacts for the desalination plant at the design stage (Section 2.1.2.3). Further mitigation measures to avoid or minimise potential environmental impacts are considered in Section 7 to Section 13 and the significance of any residual impacts assessed.

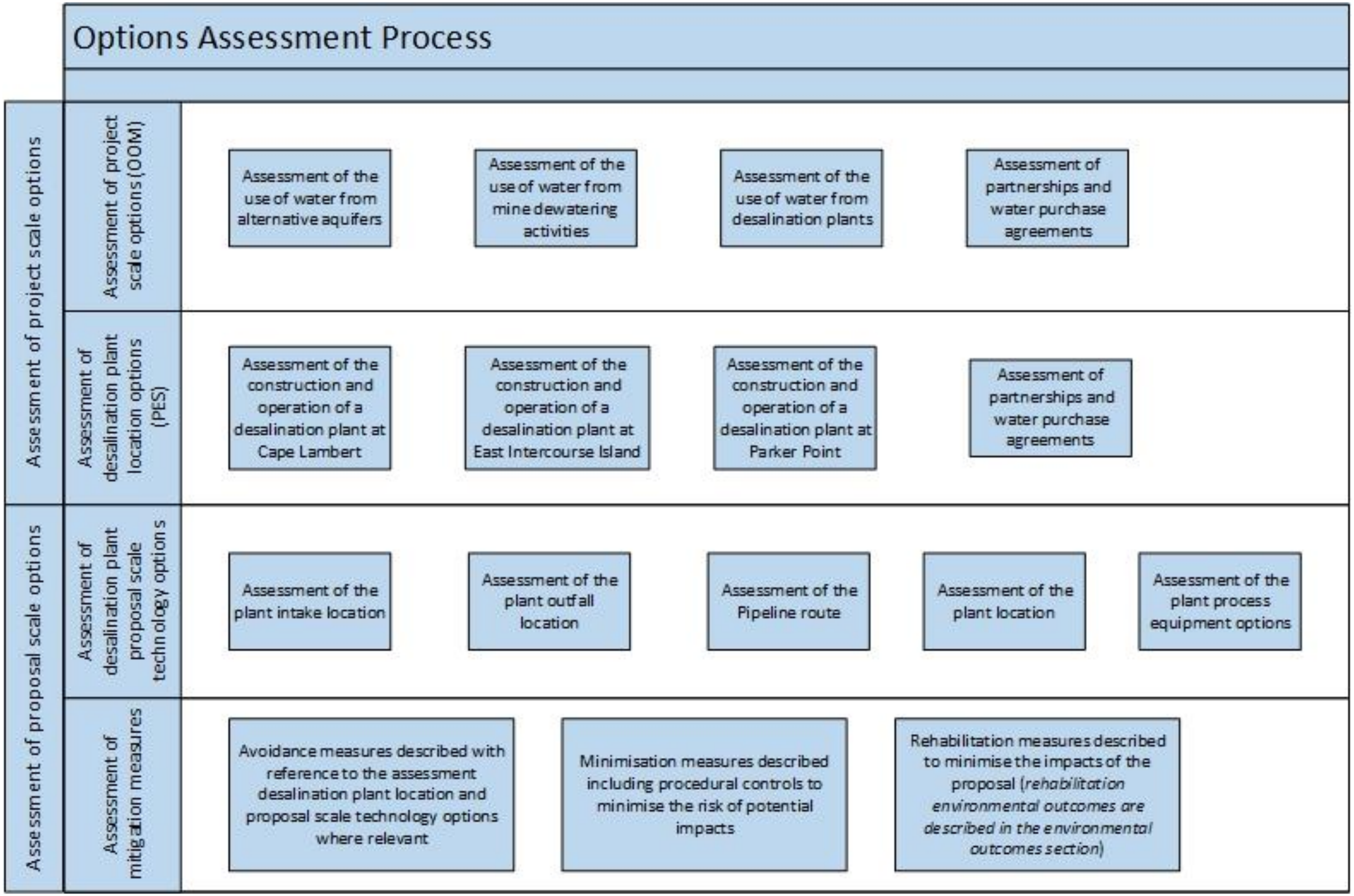


Figure 2-14: Process for assessing proposal options and alternatives

Table 2-8: Proposal alternatives and key considerations

Key Project Criteria	Proposal alternatives				
	Water-saving initiatives to reduce draw on the Bungaroo aquifer	**Production of water from alternative aquifers**	**Production of water from mine dewatering activities**	**Partnerships for water production**	**Production of water from desalination activities**
Comment	Initiatives considered would reduce consumption by around 1GL/a	Considerations included the existing Warramboo borefield (Robe Valley), or new borefields at either Caliwingina, or along the coastal water pipeline to the east of the existing coastal borefield	Options considered using water from dewatering activities at existing Rio-Tinto-operated mine sites and treating the water and conveying it to Water Corporation's Millstream facilities.	Partnerships for water production were explored to meet the water demand, including the use of excess water production from existing third-party desalination plants in the area.	Multiple locations for a desalination plant were reviewed during the study, including Parker Point, Cape Lambert, Maitland Industrial Area and East Intercourse Island.
Sustainable abstraction, taking into account climate predictions	There is no additional abstraction associated with this option.	Potential risk to sustainable abstraction.	There are uncertainties in relation to long-term sustainable supply, depending on the life of the mines and management/storage of water to meet water quality requirements.	Yes – likely.	Yes, this option allows for a sustainable volume of water, independent of climate predictions.
Short implementation timeframe	There is a short implementation time associated with these initiatives.	Approvals and construction schedules do not meet project requirements.	Approvals and construction schedules do not meet project requirements.	Unknown.	This option has the shortest approval and construction timeframes, apart from the water-saving initiatives option.
Sufficient volume of water	No. Consumption would be reduced by around 1GL/a	Water volumes are not proven at the required level of confidence.	There is potential to supply sufficient volumes.	Yes.	Yes, a sufficient volume of water can be provided through desalination.
Surety of long-term supply	This option does not provide surety of a long-term supply.	No, potential risk to sustainable abstraction.	This is dependent on factors external to this Proposal including the life-of-mine operations.	Unknown.	Yes, this option is independent of climate predictions and can therefore provide surety of long-term supply.
Avoidance/limited impacts to cultural heritage and environmental values	No impacts to cultural heritage and environmental values associated with this option.	No, development of aquifer would potentially impact groundwater-dependent ecosystems and associated heritage	Uncertain, a long pipeline route would transfer water across Traditional Owner boundaries and potentially intersect known heritage sites.	Unknown.	There are potential impacts to cultural heritage; however, most potential cultural heritage impacts can be avoided through the project design. There are potential

		values. A long pipeline route would transfer water across Traditional Owner boundaries and potentially intersect known heritage sites.			impacts to terrestrial and marine environmental values. GHG emissions would be minimised through engineering design but may be higher than alternate options.
Minimal impact on other stakeholders	No impacts on other stakeholders.	No, potential additional pressure on Water Corporation's existing WPWSS.	No, potential cultural heritage impacts and requirements for integration with Water Corporation's existing network and meeting water quality standards.	Likely.	There are potential impacts to Traditional Owners and other stakeholders; however, these can be minimised through project design and meaningful stakeholder engagement.
Conclusion	This option, while beneficial, does not sufficiently reduce the draw on the Bungaroo aquifer to avoid potential impacts	Does not meet the objective to reduce the draw on the Bungaroo reservoir by the mid 2020s. Potential environmental and heritage impacts are also considered higher risk and likely more significant than those associated with the Proposal, with additional longer-term impacts associated with the requirement for more projects due to the long-term sustainability of the water supply	This option is not considered feasible as it does not meet the objectives of the Proposal to reduce the draw on the Bungaroo reservoir by the mid 2020s. Additional environmental and heritage surveys and assessments are required and there is a high uncertainty associated with the long-term sustainability of the water supply.	The Partnership option was not considered feasible to progress, given the options could not meet the objectives of the Proposal. Additional environmental and heritage impacts are unknown and there is a high risk associated with timing and the long-term sustainability of the water supply, depending on the partnership model.	A desalination plant is the only option that provides certainty with regards to sustainable abstraction, the required volumes and a long-term surety of supply, with minimal impact to environmental and cultural heritage receptors. It also has the shortest construction timeframes, maximising the potential to more rapidly mitigate impacts associated with abstraction from the Bungaroo aquifer. The potential impacts to heritage and environment values were assessed as being a lower risk than the alternate options, with key risks able to be largely avoided or minimised through the project design.

Legend: *red = key criteria not achieved, orange = key criteria may be achieved, green = key criteria achieved*

2.4 Avoid and minimise – consideration of potential impacts during Proposal Design Phase

During the selection process that determined the preferred option to be the desalination plant at Parker Point, the design phase commenced and included further investigation of options for avoiding and minimising potential environmental, cultural heritage and community impacts. The section below describes how potential impacts were avoided and minimised during the engineering design, and Table 2-9 summarises these impacts for each environmental factor. The Proponent has undertaken considerable work to avoid and minimise the potential impacts of the Proposal.

Iterative design of development envelope and Proposal elements to avoid potential impacts from implementation of the Proposal

A key avoidance mechanism was the iterative design of the development envelope to avoid environmental and heritage values.

Key areas identified in environmental and heritage surveys were:

- Heritage sites:
    - The location of the desalination plant and pipelines was specifically selected and designed to avoid known heritage sites and designed to avoid national heritage values within the Dampier Archipelago (including Burrup Peninsula) NHP.
    - The development envelope for the water transfer pipelines was designed as narrow as feasible to ensure heritage values are avoided.
    - Potential impacts were minimised by altering construction methods to minimise the size of the machinery required for pipeline construction/dismantling close to sensitive areas.
- Vegetation and flora, terrestrial fauna habitats:
    - The proposed desalination plant has been located on an area of land reclaimed by historic dredge spoil deposition activities near the existing Dampier port operation; 83% of the development envelope has been previously disturbed or is degraded.
    - The pipeline routes were aligned within existing disturbed corridors where available and the overall development envelope was restricted to the minimum area required for construction.
    - The majority of the water transfer pipeline will either replace or upgrade the existing pipeline infrastructure and utilise existing Kangaroo Hill tanks, minimising the requirement for new infrastructure and infrastructure corridors.
- Significant benthic communities and habitat:
    - Two outfall locations were selected away from known benthic communities and habitats receptors for investigation. The wharf option was selected as the preferable location based on the results of the brine stream modelling, which showed that this location produced the smallest brine stream footprint and avoided impacts to significant benthic communities and habitats.

Seawater intake infrastructure designed and located to avoid impacts to the marine environment and social surroundings

Figure 2-15 shows the two options considered for the seawater intake location. An alternative intake pipeline from the desalination plant was considered (Option 1 in Figure 2-15). The alternative location included the consideration of constructing the pipeline beneath the sea floor, potentially resulting in direct impacts to areas of sparse mixed communities and the generation of additional suspended solids during construction. To avoid impacts, this alternative option was not progressed. Alternative designs and construction methods were also evaluated.

The intake will be constructed by refurbishing the existing redundant power station cooling-water intake pond at Parker Point (Option 2 in Figure 2-15). This approach:

- Avoids impacts to benthic habitat, the sea floor and areas of sparse mixed communities as the existing pond will be utilised, avoiding the need to construct a new pond and/or an undersea pipeline.
- Minimises the risk of elevated turbidity impacts to the marine environment from construction activities, as the pond location will be sealed from the surrounding marine environment.
- Minimises the potential impacts from noise and vibration from percussion-driven piling; drilled piles will be utilised to secure the intake pumps in the existing intake pond.
- Minimises the potential noise impacts during construction and operation due to the location of the intake infrastructure within the existing intake pond and the presence of the rock revetments surrounding the pond, which will act as a noise barrier.
- Avoids the potential impacts to marine fauna associated with entrainment at the seawater intake by replacing the existing bar screens on the existing pond culvert with 150 mm aperture screens to prevent marine fauna entering the seawater intake pond.

Figure 2-15: Seawater intake and outfall location options

Outfall designed and located to avoid and minimise impacts to the marine environment

Figure 2-15 shows the two options considered for the location of the outfall, including either discharging along the western seawall closer to the desalination plant or tethering to the Parker Point wharf piles. Alternative designs and construction methods were also evaluated for the outfall, including installation along the western seawall (the main alternative location – Option 1 in Figure 2-15), installation of a subsea pipeline and shore crossing. To avoid impacts to the seabed and limit impacts to the marine environment, these options were not progressed further.

The outfall pipeline will be tethered to the existing Parker Point wharf piles (Option 2 in Figure 2-15). This approach:

- Avoids the requirement for constructing a subsea pipeline and shore crossing and thus avoids direct disturbance to the seafloor, which:
  - Reduces the risk of indirect impacts from elevated turbidity to benthic communities and habitats
  - Minimises the potential sources of subsea noise during construction associated with seafloor construction methods.
- Reduces the risk of recirculation as the outfall will be further from the intake location than other options considered (e.g., along the western seawall)
- Avoids and minimises the potential impacts from discharge on sparse benthic communities by locating the outfall in an active shipping area where rapid mixing will occur. In addition, discharge modelling shows a significantly higher dilution at this location due to stronger currents. The propeller wash associated with shipping movements at the Parker Point wharf is also expected to aid in mixing the water column at the Proposal's discharge location, minimising the risk of temperature and/or salinity stratification occurring in the water column.

Desalination plant location selected to avoid disturbance to heritage and environmental values

One alternative site for construction of the desalination plant was considered at the decommissioned power plant site; however, this location was not progressed further.

The desalination plant will be constructed on a disturbed area of land reclaimed by historic dredge spoil deposition activities, south of the Parker Point wharf. This approach:

- Avoids impacts to heritage values
- Avoids impacts to vegetation, Priority flora and conservation-significant terrestrial fauna habitat as this site is previously reclaimed disturbed land
- Avoids the risk of contamination by avoiding construction within a site that is potentially contaminated.

Water transfer pipelines designed within existing disturbed corridors, utilising existing pipelines where feasible

The water transfer pipelines have been designed to follow existing disturbed corridors (along road verges and tracks) and, where feasible, upgrades to existing pipelines have been considered rather than constructing new pipelines. Where upgrades are within the existing disturbed pipeline routes, the pipelines will be upgraded or replaced or positioned directly adjacent (including pipelines to/from the existing Kangaroo Hill tanks).

The construction of water transfer pipelines using existing disturbed corridors and upgrades of existing pipelines (where feasible) has:

- Reduced new disturbance required for the Proposal and reduced the amount of vegetation clearing required.
- Reduced the potential for direct and indirect impacts to heritage values of the NHP by ensuring the pipelines' routes have been selected in consultation with Murujuga Aboriginal Corporation (MAC), to avoid rock outcrops and meet the existing *Conservation Agreement between the Minister for the Environment and Water Resources on behalf of the Commonwealth of Australia and Hamersley Iron Pty Ltd and Dampier Salt Limited in relation to the national heritage values of the Dampier Archipelago (including Burrup Peninsula) National Heritage Place under the EPBC Act 1999 in relation to Hamersley Land and Dampier Salt Limited Land.*
- Avoided potential direct impacts to heritage values during construction by realigning a section of the pipeline along the road to the east. See Figure 2-13, which shows where the new alignment of the pipeline is within the existing road reserve. This minimises the risk from direct impacts to rock outcrops identified in a survey with a MAC ranger in an area of the existing water pipeline south of the existing Kangaroo Hill tanks, which was found to be close to rock outcrops on either side.

Desalination plant process equipment

Seawater quality sampling over 12 months has indicated a DAF unit located in the desalination plant's pre-treatment system is unlikely to be necessary. Should there be an ongoing, unexpected change in influent seawater characteristics, or if a higher plant availability is required, the desalination plant will be staged in a way to enable a DAF unit to be retrofitted into the pre-treatment process. Air-flotation would be the normal operating method for the DAF unit; however, flocculants and coagulants may be used during periods of high TSS. When air-flotation is used, solids will be discharged through the outfall. When designing the system, the risks and options for disposing of solids when flocculants and coagulants are used was assessed. To minimise the risks of flocculants or coagulants entering the marine environment, the solids will be sent to a licenced waste management facility when flocculants and coagulants are used in the DAF unit.

Proprietary chemicals will be used for cleaning the reverse osmosis membranes in the desalination plant. The design of the desalination plant considered whether the neutralised reverse osmosis CIP waste would be discharged to the ocean or transported to a licenced waste management facility. Cleaning frequency is expected to be low (once per month to once per year). However, given the proprietary nature of the chemicals (which prevents a detailed toxicity assessment) they will be discharged to a dedicated wastewater tank and transported offsite to a licenced waste management facility, thereby avoiding impacts to the marine environment associated with discharging the waste to the ocean.

Table 2-9: Consideration of potential impacts to environmental factors during Proposal Design Phase

Design process	Environmental Factor – Impacts Avoided or Minimised					
	Marine Environmental Quality	Benthic Communities & Habitats	Marine Fauna	Flora and Vegetation	Terrestrial Fauna	Social Surroundings
1. Iterative design of development envelope to avoid potential impacts from implementation of the Proposal	✓	✓	✓	✓	✓	✓
2. Avoid impacts in seawater intake infrastructure design – located in existing pond	✓	✓	✓			
3. Avoid impacts in outfall infrastructure design – constructed on existing Parker Point wharf piles	✓	✓	✓			
4. Avoid impacts in location of desalination plant – located on previously disturbed reclaimed land south of the Parker Point wharf				✓	✓	✓
5. Water transfer pipelines – designed within existing disturbed corridors, utilising existing pipelines where feasible				✓	✓	✓
6. Desalination plant process equipment	✓	✓	✓			

2.5 Local and regional context

2.5.1 Locality

The Proposal is situated adjacent to the town of Dampier, in the Pilbara region of WA. It is located within the City of Karratha local government area (LGA). Parker Point is approximately 22 km north-west of the LGA's administrative centre of Karratha.

The Proposal is located within the Proponent's existing port operating area and within the surrounds of the Port of Dampier, which is the world's second-largest bulk export port by tonnage. It exports iron ore, salt, liquefied petroleum gas, diesel, condensate, anhydrous ammonia, and other general cargo from resource developments across the Karratha LGA and beyond. Infrastructure tied into the Port of Dampier is extensive and spans 350 km inland to the Pilbara iron ore deposits and 200 km offshore to the oil and gas fields of the Northwest Shelf (Pilbara Ports Authority, 2021).

The closest residential township is Dampier, which is approximately 2.5 km south of the development envelope. Originally it was a closed mining town established between 1966 and 1968 to provide housing for employees working at Hamersley Iron's port facilities. It was normalised in the 1980's when employees were provided with an option to purchase homes. In the 2000's this was broadened to all people. The services and facilities once run by Hamersley Iron have been transferred to government agencies and the LGA.

In 2016, Dampier had a population of 1,104 people (ABS, 2016). The 2016 census data also indicates that at that time the population was declining, and Dampier residents focused on the sustainability of its community through retaining its population and remaining facilities and services, such as the doctor's surgery and school. Recreation services and facilities within Dampier town include the Hampton Harbour Boat and Sailing Club, the Dampier public boat ramp and the popular Dampier Beachside Markets held on Hampton Oval. The Dampier Highway is the only public access road to Dampier, with the main access to the development envelope via Parker Point Road, off the Dampier Highway.

2.5.2 Topography and major watercourses

The development envelope is located on the Burrup Peninsula which is elevated from the typically flat and low-lying coastal plains of the Western Pilbara. Gorges, creeks and drainage lines typically intersect the Pilbara landscape. There are no permanent surface water features within the development envelope. During periods of high rainfall, surface water is expected to migrate along defined drainage channels.

2.5.3 Traditional ownership and cultural heritage

2.5.3.1 Traditional ownership

Murujuga is the language name for the entirety of the area which encompasses the Burrup Peninsula. Colonial occupation and government policy made it extremely hard for Yaburara and adjacent Aboriginal groups to maintain traditional links and detailed totemic knowledge of Murujuga. This was exacerbated by the industrial developments of the 1960s. Today five traditional owner language groups provide the sacred maintenance and cultural management of Murujuga.

The traditional custodians of Murujuga comprise members of five traditional Aboriginal language groups, being the Ngarluma, Yindjibarndi, Yaburara, Mardudhunera and Wong-Goo-Tt-Oo People, collectively referred to as *Ngurra-ra Ngarli* (alt.*Ngarda-ngarli*), all of which were involved with three overlapping native title claims which were historically in place over the Dampier Archipelago, and adjacent mainland. In around 2002, the State Government entered into negotiations with the then claimant groups, which negotiations were completed in late 2002/early 2003, the end outcome of which was to allow for industrial development to progress across southern parts of the Burrup Peninsula, and which facilitated the development of a conservation estate and helped manage the protection of Aboriginal heritage. Murujuga Aboriginal Corporation (MAC) is the approved body corporate established under the Burrup and Maitland Industrial Estates Agreement (BMIEA) and are the land holders and co-managers of the Murujuga National Park. MAC, which represents the traditional Aboriginal language groups, is recognised as the consultative body in regard to cultural heritage issues within Dampier Archipelago (Murujuga).

The Proposal is also located within the contractual agreement area covered by the *Rio Tinto Ngarluma Indigenous Land Use Agreement (ILUA), 2011.* The Ngarluma people are represented by the Ngarluma Aboriginal Corporation (NAC), with formal engagement undertaken with the Proponent via the Ngarluma Rio Tinto Implementation Committee (NRIC), which meets at least twice a year.

2.5.3.2 Cultural heritage

The Dampier Archipelago (or Murujuga) contains one of the largest collections of Indigenous rock art in the world, with an estimated 1,000,000 or more individual petroglyphs, some of which are thought to be over 40,000 years old. The engravings show human images, cultural items and practises, extinct animal species such as megafauna and Thylacines (Tasmanian tiger), as well as existing avian, marine, and terrestrial animals, illustrated by their form and tracks. Murujuga also contains several rock shelters, ceremonial places, and stone arrangements, amongst other archaeological and sacred sites.

The Dampier Archipelago (including Burrup Peninsula) was included in the National Heritage List as a National Heritage Place on 3 July 2007, and covers an approximate area of 36,860 ha. The Proposal's development envelope intersects the boundary of the Dampier Archipelago (including Burrup Peninsula) National Heritage Place (National Heritage Place) in the disturbed narrow linear corridors with the existing Water Corporation water transfer pipelines north and south of the existing Kangaroo Hill tanks (0.9 ha, or 0.002%).

The existing water pipeline infrastructure was constructed in 1970-71, before the Dampier Archipelago (including Burrup Peninsula) was listed as a National Heritage Place in 2007, and the boundary was delineated to include this existing water infrastructure. As a result, the new water transfer pipeline upgrades in this section requires activities which are located within the National Heritage Place.

The following Conservation Agreement is currently in place:

> *Conservation Agreement between the Minister for the Environment and Water Resources on behalf of the Commonwealth of Australia and Hamersley Iron Pty Ltd and Dampier Salt Limited in relation to the national heritage values of the Dampier Archipelago (including Burrup Peninsula) National Heritage Place under the EPBC Act 1999 in relation to Hamersley Land and Dampier Salt Limited* Land (the 'Conservation Agreement').

This Conservation Agreement provides for management and permissible activities within the Dampier Archipelago (including Burrup Peninsula) National Heritage Place (NHP). This provides guidelines for assessing National Heritage Values and means to mitigate impact on these values (i.e., the rock art and stone arrangements). It is through the Conservation Agreement and associated Commonwealth Government requirements that primary engagement is through MAC in regard to the development and associated tangible and non-tangible heritage values.

2.5.4 Conservation reserves and environmentally sensitive areas

The closest environmentally sensitive areas to the proposed development envelope are East Lewis Island, approximately 5.5 km to the north west, and Conzinc Island, approximately 11.5 km to the north-east of the development envelope.

2.5.5 Land use and existing developments

The proposed desalination plant location is on an area of reclaimed land. The proposed intake infrastructure is located within an existing redundant power station cooling-water intake pond. The vast majority of the development area and surrounds is located within previously disturbed areas, as described below.

2.5.6 Port of Dampier

The northern portion of the development envelope is located at the Parker Point wharf, one of the number of terminals at Port of Dampier (Figure 3-1). Port of Dampier was first established in the mid-1960's to support the development of the Pilbara region resources sector, with the first shipment of iron ore leaving the Port in August 1966. Port of Dampier has since expanded and now handles the following commodities: anhydrous ammonia, condensate, diesel, iron ore, LNG, LPG, petroleum, salt and cargo (PPA, 2022a).

In 2021-22, the Port of Dampier recorded a total of 3,324 vessels arriving, which equates to an average arrival of 9 vessels arriving per day. Accounting for departing vessels, this equates to roughly 18 vessel movements through Port of Dampier every day. The total volume of cargo moved through Pilbara Ports Authority (PPA) in 2021-2022 was 733,128,000 tonnes, with Port of Dampier accounting for 161,886,031 tonnes (PPA, 2022b).

Port of Dampier has been subject to numerous capital and maintenance dredging programs undertaken by PPA and other private proponents to facilitate expansion projects (GHD 2021). In their Long Term Dredge Management Plan for the Port of Dampier, GHD (2021) list 17 approved and permitted dredging activities at the Port of Dampier that have been carried out since 1984. In order to maintain safe navigation within the Port of Dampier, PPA has undertaken periodic maintenance dredging of areas under their operational control from 2019, which is expected to continue until at least 2024 (GHD, 2021).

2.5.7 Surrounding Industries

A number of industries surround the development area, including:

- North West Shelf Project – a large liquefied natural gas (LNG) production facility
- Pluto LNG – a major LNG gas project with onshore facilities that process gas from offshore fields
- Rio Tinto Dampier Salt operations
- Yara Pilbara Fertilisers operations
- Pilbara Ports Authority
- Woodside operations.

2.5.8 Burrup Cumulative Light Environment

As above, the Port of Dampier is a busy industrialised port surrounded by a number of existing heavy industries. Shipping operations, together with processing, stockpiling and loading activities surrounding and servicing the Port collectively contribute to the cumulative artificial light emissions experienced in Port of Dampier's night environment.

A viewshed analysis was undertaken with the objective of understanding the direct visibility of artificial light from the Proposal, the findings of which is described in detail in Rio Tinto (2021). In line with the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia, 2020), the viewshed analysis identifies all areas within 20 km of the development envelope which have direct line of sight of the Proposal infrastructure and associated light sources.

Due to the presence of existing infrastructure in this area, the visual impacts of the Proposal are expected to be limited. While the infrastructure around the desalination plant and the existing intake pond can be viewed from Dampier town and offshore, the Proposal obscures only existing industrial development. The desalination plant has been designed so that it minimises disruption in the landscape and has a reduced impact to visual amenity. The plant itself has a low profile, with a lot of the processing equipment housed within buildings.

3 LEGISLATIVE CONTEXT

3.1 Environmental impact assessment process

Part IV of the EP Act is administered by EPA Services under the Department of Water and Environmental Regulation (DWER), which is responsible for overseeing implementation of Proposals under Part IV of the EP Act. Part IV of the EP Act makes provisions for the EPA to undertake EIA of significant Proposals.

EPA uses environmental principles, factors and associated objectives as the basis for assessing whether a Proposal’s impact on the environment is acceptable. As such, the environmental principles, factors and objectives underpin the EIA process.

3.2 Other approvals and regulations

3.2.1 Native Title

The Proposal is located within an area where native title has been determined to not exist. . However, there exists the BMIEA, which was signed at the time between the State Government and three native title claimant parties: the Ngarluma/Yindjibarndi, the Yaburara/Mardudhunera and the Wong-Goo-Tt-Oo, who are now collectively represented by MAC for the purposes of the BMIEA.

3.2.2 Land tenure

The development envelope is covered wholly with *Land Administration Act 1997* lease N104718, N104744, N104748, N104747, N104346 and I195323 boundaries. All the leases are granted pursuant to the *Iron Ore (Hamersley Range) Agreement Act 1963* and held by Hamersley Iron Pty Limited. The purposes of the leases are appropriate for this development.

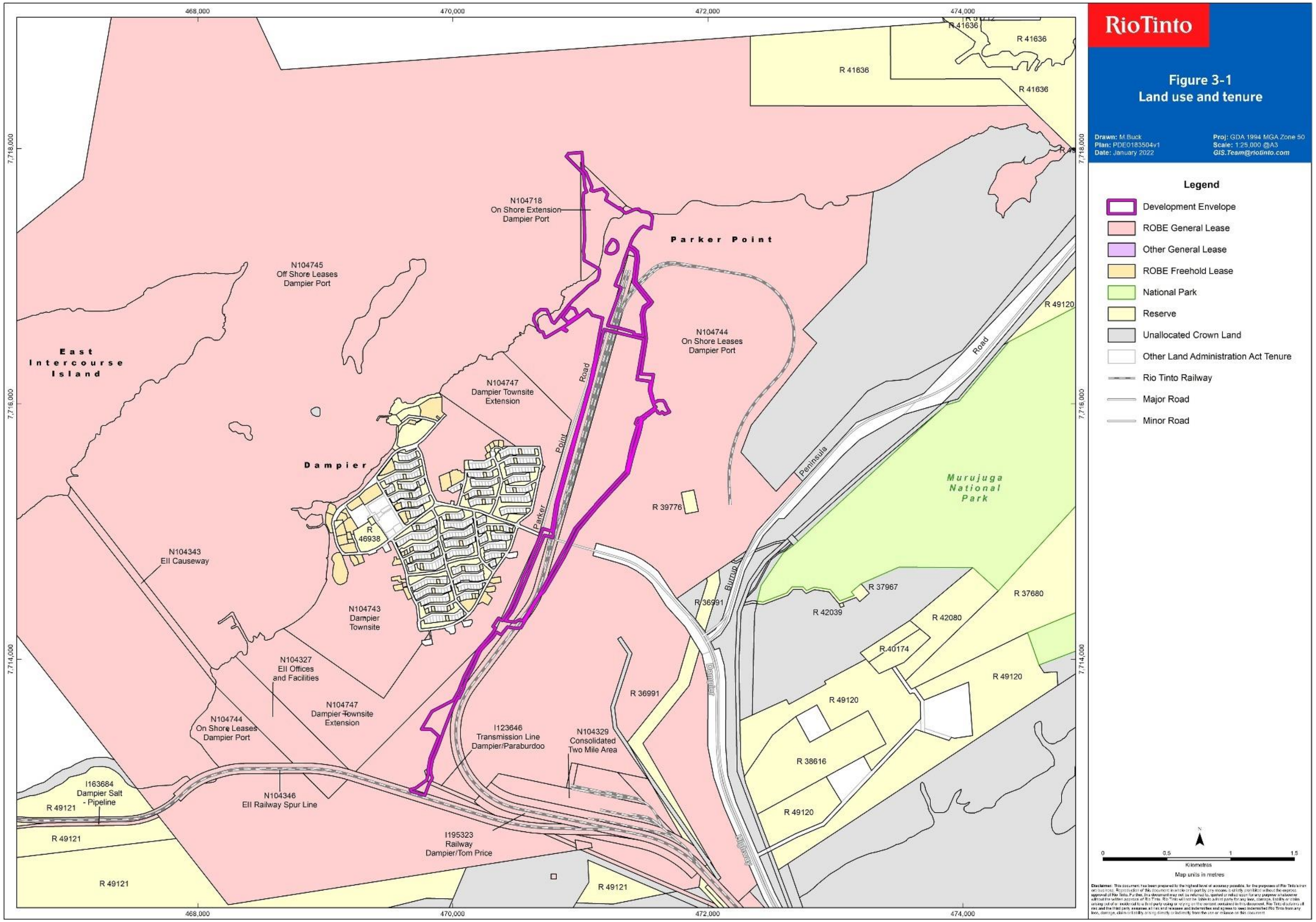


Figure 3-1: Landuse and tenure

3.2.3 State Agreement

This project is located within an area covered by the State Agreement*: Iron Ore (Hamersley Range) Agreement Act 1963* (WA).

The Proponent will seek approval from the Minister of State Development for the Dampier Seawater Desalination Plant Project under the *Iron Ore (Hamersley Range) Agreement Act 1963*.

Development of a project cannot commence until after the State Agreement approval has been obtained. Once received, the Proponent has an obligation to implement the project as approved in a timely manner.

3.2.4 Ministerial Statement 770 – Dampier port

The existing Ministerial Statement 770 covers the Proponent's existing operations at Port of Dampier. The current Proposal is separate to the Dampier port operations and is a standalone proposal providing water to multiple users, including the potable water supply to the WPWSS (including Dampier town and the broader Burrup Peninsula) and the Proponent's Parker Point and East Intercourse Island Dampier port operations.

3.2.5 Other statutory decision-making processes and approvals

The Proponent understands that amendments to the EP Act in 2020 provided additional considerations for the EPA, or the Minister for Environment, to take account of other statutory decision-making processes which can mitigate the potential impacts of a proposal on the environment.

In accordance with section 38G(4) of the EP Act, the Proponent is of the view that the EPA would be reasonable in examining and considering to what extent Part V of the EP Act provides adequate regulation of the Proposal. The Proponent notes that the capacity of the Desalinisation Plant has been designed to accept, hold and process up to 22 GL/a, resulting in emission to the environment of up to 13 GL/a of brine discharge and the production of 8 GL/a of potable water. This being the case, the design capacity of the facility meets the Prescribed Premise Criteria of being above 10 GL/a.

Furthermore, the regulatory conditions provided for by Part V Works Approvals and Licencing requirements are considered adequate to regulate and manage the implementation of the Proposal in accordance with the referral documentation and management plans that commit project specific management and mitigation measures to be implemented.

In addition to EPA's consideration of the Proposal under Part IV of the EP Act and any subsequent assessment, various other environmental assessments and authorisations would be required before the Proposal could be implemented, as summarised in Table 3-1.

The Proponent is seeking the environmental approvals shown in Table 3-1 in support of this Proposal:

Table 3-1: Other approvals and regulations

Decision-making authority	Legislation or Agreement regulating the activity	Proposal activities	Approval required	Can the statutory decision-making process regulate impacts on the environment? (Yes/No and summary of reasons)
Department of Water and Environmental Regulation (DWER)	EP Act Part V	Category 85B application	Works Approval and Licence Operating Licence Amendment	Yes. Part V of the EP Act requires a works approval to be obtained before constructing prescribed industrial premises and makes it an offence to cause an emission or discharge unless a licence or registration is held for the premises. The Works Approval will contain conditions specifying how the desalination plant must be constructed and commissioned. Once the respective licence has been amended to include the prescribed category, there will be conditions under which the desalination plant may be operated.
Economic Regulation Authority	*Water Services Act 2012 (WA) – Part 2*	Provision of water supply (potable) services	Water Services Licence	No. Under the *Water Services Act 2012* (WA), environmental considerations are matters to be considered when issuing a licence. However, existing Water Licence 33 is already in place and will incorporate the desalination plant without needing an amendment.
Minister for Water	*Water Services Act 2012 (WA) – Part 6*	Construction of the desalination plant and water transfer pipelines (Major Works) to be used to supply potable water to Dampier town and other consumers (e.g., ports, WPWSS)	Major Works Authorisation from the Minister of Water is required prior to commencing construction	Yes, potentially. Under the *Water Services Act 2012* (WA), environmental considerations (including the value of ecologically sustainable development) are to be considered when assessing the public interest. The Major Works approvals process includes a public submissions period. If a submission is made that confirms in the Minister's opinion that the Majors Works would not be in the public interest, which can include environmental impacts, the Minister may refuse to authorise the Major Works. Further, the Minister may require the Major Works proposal be modified if the Minister believes the modification is in the public interest (e.g., for environmental protection).

Decision-making authority	Legislation or Agreement regulating the activity	Proposal activities	Approval required	Can the statutory decision-making process regulate impacts on the environment? (Yes/No and summary of reasons)
Minister for Health	*Fluoridation of Public Water Supplies Act 1966 (WA)*	Fluoridation of public water supplies by adding fluorine to the potable water delivered by the desalination plant	Determination from the Minister for Health	No. There is potential that environmental concerns may be considered; however, it is our understanding the approval process focuses on public health considerations. To obtain this determination, Rio Tinto Utilities will submit a detailed proposal to the Advisory Committee for the Purity of Water. The Proposal will include the basic detail of the desalination plant, source of the water, high-level line diagram inclusive of custody transfer point, method of fluoridation and associated volumes.
Department of Health	*Medicine and Poisons Act 2014 (WA)*	Purchase and store scheduled poisons that are required for water treatment	Poison permit (industrial)	No. Approval process focuses on public health, use of poison, location of poison and fit and proper person considerations.
DWER	*Country Areas Water Supply Act 1947 (WA)*	Supply the public (Dampier town) with drinking water sourced from the desalination plant	Proclamation of a Public Drinking Water Source	No. Included for completeness only as the *Country Areas Water Supply Act 1947* does not apply to desalination plants that do not have any on-land and seawater bores. The desalination plant design does not include any on-land seawater bores and no proclamation approval is required for the desalination plant.

4 STAKEHOLDER ENGAGEMENT

The Proponent is committed to, and acknowledges the importance of, meaningful stakeholder engagement. As such, the stakeholder engagement conducted to date has informed:

- The analysis of various Proposal options and the subsequent decisions made on options to progress
- Baseline studies and an improved understanding of the existing environment
- The prediction and assessment of potential impacts from the Proposal and the development of appropriate mitigation measures.

The Proponent has existing relationships with the stakeholders identified in Table 4-1 and engages with them regularly. As such, stakeholder engagement for this Proposal is occurring within the context of other activities, including:

- Regular ongoing engagement with local stakeholders and Traditional Owners associated with the Proponent's areas of interest (such as Port of Dampier operations and cultural heritage management).
- Regular ongoing engagement with other stakeholders, including City of Karratha, Karratha District Chamber of Commerce and Industry (KDCCI), Dampier Community Association (DCA) and the Coastal Communities Environment Forum (CCEF).
- Ongoing implementation of existing Traditional Owners agreements, including business development and training, employment programs and initiatives, and business efforts to improve Traditional Owner engagement and heritage management processes.

4.1 Key stakeholders

The Proponent has identified key stakeholders, and other stakeholders, through an analysis of potential areas of interest and those who may be potentially impacted by the Proposal.

The Proponent has been and continues to engage with key stakeholders, including Traditional Owners and the surrounding community, as well as relevant local, State and Commonwealth government agencies, as shown in Table 4-1.

Table 4-1: Key stakeholders

Stakeholder
Traditional Owners
Ngarluma, Mardudhunera, Yaburara, Yindjibarndi and Wong-Goo-Tt-Oo Groups, represented by Murujuga Aboriginal Corporation (MAC)
Ngarluma Traditional Owners, represented by Ngarluma Aboriginal Corporation (NAC)
Robe River Kuruma (RRK) People, represented by Robe River Kuruma Aboriginal Corporation (RRKAC)
Community
Dampier Community Association (DCA)
Coastal Communities Environment Forum (CCEF)
Karratha and Districts Chamber of Commerce & Industry (KDCCI)
Recfishwest
Hampton Harbour Boat and Sailing Club (HHBSC) Harbour Boat and Sailing Club (HHBSC)
Local government
City of Karratha (CK)
State government
Department of Water and Environmental Regulation (DWER) – EPA Services branch, noise branch, marine ecosystem branch, water branch, Part V branch, water source protection branch
Department of Biodiversity, Conservation and Attractions (DBCA) – Parks and Wildlife
Department of Jobs, Tourism, Science and Innovation (JTSI)
Environmental Protection Authority (EPA)
Economic Regulation Authority (ERA)
Department of Planning, Lands & Heritage (DPLH)
Water Corporation
Department of Health/WA Country Health Services
Department of Health – Public and Aboriginal Health Division, Environmental Health Directorate
Pilbara Ports Authority (PPA)
Department of Mines, Industry, Regulation and Safety (DMIRS)
Department of Transport
Energy and Water Ombudsman
WA Planning Commission (WAPC)
Pilbara Development Commission (PDC)
Commonwealth government
Department of Agriculture, Water and the Environment (DAWE)
Australian Competition and Consumer Commission (ACCC)

4.2 Stakeholder engagement process

The Proponent has developed a stakeholder engagement plan to guide consultation for this Proposal. This will be revised as the Proposal progresses. Importantly, the plan outlines engagement mechanisms which continue beyond the submission of this Supporting Document.

The Proponent is applying a phased consultation approach for the design, development and implementation of the Proposal:

- **Phase 1**: Preliminary engagement with key relevant stakeholders to introduce the Proposal, including rationale and process; early identification of potential impact(s) and issues; and input on the options. Initial engagements with stakeholders on the options considered as part of this Proposal began in mid-2020.
- **Phase 2**: Consultation with targeted stakeholders during the impact assessment process to inform the Supporting Document through understanding potential impacts and management strategies occurred from mid-2020, throughout 2021 and in early 2022.
- **Phase 3:** Providing the opportunity for consultation on the draft Supporting Document to allow for review and comment by Traditional Owner groups, specifically MAC and NAC, prior to submission of the Supporting Document to the EPA.

By the time the Supporting Document is submitted to EPA, all three consultation phases noted above will have been completed. Noting consultation with stakeholders will continue throughout the design, development and implementation of the Proposal post-submission of the Supporting Document to the EPA.

Engagements are captured in a register, including details of stakeholder interests and actions. These actions are monitored for follow-up and, where applicable, these actions and stakeholder interests have been included/addressed throughout this document.

4.3 Stakeholder consultation

The objectives of the stakeholder engagement conducted for this Proposal have been to:

- Provide information to stakeholders about the Proposal;
- Consult and understand areas of interest and/or concern for stakeholders to inform decision-making, design and planning for the Proposal; and
- Provide updates and feedback to stakeholders, including on specific areas of interest.

4.3.1 Traditional owner group consultation

The Proponent is committed to authentic, meaningful engagement with respect to each traditional owner group's participation in the consultation process. The aim of consultation is to avoid (direct and indirect) impacts to social, cultural and heritage values wherever possible, and otherwise minimise these impacts, in a culturally sensitive manner.

As a primary objective of the Proposal is to reduce water abstraction from the Bungaroo aquifer, RRK People and their representatives have been actively engaged regarding this Proposal. These early engagements directly informed the options assessment process, resulting in the location and design of this Proposal at Parker Point, in order to assist in preserving places of cultural and ecological significance in the Bungaroo and Robe River area, while not negatively impacting places or values associated with the Murujuga National Park (refer to Section 2.3).

The location of this Proposal at Parker Point is within the contractual agreement area covered by the *Rio Tinto Ngarluma Indigenous Land Use Agreement, 2011.* The Ngarluma people are represented by NAC, with formal engagement via the Ngarluma Rio Tinto Implementation Committee (NRIC) which meets at least half yearly. Consultations regarding the Proposal have been undertaken with Ngarluma members and NAC representatives, as detailed in Table 4-2.

More broadly, the Dampier Archipelago (Murujuga) was historically covered by three overlapping native title Claims, representing what now comprises five traditional language groups, namely the Ngarluma, Mardudhunera, Yaburara, Yindjibarndi and Wong-Goo-Tt-Oo People. MAC is the approved body corporate established under the BMEIA to represent these Groups and are the land holders and co-managers of the Murujuga National Park, located to the east of the Proposal area (Figure 2-1). Consultations regarding the Proposal have been undertaken with MAC and its Circle of Elders, as detailed in Table 4-2.

Ongoing consultation with the traditional owner groups will occur throughout the construction and operations of this Proposal. The Proponent is committed to supporting each group to achieve the right consultation and engagement balance in accordance with the wishes of traditional owners and understands the need for continuous review and engagement with traditional owners.

4.3.2 Engagement summary

A summary of stakeholder consultation relevant to this Proposal is provided in Table 4-2. As directed by EPA in its instructions for preparing an ERD (EPA, 2021a), generic discussions with decision-making bodies have not been included and Table 4-2 focuses on Proposal-specific consultation with stakeholders.

Areas of interest raised by stakeholders during the consultation undertaken to date can be summarised across six categories:

- **Drinking water**: Some stakeholders have expressed an interest in existing and future water quality in Dampier. The supplied water will meet Water Corporation, the Department of Health and *Australian Drinking Water Guideline Values for Potable Water*, *2018*. Engagement is ongoing on this matter.
- **Wastewater**: Some stakeholders have expressed an interest in the management of the resulting brine stream from the desalinisation process and the potential for impacts to marine environmental quality (MEQ), marine fauna and fishing opportunities. The potential impacts to MEQ and fishing are addressed in Section 7 and potential impacts to marine fauna are addressed in Section 10.
- **Amenity**: Potential impacts to amenity, including noise and traffic, have been raised, primarily in relation to the construction phase. This is addressed in Section 0.
- **Heritage**: Some stakeholders have expressed concern regarding potential impacts to heritage areas, both in terms of Indigenous heritage sites and the National Heritage listed area. Lessening of impacts in the Robe Valley region was viewed favourably in consultations by MAC, NAC and RRKAC. This engagement is ongoing.
- **Monitoring**: Some Traditional Owner groups have expressed an interest in participating in monitoring of works near heritage and conservation areas, as well as involvement in long-term monitoring of marine water quality, including through existing Ranger programs.
- **Local employment and business development opportunities**: Several stakeholders have expressed interest in local employment and business development opportunities, including Indigenous opportunities. While these are not directly considered as part of 'social surroundings' under the *EP Act, 1986*, the Proponent is committed to local procurement and employment and Indigenous participation in its operations. Engagement is ongoing.

Table 4-2: Stakeholder consultation register

Stakeholder	Date	Issues/topics raised	Proponent response/outcomes
DWER – Part V Branch	11 February 2020	Presentation and introduction of the Proposal.	Nil actions, provide updates at subsequent meeting.
DWER – Water Branch	2 June 2020	Presentation and update on current drawdown and vegetation health monitoring at Bungaroo.	Provide maps of supplementary bore and confirm capacity of plants (both completed).
Coastal Communities Environmental Forum (CCEF; including CK, PPA, DBCA)	16 June 2020	Update on the Proposal and discussion on: • coral monitoring • turtle monitoring • water source and water monitoring • light monitoring • dust and weeds near heritage sites • ecological health studies on Bungaroo bore field • key driver of proposal to reduce stress on the Bungaroo aquifer • engineering and design progressing to support the capital cost estimate; site survey and soil investigation completed • Proposal timeline • Proposal power supply • possibility of future town water supply/ partnership with Water Corporation • water quality • water supply to Karratha • environmental impact assessment underway and environmental surveys commenced in July 2020 • location of outfall.	Coral monitoring, turtle monitoring and light monitoring queries answered within forum. Weeding near heritage sites discussed at forum. Dust management discussed at forum. Ecological studies at Bungaroo discussed at forum. Annual recycled water information for Dampier operations provided at forum. Two potential locations for brine stream discussed – under the wharf or off the north-south sea wall. Plume modelling indicates salinity returns to background sea water concentrations within 50 m of the outfall. Power supply and timeline queries answered at forum. Possibility for future town water supply and partnership with Water Corporation to be considered in future phases. Water quality query answered in forum. Water supply to Karratha query answered in forum. Action – further discussions to be held between CCEF and the Proponent.

Stakeholder	Date	Issues/topics raised	Proponent response/outcomes
DWER – EPA Services	9 September 2020	Presentation and introduction of the Proposal and options being progressed: • discussion on design considerations (alternatives considered) to avoid or reduce impacts to terrestrial and marine environment and heritage values • preliminary brine stream modelling • Proposal timing.	Follow-up meeting specifically with DWER – Marine Branch held on 25 September 2020 to discuss marine aspects of the Proposal.
NAC	11 September 2020	Presentation and introduction to the Proposal and discussion of options assessment.	Action – further discussions to be held between NAC and the Proponent.
DWER – Marine Branch	25 September 2020	Detailed presentation and discussion of marine aspects of the Proposal: • completed surveys • preliminary brine stream modelling results • design options and considerations for the marine environment • additional work planned.	Additional benthic community habitat (BCH) verification surveys undertaken further to the west of the seawall option and further north of the existing transects north of the stockpile area to verify BCH habitats in extent of preliminary brine stream modelling. Additional modelling information presented for toxicants to support change to level of ecological protection.
MAC	2 October 2020	Presentation and introduction to the Proposal and discussion of options assessment. Discussion of the protection of heritage places in both the Robe Valley and in the Parker Point location.	Refer to Section 8.1.3.2. Action – further discussions to be held between MAC and the Proponent.
DWER – Water Branch	2 November 2020	Update and discussion regarding CWSP bore field, CWSP vegetation health monitoring, blind cave eel update and proposed desalination plant.	Nil actions; provide updates at subsequent meeting.
Robe River Kuruma Aboriginal Corporation (RRKAC)	4 November 2020	Discussion on water abstraction on Robe country and indicated support of the desalination plant option at Parker Point.	Refer to Section 2.3 for description of project-scale options. Proponent provided details on water catchment on RRK country. In-principle support for the Proposal by RRK people for lessening of potential impacts on cultural sites and in the Robe area. Action – ongoing discussions to be held between RRK and the Proponent.

Stakeholder	Date	Issues/topics raised	Proponent response/outcomes
Coastal Communities Environmental Forum (CCEF; including DBCA, PPA, CK, Fisheries, DWER)	19 November 2020	Presentation and introduction to the Proposal and discussion of: • Proposal timeline and description • key driver of Proposal to reduce stress on the Bungaroo aquifer • description of reverse osmosis desalination process and additional treatment for potable water quality • proposed location of intake, desalination plant and brine stream outfall options • plume modelling of brine stream • Proposal power supply • weed management • dust • wind • lighting • spoil grounds • alternative energy sources • greenhouse gas reductions and Rio Tinto's renewable energy commitment.	The Proponent supplied answers to queries on the Proposal timeline and power supply. Dust, wind, and lighting queries answered within the forum. Spoil grounds, power source and alternative energy source queries answered within the forum. The desalination plant will be powered by Rio Tinto's power grid network. Timeline queries answered within the meeting. Action – the Proponent to provide updates regarding: • Dust Mag trial • weed management • timelines.
MAC (Board and Circle of Elders)	17 February 2021	Update on the Proposal and discussion. Cross-country water transfer is not appropriate. As such, supportive if minimal issues regarding cultural heritage impacts. Ongoing engagement requested.	In-principle support by MAC for the Proposal to be located at the Parker Point location will mean a lessening of potential impacts on cultural sites and environment in the Robe area. Action – further discussions to be held between MAC and the Proponent.
DWER – Marine Branch and EPA Services	25 March 2021	Update on the Proposal and discussion regarding marine modelling approach (including plant size, marine chemistry, and brine stream outfall location). Modelling approach to ecotoxicology.	Agreement on brine stream modelling approach, refer to Section 7.

Stakeholder	Date	Issues/topics raised	Proponent response/outcomes
MAC	12 to 15 April 2021	Biological survey participation – physical on-ground survey of pipeline through NHP to support baseline flora, vegetation, fauna. Discussion regarding values, involvement of people and rangers in environmental and heritage monitoring. This included making sure the location of camera traps and other items will not impact on values of area.	Action – further discussions to be held between MAC and the Proponent.
NAC	21 April 2021	Update on the Proposal and discussion regarding: • Part IV requirements including water usage, footprint, brine stream, water supply current, (no) chemical usage in brine, cultural protocols across country, future engagement activities.	Refer to Section 0 – Social Surroundings. In-principle support for the Proposal by NAC. Action – further discussions to be held between NAC and the Proponent.
DWER -Part V Branch	21 April 2021	Update on the Proposal, including project background, the desalination plant option and staged implementation potential.	Nil actions, provide updates at subsequent meeting.
MAC	13 May 2021	Pipeline route heritage site walk with focus on the NHP and heritage protection. Proposed water pipeline alignment through the NHP walked with a MAC ranger and Proponent representatives (engineering design team, surveyor, project manager, heritage advisor). Areas where engineering may need to be modified to avoid impact to places of heritage value were identified. This allowed direct feedback to engineers to talk about what was proposed and how construction occurs and to directly understand values (Mulvaney & Murujuga Aboriginal Corporation, 2021).	Refer to Section 0 – Social Surroundings. One of the key outcomes of this site walk was the realignment of the section of pipeline south of the existing Kangaroo Hill tanks, from the existing route between the rocky outcrops to a new alignment along the road reserve to the east. This avoids the potential for direct impacts to the rocky outcrops during construction works.
Dampier Community Association (DCA)	31 May 2021	Update on the Proposal and discussion regarding modelling and marine life in brine outfall area.	Proponent provided details on modelling data to answer community concerns about marine life. Action – further discussions to be held between DCA and the Proponent.

Stakeholder	Date	Issues/topics raised	Proponent response/outcomes
Coastal Communities Environmental Forum (including CK, PPA, DBCA)	31 May 2021	Update on the Proposal and discussion on: • brief history of the WPWSS and status of Bungaroo aquifer, noting driver for project is groundwater levels in Bungaroo • general layout of the proposed desalination plant • environmental impact assessment is underway • marine life within brine stream outfall area.	Marine life within brine stream discharge area queries answered at meeting – the discharge location selected was in pre-disturbed area beneath the wharf where no sensitive habitats were present, and concentrations were expected to return to background levels within 50 m of the discharge location.
DCA	17 June 2021	Update on the Proposal and discussion regarding future engagement opportunities.	Action – further engagements to occur throughout life of Proposal, with DCA regular engagements as part of operations.
DWER – Part V Branch	28 June 2021	General update, including proposal figure (i.e., high-level plan).	Nil actions, provide updates at subsequent meeting.
Karratha Districts Chamber of Commerce and Industry (KDCCI)	29 June 2021	Introduction to the Proposal and discussion regarding background, scope, options, timelines, and future engagement: • potable water quality, taste and 'hardness' of water • construction workforce location • local procurement and local content opportunities, including Indigenous opportunities • repurposing of infrastructure if it is positive for both Rio Tinto and the Burrup.	The Proposal will mix water from Millstream and Bungaroo, which are understood to be quite hard. They will be blended daily. The Proponent must meet Water Corporation's specifications, which are above and beyond Australian Standards. Water Corporation has provided guidelines on taste, such as reducing bromide to negligible levels. If the water supply was 100% desalination it would be much softer, but as it will be mixed there is essentially little change. If anything, a little softer on some days. Accommodation options for workforce, including possible use of SeaRipple camp, will be considered. The Proponent is currently engaging with Murujuga Aboriginal Corporation and DCA. Heritage, flora, fauna, and marine surveys are being conducted. KDCCI suggested the Proponent attends the Pilbara Indigenous Business Network Group events to engage with/inform local community. Action – the Proponent will continue to engage with KDCCI and attend and provide information on the Proposal at a business After Hours event, or a Business Breakfast.

Stakeholder	Date	Issues/topics raised	Proponent response/outcomes
Pilbara Development Commission (PDC)	29 June 2021	Introduction to the Proposal and discussion regarding background, scope, options, timelines, and future engagement: • local procurement and local content opportunities, including Indigenous opportunities • power supply • value in waste streams • opportunities to consider third-party partnerships in renewables • potable water quality and 'hardness' of water.	Power supply query answered in meeting. Partnership opportunities discussed at the meeting. The Proponent provided feedback in the meeting on rationale for the desalination plant versus water from mining activities. The Proponent provided information on the broader water scheme and discussions with Water Corporation around capacity and flexibility. Actions – the Proponent will: • provide feedback on local procurement policy and what this means for local businesses • provide feedback on construction workforce and accommodation for workers in future stage • consider opportunities for utilising waste streams • continue to engage with PDC.
City of Karratha (CK)	30 June 2021	Introduction to the Proposal, including background, scope, options, timelines, and future engagement Specific topics for discussion included: • water licencing requirements • approvals processes through CK • traffic management during construction • water pipeline alignments if including intersection with CK reserves and land interests • construction workforce and accommodation requirements • maintenance of existing access road/move toward permanent roads • future engagement process and timeframe • local content opportunities • timeline for community consultation.	Rio Tinto answered query regarding water transfer pipeline routes in the meeting. Maintenance of existing access roads (and possible permanency of roads) will be considered in a later phase. Workforce and accommodation requirements will be considered in Feasibility Study. Actions – the Proponent will: • seek advice from Department of Health regarding potable water • keep CK updated on water licencing requirements • confirm with CK any Shire development approvals required for the project • share details on the project's impact on local road network and other impacts on town due to the project's construction in future phases • discuss any intersection with city reserves and land interests with CK • consider local content opportunities during Feasibility Study

Stakeholder	Date	Issues/topics raised	Proponent response/outcomes
			• include appropriate local community engagement and communication mechanisms in the stakeholder engagement plan • continue to engage with CK.
RecFishWest	15 July 2021	Presentation and introduction to the Proposal, including background, scope, options, timelines, and future engagement. Discussion regarding brine stream discharge and recreational fishing and additional engagement with recreational fishing clubs.	All works are within the port area. Stakeholder engagement plan includes engagement and communication with the two recreational fishing clubs. Action – further discussions to be held between RecFishWest and the Proponent.
CK Councillors	19 July 2021	Presentation and introduction to the Proposal, including background, scope, options, timelines and future engagement. Discussion regarding: • marine environment and plume modelling • noise emissions • consideration of other options for water supply • project location • power source Life of Plant • Proposal cost estimate.	The Proponent provided post-engagement feedback on questions asked during the engagement session, including information relating to brine, estimated construction costs, accommodation, State Agreement/Development Approval noise emissions, water supply options, power source. CK Councillors suggested the Proponent does not put any further pressure on town's accommodation. CK Councillors suggested the Proponent focus on local jobs and procurement and minimise any downsides that impact on residents, i.e., noise, vehicle movements, flights and accommodation. Action – further discussions to be held between CK councillors if any major developments. Answers to questions raised at this forum were compiled as a question-and-answer sheet and provided to CK Council.
NAC	28 July 2021	Presentation by the Proponent to the NAC Board meeting. Discussion on the Proposal and ongoing engagement with NAC.	Proponent provided details of the Proposal. Action – further discussions to be held between NAC and the Proponent.

Stakeholder	Date	Issues/topics raised	Proponent response/outcomes
DAWE – North WA Section Assessment Team	25 October 2021	Pre-referral discussion of the Proposal context and details, including: • Proposal description and scope • overview of work undertaken to avoid and minimise potential environmental impacts • summary of relevant Matters of National Environmental Significance • sought preliminary feedback on items to address in referral documentation • Proposal timing.	Follow-up meetings arranged specifically with DAWE Heritage Team to discuss heritage aspects of the Proposal.
DWER – Noise Branch	4 November 2021	Introduction of the Proposal and discussion of: • Proposal description and scope • noise assessment methodology and noise sources • summary of potential construction noise impacts • conclusion of noise assessment in line with Environmental Protection (Noise) Regulations 1997.	Noise Branch satisfied with noise assessment methodology used and conclusion.
DWER – Part V Branch	09 November 2021	Discussed the desalination plant being delivered in two stages.	Works Approval valid for five years, so possible to complete both phases under the single Works Approval.
DWER – Marine Branch	17 November 2021	Update on the Proposal and discussion regarding marine modelling approach (including plant size, marine chemistry, and brine stream outfall location): • modelling approach to ecotoxicology • proposed revised boundaries for the levels of ecological protection.	Proponent to include in referral documentation: • Trigger values for temperature and TSS • Validation monitoring of diffuser discharge/plume • Additional assessment of the potential for water quality impacts on a small patch of BCH.
MAC	27 November 2021	Social Surroundings survey and post survey discussion	Information on this survey is provided in detail in Section 8.1.3.2 – Social Surroundings.
NAC	30 November 2021	In field consultation and discussion	Information on this consultation is provided in Section 8.1.3.2 – Social Surroundings.

Stakeholder	Date	Issues/topics raised	Proponent response/outcomes
DAWE Heritage Team and North WA Section Assessment Team	25 January 2022	Discussion of heritage matters relating to the Proposal, including: • heritage survey coverage • Cultural Heritage Management Plan (CHMP) to manage potential impacts • power supply for the Proposal and industrial emissions.	Proponent to include additional discussion of heritage survey coverage, CHMP, power usage and supply for the Proposal.
DAWE North WA Section Assessment Team	17 May 2022	Discussion of marine fauna and heritage matters relating to the Proposal, including: • management of potential underwater noise from construction of the intake pond • heritage issues with construction within the National Heritage Place (NHP) discussed, and advice that potential construction impacts to heritage sites need to be a focus of the management.	Proponent sought technical advice on the potential to generate problematic underwater noise issues (determined to be unlikely) and provided additional mitigation measures in the Proposal's management approach. An addendum to the current Burrup CHMP has been prepared that applies specific management controls for construction activities within the NHP.
DWER – Part V Branch	25 August 2022	Discussion on whether the Proposal would meet Part V Prescribed Premise criteria and therefore be adequately regulated under this part of the EP Act.	DWER advised that this will be determined via the Part IV process, as the EPA will refer to Part V, and seek comments. Whether they choose to assess or not, it may be likely the works will require a Works Approval.
MAC	July-August 2022	Content design and process relation to the Proposal CHMP.	Development of the Proposal specific CHMP, with MAC buy-in.
MAC (Circle of Elders)	21 September 2022	DSDP CHMP was raised and endorsed at the Circle of Elders.	N/A.

Stakeholder	Date	Issues/topics raised	Proponent response/outcomes
DWER (EPA-S)	29 September 2022	Pre-referral meeting held in accordance with DWER's prescribed process. Key discussion points included: • Initial discussions introducing the Proposal. • Discussed the key environmental factors that required attention and consideration in the Proposal's impact predictions, management measures. • Outlined the environmental investigations and survey work that was proposed and being undertaken to inform the referral of the Proposal. • Discussed consultation undertaken to date with traditional owners and management measures and commitments to protect heritage values within the development envelope.	N/A

5 ENVIRONMENTAL PRINCIPLES

Section 4a of the EP Act identifies the five environmental principles for environmental management. Table 5-1 demonstrates how these principles have been considered as part of the Proposal.

Table 5-1: Environment Protection Act principles and how they are considered in the Proposal

Principle	Consideration
1. The precautionary principle ***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 should be guided by: (a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and (b) an assessment of the risk-weighted consequences of various options.***	The Proponent has commissioned studies to increase scientific certainty. The precautionary principle was taken during the assessment of potential options to minimise environmental risk. Where there is still uncertainty associated with study results, the precautionary principle has been applied. For example, taking the worst-case number of dilutions from whole effluent toxicity (WET) testing completed at desalination plants throughout Australia. Additional precautionary avoidance and mitigation measures to avoid potential serious or irreversible damage to the environment included: • The Proposal development envelope will be located in existing disturbed areas and within existing pipeline corridors where available, reducing the potential impacts in relation to clearing of native vegetation. <u>Social Surroundings</u> • The development envelope has been altered to exclude heritage sites and values. • Ongoing consultation will be undertaken with MAC about the design and layout of the Proposal to ensure it is culturally appropriate and acceptable. <u>Marine Environmental Quality</u> • An existing intake pond will be used to minimise TSS impacts during construction. • If the DAF unit is installed solid wastes from operating this unit with coagulants and flocculants will be taken to an appropriate waste disposal facility, rather than disposed to the ocean, to minimise the risk of flocculants and coagulants entering the marine environment. • The outfall diffuser has been designed and located in an area to facilitate rapid mixing of the discharge. • Ultra-filtration has been selected over more traditional multi-media filters because it is chemical-free during operations. • The pipeline will be buried, where possible, overland from the desalination plant to the start of the Parker Point wharf to minimise heat transfer from higher ambient air temperatures and to minimise the elevation in water temperature above ambient water temperatures.

Principle	Consideration
2. The principles of intergenerational equity ***The present generation should ensure the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.***	The Proposal has been designed to provide a sustainable water supply and mitigate the impacts from unsustainable groundwater supplies. The Proposal has been specifically designed to avoid and minimise environmental impacts and no irreversible long-term impacts are predicted. <u>Marine Environmental Quality</u> • MEQ will be managed within the boundaries of the revised levels of ecological protection (LEP) to ensure the health, diversity and productivity of significant benthic communities and habitats are maintained. <u>Social Surroundings</u> • The development envelope has been adjusted to avoid impacts to heritage sites to ensure the values of the NHP are maintained.
3. The principle of the conservation of biological diversity and ecological integrity ***Conservation of biological diversity and ecological integrity should be a fundamental consideration.***	Biological surveys have been completed to confirm the location and status of environmental values within the vicinity of the Proposal. The Proponent has undertaken measures to avoid and minimise impacts in accordance with the mitigation hierarchy, including limiting Proposal disturbance to areas that have already been cleared or highly disturbed. Therefore impacts to areas of higher biological diversity have been avoided through the design process. Given the nature of the impacts (small area of vegetation and no habitat for significant fauna species will be disturbed) the Proposal can be implemented to ensure consistency with the principle of conservation of biological diversity and ecological integrity.
4. Principles relating to improved valuation, pricing and incentive mechanisms ***(a) Environmental factors should be included in the valuation of assets and services. (b) The 'polluter pays' principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement. (c) The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes. (d) Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems.***	The Proposal has been designed to avoid and minimise environmental impacts. The costs of these mitigation controls resulted in additional costs to the Proposal development and operation. The Proponent will be responsible for bearing the costs of implementing measures to reduce and offset greenhouse gas (GHG) emissions, including the costs of adopting advances in process management and other measures in the future to further reduce and offset GHG emissions to achieve net zero along a trajectory to net-zero by 2040 (Proponent's target).

Principle	Consideration
5. The principle of waste minimisation ***All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.***	The main waste stream from the Proposal is the brine stream discharge to the ocean. The mitigation hierarchy has been applied to this waste stream to reduce the impact to the marine environment. The re-use of material during the construction phase has also been considered, including the re-use of topsoil and excavated materials. An ‘avoid, reduce, re-use, reprocess, recycle, recovery and dispose’ hierarchy of waste management approach will be implemented across all components and phases of the project, in accordance with the objectives of the *Waste Avoidance and Resource Recovery Act 2007*.

6 ENVIRONMENTAL FACTORS AND OBJECTIVES

6.1 Summary of environmental factors and objectives

Environmental factors are parts of the environment that may be impacted by an aspect of a proposal. Each environmental factor has an identified objective against which significant impacts of the Proposal are assessed.

Based on the *Statement of environmental principles, factors and objectives* (EPA, 2016a), Table 6-1 lists the identified two preliminary environmental factors, their corresponding objectives and their relationship to the Proposal. The five other relevant environmental factors are also listed.

Table 6-1: Environmental factors and Environmental Protection Authority objectives in relation to the Proposal

Environmental factor	EPA objective	Relationship to Proposal
Preliminary key environmental factors		
Marine Environmental Quality	To maintain the quality of water, sediment and biota so environmental values are protected.	Discharges during commissioning and operations are likely to impact local water quality. This is considered a preliminary environmental factor and is assessed in Section 7.
Social Surroundings	To protect social surroundings from significant harm.	Activities during construction, commissioning and operations have the potential to impact social surroundings. This is considered a preliminary environmental factor and is assessed in Section 0.
Other factors relevant to the Proposal		
Benthic Communities and Habitats	To protect benthic communities and habitats so biological diversity and ecological integrity are maintained.	Discharges during construction, commissioning and operations have the potential to impact benthic communities and habitats. This is considered another relevant factor and is assessed in Section 9.
Marine Fauna	To protect marine fauna so biological diversity and ecological integrity are maintained.	Activities during construction, commissioning and operations have the potential to impact marine fauna. This is considered another relevant factor and is assessed in Section 10.
Flora and Vegetation	To protect flora and vegetation so biological diversity and ecological integrity are maintained.	Activities during construction are likely to impact small areas of flora and vegetation. This is considered another relevant factor and is assessed in Section 11.
Terrestrial Fauna	To protect terrestrial fauna so biological diversity and ecological integrity are maintained.	Activities during construction, commissioning and operations have the potential to impact terrestrial fauna. This is considered another relevant factor and is assessed in Section 12.
Greenhouse Gas Emissions	To reduce net GHG emissions in order to minimise the risk of environmental harm associated with climate change.	GHG emissions for the Proposal have been quantified and fall well below the threshold for assessment as an environmental factor (EPA, 2020). Emissions and potential impacts have been quantified in Section 13 to provide assurance of the predicted GHG emissions.

Environmental factor	EPA objective	Relationship to Proposal
Not relevant to the Proposal		
Coastal Processes	To maintain the geophysical processes that shape coastal morphology so the environmental values of the coast are protected.	Construction of the intake is contained within the existing intake pond. The outfall does not require any seabed construction and is placed on an existing pile. Coastal processes are unlikely to be impacted by the Proposal. This factor is not considered relevant to the Proposal.
Inland Waters	To maintain the quality of groundwater and surface water so environmental values are protected.	Due to the location of the Proposal, there is not expected to be any impacts on groundwater and surface water. This factor is not considered relevant to the Proposal.
Terrestrial Environmental Quality	To maintain the quality of land and soils so environmental values are protected.	The chemical, physical, biological and aesthetic characteristics of soils are not expected to be impacted by the Proposal. This factor is not considered relevant to the Proposal.
Subterranean Fauna	To protect subterranean fauna so biological diversity and ecological integrity are maintained.	Subterranean fauna are not expected to be impacted. This factor is not considered relevant to the Proposal.
Landforms	To maintain the variety and integrity of distinctive physical landforms so environmental values are protected.	Distinctive physical landforms are not expected to be impacted. This factor is not considered relevant to the Proposal.
Human Health	To protect human health from significant harm.	This factor deals with potential radiation impacts and is therefore not relevant to the Proposal.
Air Quality	To maintain air quality and minimise emissions so environmental values are protected.	Some temporary and localised impacts to air quality may occur during construction and operation of the desalination plant. However, this is not considered an environmental factor.

7 MARINE ENVIRONMENTAL QUALITY

EPA's objective for marine environmental quality is *to maintain the quality of water, sediment and biota so environmental values are protected*

The relevant policy and guidance for marine environmental quality is described in Appendix E.

7.1 Receiving environment

7.1.1 Studies and information sources

The Proponent's environmental consultants undertook a number of marine environmental studies and investigations within the development envelope and surrounding marine environment to support the Referral documentation. Table 7-1 lists the relevant studies and publications for MEQ. These studies and investigation have informed the description of the existing environment and assessment of impacts for the Proposal.

Table 7-1: Relevant studies undertaken that support the Proposal

Author	Study (date)	Summary
Advisian	*Baseline water quality monitoring report (*Advisian, 2022a)	Baseline data used to derive EQC for physical water quality parameters
Advisian	*Water Quality Modelling Report (*Advisian, 2022b; Appendix F)	Hydrodynamic and water quality modelling to assess the brine discharge characteristics.
BMT	*Technical note: A review of desalination discharge triggers* (BMT, 2021)	Ecotoxicology data from desalination plants across Australia.
MScience	*Proposed Dampier and Cape Lambert desalination plants gap analysis: Review of available data* (MScience, 2020a)	Summary of the available information and additional studies required.
MScience	*Dampier Desalination Plant – Parker Point power station pond sediment quality study* (MScience, 2020b; Appendix G)	Investigation of the potential impacts associated with the remobilisation of contaminants within the existing intake pond.
MScience	*Memo: Parker Point benthic community and habitat survey* (MScience, 2021a; Appendix H)	Survey of the distribution of the BCH within the area potentially impacted by the Proposal.
MScience	*Memo: Parker Point physical water quality* (MScience, 2021b)	Summary of the spatial and temporal variability of water quality.
MScience	*Assessment of marine impacts* (MScience, 2021c; Appendix I)	Assessment of the potential impacts to marine environmental quality, benthic communities and habitats and marine fauna.

7.1.2 Marine Water Quality

The water quality in Mermaid Sound (including the Port of Dampier) has been comprehensively studied over the past 20 years, which has provided a sound understanding of the existing water quality of the area.

Mermaid Sound is located within the continental shelf waters of the North West Shelf. The waters of the North West Shelf are dominated by a semi-diurnal tidal cycle with a pronounced spring-neap cycle. Tides flood towards the south-east and ebb towards the north-west (Pearce et al., 2003). Tidal currents within Mermaid Sound are influenced by the islands of the Dampier Archipelago (Murujuga) and range up to 5.1 m (Mills, 1985). Tidal currents within Mermaid Sound are channelled through the islands and along Mermaid Sound and Mermaid Strait, converging near the Intercourse Islands at the south of the Dampier Archipelago (Murujuga) (Pearce et al., 2003). Wave heights in Mermaid Sound typically reduce by at least 50% as they move down Mermaid Sound from the open ocean (Pearce et al., 2003). The waters of Mermaid Sound are characterised by low nutrient levels; however, on occasions, blooms of nitrogen-fixing microbes such as *Trichodesmium* or mangrove mud-flat cyanobacterium may contribute significant amounts of nutrients into the marine environment (Pearce et al., 2003). Water quality on the North West Shelf and within Mermaid Sound is typically very high (McAlpine et al., 2004).

The Proponent's marine consultants undertook marine water quality data sampling between May 2020 and May 2021 (MScience, 2021b). Data was also collected from a fixed instrument that was recording every 30 minutes over a period of one year between May 2020 and May 2021. This data was collected to provide a cross-seasonal assessment of relevant water quality parameters (salinity and temperature) from a near-seabed site close to the proposed discharge location.

The study was undertaken to inform the impact assessment and understand whether significant vertical stratification of water quality parameters exists within the vicinity of the proposed discharge in summer or winter, and whether long-term water quality data collected close to the proposed discharge location was representative of water quality throughout an area potentially affected by the Proposal (MScience, 2021b). The study undertook site sampling over two days in winter 2020 and one day in summer 2021 for differing tidal states.

Sampling sites in the area were categorised as inner (shallow sites within the area south of the Parker Point wharf outside of channels, berths and swing basins) and outer (deeper sites around the wharf and to the north and west of the wharf) (Figure 7-1).

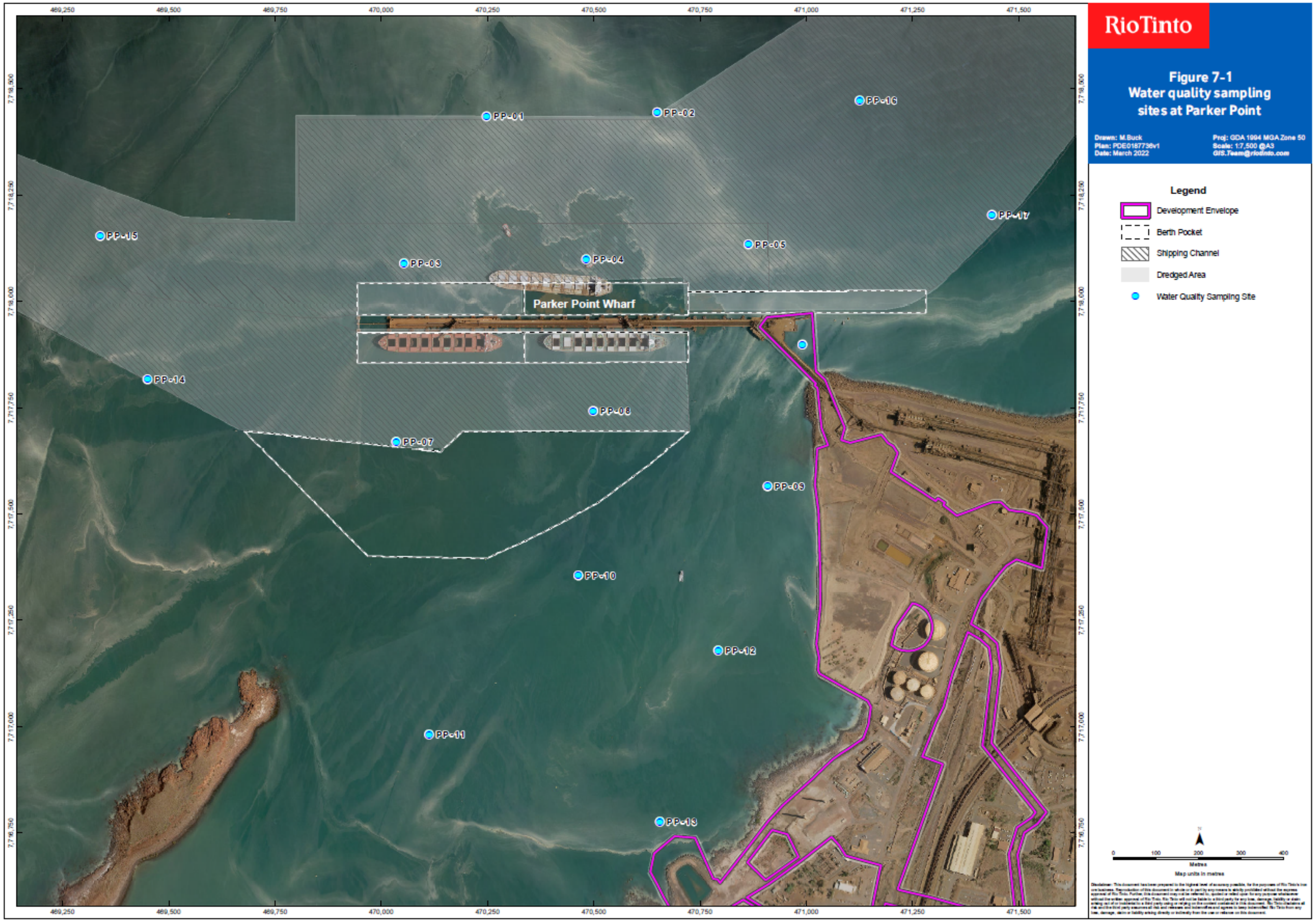


Figure 7-1: Physical water quality sampling locations (MScience, 2021b)

Mean values of physical water quality data, averaged over sites and depths, collected during the sampling period are provided in Table 7-2 (MScience, 2021b).

Table 7-2: Parker Point mean values of baseline water quality data

Zone	Season	Temperature (°C)	Salinity (g/l)	Dissolved oxygen (%)	pH	Turbidity (NTU)
Outer	Summer	32.2	37.2	103.9	8.2	1.1
	Winter	21.6	36.8	100.7	8.1	1.1
Inner	Summer	32.3	37.3	100.6	8.1	1.4
	Winter	21.6	36.9	101.4	8.1	1.3
Summer (both zones)		32.25	37.25	102.25	8.15	1.25
Winter (both zones)		21.6	36.85	101.05	8.1	1.2

7.1.3 Intake pond sediment quality

Sediments in the existing intake pond were tested to determine whether additional measures were required to mitigate the risk from resuspension of contaminants, as described in Section 7.1.1. Concentrations of potential contaminants of concern in sediment samples collected in the existing intake pond were shown to be below the default Sediment Quality Guideline Values (SQGV) (ANZG, 2018) (MScience, 2020b), with the exception of iron (see Appendix G). Iron levels were consistent with previous recent assessments of sediments in the Port of Dampier (MScience, 2015; MScience, 2020a) and are likely to be representative of ambient conditions for potential stockpile sites.

Assays for the suite of organic compounds (total petroleum hydrocarbons, polyaromatic hydrocarbons, BTEX, naphthalene, organochlorine/ organophosphorus pesticides and phenoxyacetic acid herbicides) analysed showed none were detected in any sample. The nutrient concentrations reported were similar to other studies of marine sediments in the Port of Dampier (MScience, 2007; WorleyParsons, 2009) and were generally low, which can be attributed to the relatively low nutrient supply.

Overall, sediment concentrations of contaminants of potential concern were below the default SQGVs described in the ANZG, below the environmental investigation levels and health investigation levels prescribed by the National Environmental Protection Measures and below the contaminant threshold values detailed in the DWER landfill waste guidelines.

7.1.4 Existing Pilbara Coastal Waters Environmental Quality Management Framework

The Western Australian Environmental Quality Management Framework (EQMF) was developed to protect and maintain the quality of the State's marine environment and is consistent with the State Water Quality Management Strategy (SWQMS) and National Water Quality Management Strategy (NWQMS).

The key management elements of the EQMF include the establishment of Environmental Values (EVs) and Environmental Quality Objectives (EQOs). This is a hierarchical framework in which EVs are established for significant water resources and for each EV broad EQOs are established.

Environmental values (EVs) are defined as particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health which require protection. EQOs are high level management objectives that describe what must be achieved to protect each EV (EPA 2016). In the marine environment, five EVs are recognised as potentially applying throughout WA coastal waters (EPA, 2016c), specifically:

- Ecosystem health
- Fishing and aquaculture
- Recreation and aesthetics

- Industrial water supply
- Cultural and spiritual.

In accordance with EPA (2016), the ‘Ecosystem Health’ EQOs are spatially allocated into four LEPs: Maximum, High, Moderate and Low. This allows areas identified as important for conservation and biodiversity protection to be maintained in their natural state, while recognising societal uses may preclude a high level of ecological protection from being achieved near industrial activities (including desalination discharges). The LEPs are spatially defined in an Environmental Quality Plan (EQP) that defines the spatial boundaries of each LEP.

In 2006, the then Department of Environment (DoE) published the Pilbara Coastal Water Quality Consultation Outcomes Report (DoE, 2006) to provide an Environmental Quality Management Framework (EQMF) for protecting the marine environmental quality of Pilbara coastal waters. The report established the existing Environmental Values (EV), Environmental Quality Objectives (EQO) and Levels of Environmental Protections (LEP) for the waters off the Dampier Peninsula (Figure 7-2).

The Pilbara Coastal Water Consultation Outcomes (Department of Environment 2006) specifies EVs, and associated EQOs, for the Pilbara Region. Four LEPs are considered under the environmental quality objective (EQO) for the maintenance of ecosystem integrity. This allows areas identified as important for conservation and biodiversity protection to be maintained in their natural state, while recognising societal uses may preclude a high level of ecological protection from being achieved near industrial activities (including desalination discharges). The LEPs are spatially defined in an Environmental Quality Plan (EQP) that defines the spatial boundaries of each LEP. An EQP exists for Mermaid Sound (Figure 7-2). The power station discharge (4) is no longer operating; however, the Proposal is located in this area and will repurpose the existing intake pond.

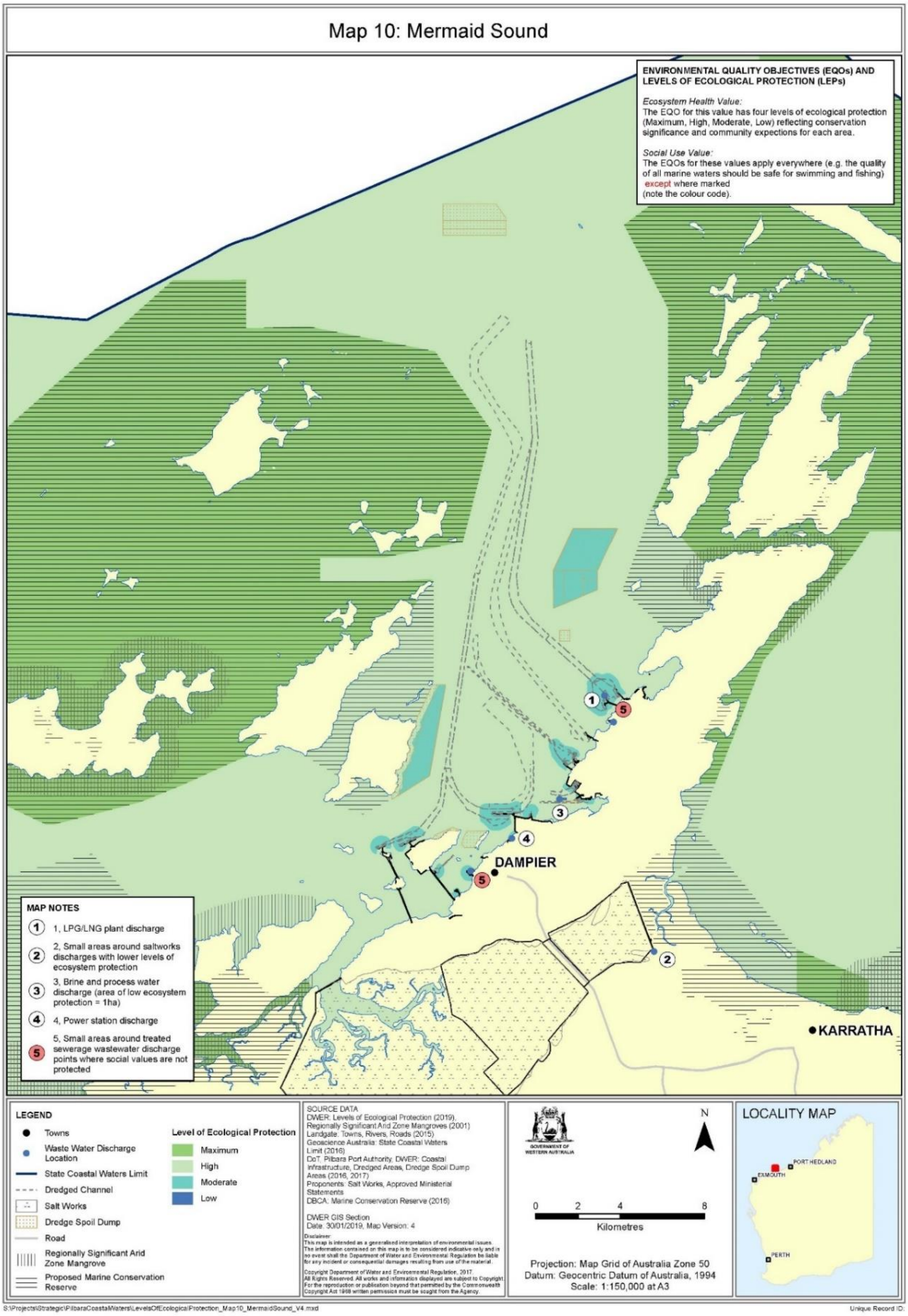


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Figure 7-2: Existing ecological protection areas of Mermaid Sound (DEC, 2006)

7.1.5 Environmental Quality Management Framework (Desalination Plant)

In accordance with the EPA's technical guidance and the current Pilbara Waters EQMF, the potential impacts to the five EVs listed in the previous section have been considered through the development of conceptual models for the operational phases and are summarised in Table 7-3.

Table 7-3: Environmental values

Environmental values	Environmental Quality Objectives	Consideration of Environmental Values
Carried through the assessment		
Ecosystem health	Maintenance of ecosystem integrity. This EQO is split into sub-objectives based on the LEP as follows: • Maintain ecosystem at a maximum LEP. • Maintain ecosystem at a high LEP. • Maintain ecosystem at a moderate LEP. • Maintain ecosystem at a low LEP.	Ecosystem health could potentially be affected by the desalination plant discharge and this environmental value is carried through the assessment.
Cultural and spiritual[2]	Cultural and spiritual; values of the marine environment are protected.	Cultural and spiritual values could potentially be affected by a change to water quality and potential biological impacts associated with the discharge and this environmental value is carried through the assessment. It is considered that should the relevant EV's for ecosystem health are met, then by default the EV's for cultural and spiritual have been met.
No further management is required to achieve the EQO		
Recreation and aesthetics	Water quality is safe for primary contact recreation (e.g., swimming and diving). Water quality is safe for secondary contact recreation (e.g., fishing and boating). Aesthetic values of the marine environment are protected.	Waters of the inner Dampier Archipelago (Murujuga) experience naturally high levels of turbidity as a result of shallow bathymetry, tropical cyclone events and local resuspension of fine sediments caused by wind and tidal mixing (Stoddart & Anstee, 2005). The proposed location for the discharge is within Rio Tinto's existing Parker Point operations where propeller wash from vessels periodically elevates the turbidity of the port waters. Due to the limited volume and level of TSS discharged, no aesthetic impacts beyond those currently present at the port are expected and the EQO is expected to be met, therefore no further management is proposed. There is a waterside restricted area surrounding the Parker Point wharf, which prevents recreational activities occurring in an area likely to be affected by the discharge; therefore, primary and secondary contact recreational impacts are not expected and the EQO will be met without further management.

[2] The EQO to protect cultural and spiritual values applies to Aboriginal cultural and spiritual values. In the absence of any specific environmental quality requirements for protection of this value, it is assumed that if water quality is managed to protect ecosystem integrity, protect primary contact recreation, protect the quality seafood for eating and maintain aesthetic values, then this may go some way toward maintaining cultural values. However, it is more problematic to define spiritual value in terms of environmental quality requirements.

Environmental values	Environmental Quality Objectives	Consideration of Environmental Values
Fishing and aquaculture (social use value)3	Seafood (caught or grown) is of quality safe for eating. Water quality is safe for aquaculture purposes.	Although aquaculture leases are present within Mermaid Sound, they are at significant distances from the Proposal and are not expected to be affected by the discharge. Fishing activity around the discharge location is also restricted due to the waterside restricted area surrounding the Parker Point wharf; thus, impacts to seafood are not expected. The EQO is expected to be met and therefore no further management is proposed.
Industrial water supply (social use value)[4]	Water quality is suitable for industrial use.	No water intakes are present near the Proposal; therefore, no potential impacts to industrial water supplies are expected and the EQO will be maintained without further management.

The Proponent's consultants used worst-case dilution scenarios to assess the potential toxicity of the discharge, with 59 dilutions used as the threshold to define the predicted spatial extent of the low LEP and 222 dilutions used as the threshold to define the predicted spatial extent of the moderate LEP. Additionally, the 95th percentile of modelled data (rather than the median used for physico-chemical parameters) was used as per the recommendations in *Technical guidance – Protecting the quality of Western Australia's marine environment* (EPA, 2016c).

7.2 Potential environmental impacts

A number of potential environmental impacts have been avoided and/or mitigated through the Proposal development and engineering design process (section 2.4). Direct and cumulative impacts are described in the following section. No indirect impacts were identified.

7.2.1 Direct impacts

Potential direct impacts of the Proposal to MEQ during construction and operations have been identified in Table 7-4.

Table 7-4: Potential direct environmental impacts

Potential impacts	Proposal phase	Activities with potential to have impact
Hydrocarbon Spills	Refurbishment of the existing intake pond	• Hydrocarbon spill from a construction vessel.
Changes to marine water quality (Turbidity)	Refurbishment of the existing intake pond	• Reconnection of the intake pond to the marine environment. • Disturbance of sediment on the seaward side of the intake pond during construction of culvert intake infrastructure.
Changes to marine water quality (Brine Discharge)	Reverse osmosis (Potable water production) during operation	• Operational discharge of brine through the diffuser into the marine environment.

[3] While the EQO for aquaculture would generally apply to all marine waters, it is operationalised by applying the EQC at the boundary of the approved aquaculture lease and targeted to the species that are grown there.

[4] No industrial water supplies are present in the area potentially impacted by the proposal and thus this EV is not considered further.

7.2.2 Cumulative impacts

The Proposal presents a low likelihood of contributing to cumulative impacts to marine environmental quality given the limited spatial extent of the revised low and moderate LEP, and that these LEPs do not overlap with the low or moderate LEPs from other proponent's discharges within Mermaid Sound (given the distances between).

7.3 Mitigation and monitoring

This section describes the mitigation measures that have been applied to the potential impacts to mitigate the risks of significant residual impacts. To develop these mitigation measures, the mitigation hierarchy of 'avoid, minimise and rehabilitate' has been applied, with a focus on avoiding impacts where possible.

For this Proposal, the implementation of mitigation measures significantly reduces impacts to the environment and enables the Proposal to meet EPA's objective for MEQ.

The Operational Environmental Management Plan (OEMP) (Rio Tinto, 2022b) presents a robust Environmental Quality Management Framework (EQMF) to confirm the predicted performance of the diffuser and includes the following monitoring programs:

Marine Monitoring Program 1 – ensure the whole effluent toxicity from the operational discharge is below the worst-case dilution criteria used in the impact assessment

Marine Monitoring Program 2 – model verification and confirmation that the levels of ecological protection are achieved

Table 7-5 sets out the mitigation measures that have been applied to each potential impact.

Table 7-5: Marine environmental quality mitigation measures

Potential impact	Applicable proposal phases	Mitigation method
EPA objective: To maintain the quality of water, sediment and biota so environmental values are protected (EPA, 2021b)		
Direct impact: **Hydrocarbon Spills**	Construction	**Avoid** Construction work on the intake infrastructure has been designed to occur inside the existing intake pond (which will be plugged and disconnected from the surrounding marine environment) as far as possible to avoid the potential for elevated TSS outside of the seawater intake pond. **Minimise** All spills to be reported and managed in accordance with the Oil Spill Contingency Plan – Cape Lambert and Dampier Ports.
Direct impact: **Changes to marine water quality (Turbidity)**	Construction	**Avoid** Construction work on the intake infrastructure has been designed to occur inside the existing intake pond as far as possible to avoid the potential for elevated TSS outside of the seawater intake pond. The culverts connecting the existing intake pond with the ocean will be blocked during activities that may result in elevated levels of TSS in the existing intake pond, such as the placement and removal of the temporary causeway. **Minimise** A silt curtain will be used on the ocean side of the culverts to minimise the potential for elevated TSS beyond the existing intake pond culverts during the replacement of the culvert screens and removal of sediment from the existing culvert. Material removed from the culverts will be directed back towards the existing intake pond. A sediment trap will be included in the construction of new drainage surrounding the intake infrastructure pad. **Rehabilitate** Before the culverts are unplugged, the water quality of the existing intake pond will be tested to ensure it is suitable for exchange with open ocean waters. The requirements for monitoring the pond water and the potential management measures are contained within the EMP (Rio Tinto, 2022b).

Potential impact	Applicable proposal phases	Mitigation method
Direct impact: **Changes to marine water quality (Brine Discharge)**	Commissioning Operations	**Avoid** Some neutralised reverse osmosis CIP waste[5] will be discharged to a dedicated wastewater tank and transported offsite to a suitable disposal facility due to the nature of the CIP chemicals. Solid wastes associated with the DAF unit when operating with the use of coagulant and flocculant will be taken to an appropriate waste disposal facility to mitigate the risk of flocculants and coagulants entering the marine environment. Aluminium-based coagulants commonly used in drinking water treatment (e.g. alum, ACH, etc) shall not be used because of the known toxicity associated with aluminium. **Minimise** The diffuser has been designed and located in an area to facilitate rapid mixing of the discharge. Monitoring will be completed as per the OEMP (Rio Tinto, 2022b) to confirm the predicted performance of the diffuser and maintenance of the LEP. CIP chemicals from the pre-screening and ultra-filtration screens will be neutralised before discharge through the diffuser. Ultra-filtration has been selected over more traditional multi-media filters because it is chemical-free during operations. Air-only would be the predominant mode of operation for the DAF unit throughout the desalination plant's operating year, while the influent seawater TSS is below 30 to 50 mg/L. Considering that seawater sampling over 12 months suggests the TSS at Parker Point is typically below 10 mg/L, it is expected this would be the normal operating mode and this mode has no associated chemicals. The primary cationic coagulant, if required in the DAF unit, will be inorganic compounds such as ferric sulfate or ferric chloride, both of which are commodity chemicals that have good biodegradability profiles. WET testing will be completed as per the OEMP (Rio Tinto, 2022b). The testing will confirm the number of dilutions used to define the LEP remain appropriate. **Rehabilitate** Before the culverts are unplugged, the existing intake pond water quality will be tested to ensure it is suitable for exchange with open ocean waters. The requirements for monitoring the pond water and the potential management measures are contained within the EMP (Rio Tinto, 2022**b).** If a spill occurs, remediation will be managed in accordance with Oil Spill Contingency Plan – Cape Lambert and Dampier Ports.

[5] Note: this refers to the reverse osmosis CIP waste. The neutralised CIP waste from the pre-screening and ultra-filtration unit will be combined with the discharge through the diffuser.

7.4 Assessment and significance of residual impacts

This section provides an assessment of the potential residual impacts to MEQ resulting from the construction, commissioning and operational phases of the Proposal. The following impact assessment assumes the mitigation measures listed in Section 7.3 are implemented, and therefore only the residual impact is discussed.

Baseline data is used to assess the residual impacts associated with the physico-chemical components of the discharge for which baseline data is available. Hydrodynamic modelling undertaken by Advisian (2021) for the dispersal, dilution and trajectory of the brine discharge plume using relevant dilution scenarios provided the following outcomes for temperature and Total Suspended Solids (TSS), which are considered negligible in environmental impact and not considered further in the assessment of MEQ:

- Temperature models predicted brine discharge to be < 2ºC above ambient and are not considered likely to result in an exceedance of the EQC values for the designated LEPs (Advisian 2021). As such, the temperature of the brine discharge is considered unlikely to significantly impact Marine Environmental Quality in the Project area and has not been assessed further.
- The model results indicate that TSS concentrations will reduce to 0.18 mg/L above background i.e. 10.18 mg/L, within 40 m and 50 m of the outfall for Summer and Winter conditions, respectively. As such, the TSS of the wastewater discharge is considered unlikely to significantly impact Marine Environmental Quality in the Project area.

The Proponent’s consultants used worst-case dilution scenarios to assess the potential toxicity of the discharge, with 59 dilutions used as the threshold to define the predicted spatial extent of the low LEP and 222 dilutions used as the threshold to define the predicted spatial extent of the moderate LEP. Additionally, the 95th percentile of modelled data (rather than the median used for physico-chemical parameters) was used as per the recommendations in *Technical guidance – Protecting the quality of Western Australia’s marine environment* (EPA, 2016c).

7.4.1 Direct impacts

7.4.1.1 Hydrocarbon Spills

Unplanned discharge of waste or hydrocarbon spills from vessels during construction can negatively impact marine environmental water quality within the development envelope and waters of the Dampier Archipelago (Murujuga) more widely, depending on the nature of the discharge. It is anticipated that construction work for the Project will be conducted from the shore and/or off the jetty where feasible. However, there may be times when a construction barge and dive support vessel (two additional vessels) will be required to support the construction activities.

Vessels will typically be stationary during construction activities. Small spills will be handled in accordance with the vessel SOPEP (if the vessel is over 400 gross tonnes) and the Oil Spill Contingency Plan – Cape Lambert and Dampier Ports. Vessels will be operating at slow speeds or anchored during construction activities, thus the risk of compromising a vessel fuel tank is very low and not expected to occur. Additionally, the fuel tanks associated with the construction vessels for the Proposal will be considerably smaller than the vessels loading and unloading at Parker Point. All vessels within port limits must manage wastes in accordance with Port of Dampier requirements appropriate to the class of vessel (including Australian Maritime Safety Authority (AMSA) and The International Convention for the Prevention of Pollution from Ships (MARPOL) legislative requirements). The risk of a spill during construction activities is considered to be extremely low and the mitigation measures are expected to help minimise the risk of any significant environmental impacts if a spill was to occur.

7.4.1.2 Changes to marine water quality (Turbidity)

Refurbishment of the existing intake pond

Silt curtains are expected to be effective in minimising the potential impacts associated with elevated TSS beyond the culvert. Sediment resuspension effects from excavation and underwater jetting to refurbish the existing intake pond culverts will be localised to within the silt curtain (used to minimise sediment dispersion during these works). The relatively small area of excavation (18 m^2) and the short duration of sediment uplift events in a naturally turbid environment are unlikely to significantly impact the structure and function of the marine ecosystem or the quality of water beyond the limits of natural variation; therefore, no significant impacts to water quality are expected.

Elevated levels of suspended sediments may be present in the runoff from the drainage surrounding the intake infrastructure pad. To mitigate the potential for the concentration of the TSS load in the run-off, a sediment trap will be constructed in the drainage channel. The sediment trap will retain the TSS in the runoff for a sufficient period of time to allow the majority of the sediment to settle within the trap.

Given the low levels of contaminants of potential concern in the sediments, it is not expected that the return water will have elevated concentrations of contaminants.

The mitigation measures proposed, including plugging the culverts of intake pond with the ocean will limited the decline in water quality to the existing intake pond; therefore, no significant impacts to MEQ outside of the existing intake pond are expected during this activity. Sediment resuspension effects from excavation and underwater jetting to refurbish the existing intake pond culverts will be localised to within the silt curtain (used to minimise sediment dispersion during these works). Silt curtains are expected to be effective in minimising the potential impacts associated with elevated TSS beyond the culvert.

Before the culverts are reopened, water quality will be tested to ensure it is suitable for exchange with the open ocean (Rio Tinto, 2022b).

Given the low levels of contaminants of potential concern in the sediments, it is not expected that the return water will have elevated concentrations of contaminants. The water would be returned to the existing intake pond and the culverts will be closed from the open ocean during this process. The water from the pond will be tested before re-opening the culverts and exchange with the open ocean (Rio Tinto, 2022b).

No significant impacts to MEQ are expected, based on the lack of contaminants in the existing intake pond sediments and the additional mitigation measures proposed. These will ensure water from the existing intake pond is of suitable quality before the culverts are reopened.

7.4.1.3 *Changes to marine water quality (Brine Discharge)*

Some changes to water quality are expected within the areas defined as low and moderate levels of ecological protection (LEP). The Proponent's consultants used worst-case dilution scenarios to assess the potential toxicity of the discharge, with 59 dilutions used as the threshold to define the predicted spatial extent of the low LEP and 222 dilutions used as the threshold to define the predicted spatial extent of the moderate LEP. Additionally, the 95th percentile of modelled data (rather than the median used for physico-chemical parameters) was used as per the recommendations in *Technical guidance – Protecting the quality of Western Australia's marine environment* (EPA, 2016c).

The Proposal will result in the following residual impacts to water quality:

- There will be a small increase in the toxicity associated with the brine discharge. The highest levels of toxicity from Australian desalination plants has been assumed in the impact assessment, however significant work has been completed during the design process to reduce impacts associated with the toxicity of the discharge. Therefore, the actual toxicity is expected to be much lower and the EQC are expected to be met within the Low and Moderate LEP.

Discharge of hypersaline water (Salinity)

The reverse osmosis desalination process will result in a discharge of hypersaline water through the diffuser to the marine environment. The discharge stream from the desalination plant will have a salinity of approximately 64 ppt. The actual salinity at any point in time depends on the salinity at the intake. A higher salinity at the intake would result in higher salinity in the discharge. The reverse osmosis process removes dissolved salts from the seawater, and the reject water, combined with the water from the backwash tank, is discharged to the ocean (Figure 2-3).

A baseline salinity dataset was collected over both summer and winter near the discharge location. Physico-chemical stressors are often locality-specific and the biological communities are generally adapted to these background conditions (EPA, 2016b). It is expected that species near the Proposal are adapted to the local conditions. Therefore, the approach to assess impacts from physico-chemical parameters (EPA, 2016b) has been applied to assess the spatial extent of potential impacts from the salinity component of the discharge.

The baseline data was used to derive EQC for physico-chemical parameters as per *Technical guidance – Protecting the quality of Western Australia's marine environment* (EPA, 2016c). The EQC are summarised in Table 7-6.

CTD casts were also completed in summer and winter to assess the spatial variation in water quality and/or stratification of the water column (MScience, 2021b). Spatial variation of salinity and stratification of the water column was low during winter, with some slight stratification during summer: bottom samples had salinities on average 0.12 g/l greater than the surface (MScience, 2021b).

Table 7-6: Environmental quality criteria for salinity

Level of ecological protection	Percentile of natural background data	Season	Threshold/EQC (ppt)
Low/moderate boundary	Seasonal 95th percentile of background data	Summer	37.08
		Winter	36.2
Moderate/high boundary	Seasonal 80th percentile of background data	Summer	36.86
		Winter	36.07

Near-field and far-field models were combined to predict the dilution of the proposed discharge. The near-field dilution process occurs because of the velocity, momentum and upwards trajectory of the discharge jet, which ensures the plume is rapidly dispersed before the diluted plume reaches the ocean floor. The far-field dilution process occurs when initial turbulence decays and mixing take place because of turbulence generated by tidal currents and the plume dispersion itself.

To determine the boundary and distance of the LEP, the following models were used:

- Near-field Model – To predict the dilution of the near-field plume, a preliminary analysis of the outfall performance was undertaken using the Roberts et al. (1997) formula, which is based on extensive laboratory experiments. To support the derived results about the near-field dilution, a 3D near-field model was set up with the same diffuser specifications as derived from the Roberts et al. formula. The 3D near-field model was run and coupled with the far-field model domain.
- Far-field Model – To determine the boundaries of the LEP, a far-field model was used. A local MIKE 3D hydrodynamic model of the project area was used to simulate the brine stream plume dilution to the far-field area after the initial near-field mixing. This 3D coupled model simulated the discharge dilution process for both initial turbulence and mixing by the tidal currents.

The 50th percentile of the modelled data was compared with the thresholds in Table 7-6 in accordance with *Technical guidance – Protecting the quality of Western Australia's marine environment* (EPA, 2016c).

The modelling (Figure 7-3) showed the plume rapidly dispersed, and when the 50th percentile of modelled data is compared with the EQC for a low LEP, the threshold is not exceeded due to the rapid dilution at the diffuser (Advisian, 2022b). The thresholds for a moderate LEP are exceeded in the immediate vicinity of the discharge and in a small area within the existing moderate LEP (Figure 7-3).

Modelling of the vertical profile of the brine stream plume indicates that after the initial dilution phase (jetting of the brine through diffuser ports at 45º to the seabed), the brine sinks to the seafloor before dispersing along gradients. A very high rate of initial dilution is achieved through the diffusers, resulting in salinity concentrations within the modelled (far-field) brine stream plume being within 1 ppt of background concentration between 20 to 40 m of the outfall. As such, the salinity of the brine discharge is considered unlikely to significantly impact MEQ.

The retention of brine at the seabed may lead to persistent stratification and reduced dissolved oxygen in the deepest parts of the receiving environment. However, given the rapid dilution of salinity predicted, such effects are likely to be minor. In addition, Parker Point and the area around the proposed discharge are regularly subjected to propeller wash from ship and tug movements. The effect of vessel movements on the brine stream plume was not included in the modelling. The modelling, therefore, represents a conservative approach, since vessel movements will increase mixing of the water column around the outfall and further reduce the potential for significant stratification.

Figure 7-3: Modelled summer and winter salinity dispersal

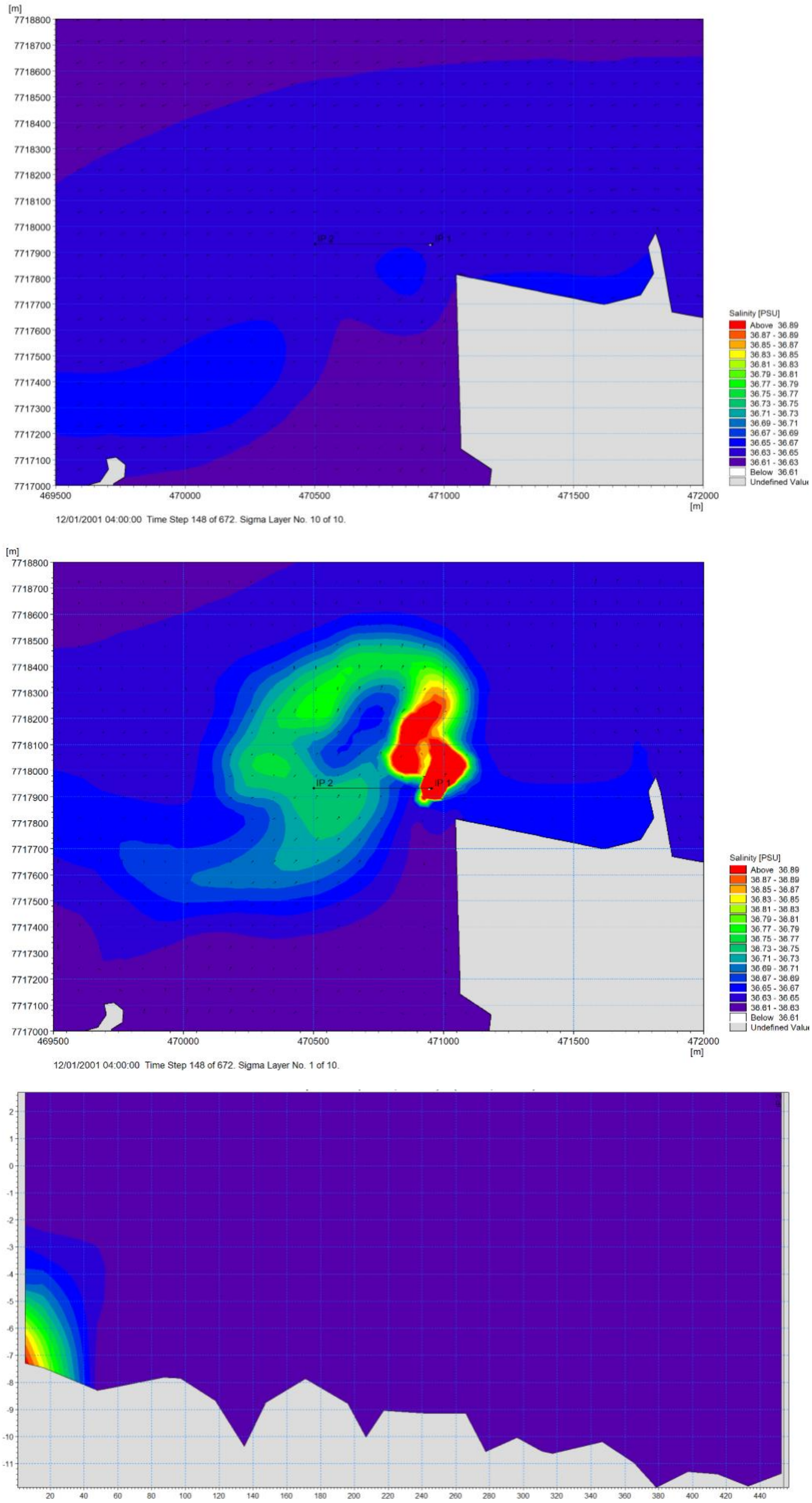

Figure 7-4: Modelled summer salinity dispersal (top: plan view of surface dispersal, mid: plan view of bottom dispersal, bottom: profile view of dispersal)

Discharge of brine solution (Toxicity)

The proposed pre-treatment screens and ultra-filtration screens CIP chemical are typical of those used in desalination plants across Australia. These are discharged to the backwash tank are then combined with the reverse osmosis reject water and discharged to the ocean.

Testing of brine samples and brine plus discharged CIP chemicals from operational desalination plants shows the addition of waste streams from the CIP and backwash sumps, creating the whole effluent sample, do not have a significant impact on toxicity (Intertek, 2018). WET testing of desalination wastewater has been undertaken on occasion for previous Australian desalination projects. BMT (2021) reviewed desalination discharge environmental management triggers for desalination plants across Australia to determine suitable dilution thresholds for the current project. Publicly available WET test data was collated from reports from nine desalination plants across Australia: four in WA, three in South Australia, one in Victoria and one in New South Wales (BMT, 2021).

The Proponent's consultants used worst-case dilution scenarios to assess the potential toxicity of the discharge, with 59 dilutions used as the threshold to define the predicted spatial extent of the low LEP and 222 dilutions used as the threshold to define the predicted spatial extent of the moderate LEP. Additionally, the 95th percentile of modelled data (rather than the median used for physico-chemical parameters) was used as per the recommendations in *Technical guidance – Protecting the quality of Western Australia's marine environment* (EPA, 2016c).

The predicted low LEP is expected to remain predominantly within the footprint of the existing infrastructure of the active port, extending a maximum distance of 35 m from the diffuser location. There is an existing moderate LEP that encompasses the majority of the Parker Point port facilities, with an approximate 200 m buffer around the reclaimed land area and landside facilities. The area between the existing moderate LEP and the land was surveyed; the only area of BCH identified in this area was a 1 ha sparse (less than 10% cover) mixed community to the south of the proposed discharge, with occasional small (<30 cm width) corals.

The modelled low LEP extends between the existing moderate LEP and the shoreline and it is proposed that the existing zone of moderate LEP is extended landwards and an additional low LEP is extended to a 70 m radius surrounding the discharge. No significant impacts to MEQ are predicted outside of the proposed moderate LEP, with water quality expected to be at background levels beyond the moderate LEP.

No significant impacts to MEQ are expected beyond the revised moderate LEP, given:

- Backwashed CIP chemicals from the reverse osmosis screens will report to the backwash tank for off-site disposal
- Ultra-filtration CIP and CEB waste will be neutralised and monitored prior to discharge
- A conservative approach has been taken to estimating the dilution required to meet a high LEP and a moderate LEP and for revision of the EQP.

Figure 7-5: Whole effluent toxicity testing modelling results

Figure 7-6: Proposed environmental quality plan

7.5 Summary of significance of residual impacts

This section summarises the significance of residual impacts for MEQ in accordance with the Statement of Environmental Principles, Factors and Objectives (EPA, 2021b). The connections and interactions between other environmental factors are considered in the holistic impact assessment (Section 14). The remaining matters as outlined in Section 6 of the Statement of Environmental Principles, Factors and Objectives (EPA, 2021b) are considered in Table 7-7.

In summary, the Table 7-7 demonstrates that by implementing the mitigation measures and revising the existing EQP, the Proposal can meet EPA's objective for MEQ.

7.6 Summary of significance of residual impacts

It is considered that by implementing the mitigation measures and revising the existing EQP, the Proposal can meet EPA's objective for MEQ.

Table 7-7: Summary of residual impacts

Residual impact	Consideration of key EPA (2021) Matters	Significance of residual impact	Recommended conditions and DMA regulation for significant residual impacts[6]
Change to marine water quality (Turbidity)	**Values, sensitivity and quality of the environment** The nearshore waters of Mermaid Sound are naturally turbid with a relatively high sediment load. Sediment loads increase during periods of high metocean energy, including tropical cyclones. There are no significant benthic communities or habitats in the area proposed to be reclassified as a high or moderate level of ecological protection (LEP). **Extent** An area designated as a high LEP is proposed to be reclassified as a moderate LEP. The area is relatively small compared to the existing area of moderate LEP. The reclassification is not expected to affect the environmental values (EVs) described in Table 7-3. An area 70 m from the proposed discharge location is proposed to be reclassified as a low LEP. The area proposed for reclassification is relatively small and within proximity to the existing wharf. It is in an area of heavy industrial activity that is regularly dredged. Therefore, the reclassification of this area is not expected to have a significant impact on the EVs described in Table 7-3. **Resilience of the environment** The existing marine environment is subject to elevated levels of TSS and is well mixed. The sparse mixed community to the south of the proposed discharge is subject to naturally elevated levels of TSS and periodic events that increase TSS well beyond the levels predicted during construction and operations. Therefore, the environment is considered resilient to the levels of TSS predicted to be generated by this Proposal. **Consequence of mitigation hierarchy** The mitigation hierarchy will restrict the spatial extent of impacts predicted through construction. The project has been designed to limit the TSS concentration at the diffuser through the premixing of the cleaning chemicals with the reject reverse osmosis stream. **Cumulative effects** Current propeller wash from the nearby port operations is expected to temporarily elevate TSS vessels for short periods of time during vessel movements at the port. TSS levels predicted from this Proposal will only contribute a small amount of additional suspended sediment to the system. Further, TSS levels in the vicinity of any BCH are expected to be indistinguishable from the natural TSS levels.	Not considered significant due to the short timeframe and localised nature of the construction impacts and the low levels of TSS beyond 50 m from the proposed diffuser location. It is expected the EPA objective for MEQ will be met.	No conditions proposed. Management actions proposed in the CEMP (Rio Tinto, 2022b) are considered sufficient to manage this potential impact.

[6] Mitigation actions for potential impacts that do not result in *significant residual impacts* are described in the EMPs

Residual impact	Consideration of key EPA (2021) Matters	Significance of residual impact	Recommended conditions and DMA regulation for significant residual impacts[6]
	Level of confidence in the prediction of residual impacts A significant amount of baseline data was collected to understand the expected TSS at the diffuser and there is a high level of confidence in the TSS predicted. The EMP details a monitoring program to validate the model and ensure the predictions in the model are accurate or conservative.		
Changes to marine water quality (Brine Discharge)	**Values, sensitivity and quality of the environment** Coastal waters of the North West Shelf are generally very high quality. The spatial extent of the proposed revised LEP is driven by the modelling of a highly conservative estimate of the WET of the discharge waters. The WET thresholds for a low and moderate LEP are exceeded in an area currently designated as a high LEP. This area is adjacent to the coastline. The seabed is typically bare silty sand, with the exception of a small rock outcrop with a mixed community of less than 5% cover approximately 120 m to the south of the proposed discharge. The proposed changes to the LEP are not expected to have a significant impact on the EVs described in Table 7-3. **Extent** An area designated as a high LEP is proposed to be reclassified as a moderate LEP. The area is relatively small compared to the existing area of moderate LEP. The reclassification is not expected to affect the EVs described in Table 7-3. An area 70 m from the proposed discharge location is proposed to be reclassified as a low LEP. The area proposed for reclassification is relatively small and within proximity to the existing wharf. It is in an area of heavy industrial activity that is regularly dredged. Therefore, the reclassification of this area is not expected to have a significant impact on the EVs described in Table 7.3. **Resilience of the environment** The marine environment within the proposed low and moderate LEPs is well mixed. This is demonstrated by the modelling, which shows a rapid dilution of the proposed plume within proximity to the proposed discharge (dilution >1:50 within 35 m of the proposed discharge location). The revised LEPs are based on highly conservative worst-case assumptions. It is expected the plume will be diluted sufficiently and there is no effect to significant BCH. **Consequence of mitigation hierarchy** The mitigation hierarchy will restrict the spatial extent of impacts predicted through commissioning and operations. The project has been designed to reduce the potential toxicity of the discharge at the diffuser.	Not considered significant due to the localised nature of the potential residual impacts. It is expected the EPA objective for MEQ will be met.	To ensure the outcome is met, the Proponent shall implement the monitoring program within the Environmental Management Plan (Rio Tinto, 2022b).

Residual impact	Consideration of key EPA (2021) Matters	Significance of residual impact	Recommended conditions and DMA regulation for significant residual impacts[6]
	Cumulative effects There are no other discharges within the proposed revised low or moderate LEPs and other regional discharges are not expected to combine with this discharge, thus no cumulative impacts are expected. **Level of confidence in the prediction of residual impacts** The worst-case WET testing data from Australian desalination plants was used in the assessment. However, given the design and controls associated with the desalination plant, it is expected the discharge will be less toxic than the worst case used to inform the impact assessment. Therefore, there is a high level of confidence in the prediction of the residual impacts. The EMP details a monitoring program to validate the model and ensure the predictions in the model are accurate or conservative. The EMP will also confirm the assumption that the WET testing data used to inform the impact assessment is conservative.		

7.7 Environmental outcomes

EPA's objective for marine environmental quality is to maintain the quality of water, sediment and biota so environmental values are protected (EPA, 2021b).

Desalination plants result in the discharge of brine/water back to the ocean. The Proposal will result in the discharge of hypersaline water through a new diffuser constructed on an existing wharf, discharging into an existing industrial port environment. The Proposal will result in minor impacts to water quality in waters immediately surrounding the proposed discharge location, with the potential water quality impacts expected to be limited to within the revised moderate LEP as shown in Table 7-3.

Due to the design of the Proposal and the significant focus on reducing environmental impacts, including the export of wastes that contain proprietary chemicals, the potential toxicity of the discharge from the Proposal will not be higher than the worst case from previously-constructed desalination plants within Australia. This will be validated by the monitoring program proposed as part of the EMP (Rio Tinto, 2022b), which will include provisions for public reporting of marine environmental quality data.

The brine is expected to rapidly dilute and no thresholds for a low LEP associated with salinity are exceeded within the model domain. The salinity thresholds for a moderate LEP are exceeded up to a maximum distance of approximately 300 m from the discharge and remain well within the proposed revised moderate LEP boundary, based on the modelling WET thresholds.

Only minor amendments are required to the existing LEPs. The amendments are proposed to accommodate a low LEP immediately surrounding the discharge and a minor amendment to the existing moderate LEP, which does not currently cover the proposed discharge location or plume. These amendments are spatially small and do not extend over any significant benthic communities, nor are they expected to result in indirect impacts to other environmental factors. The discharge and surrounding waters will be monitored to ensure the EQC are met at the boundaries of the proposed LEP areas.

The environmental outcomes for MEQ are:

> *"To meet the Environmental Quality Criteria defined in the Environmental Management Plan (Rio Tinto, 2022b) for a Moderate Level of Ecological Protection inside of the boundary of the Low Level of Ecological Protection area as defined in Figure 7-6."*

And

> *"To meet the Environmental Quality Criteria defined in the Environmental Management Plan (Rio Tinto, 2022b for a High Level of Ecological Protection inside of the boundary of the revised Moderate Level of Ecological Protection area as defined in Figure 7-6."*

The proposed condition for MEQ is:

> *"To ensure the outcome is met, the Proponent shall implement the monitoring program within the Environmental Management Plan (Rio Tinto, 2022b)."*

7.7.1 Conclusion

The Proponent considers that the Proposal can be managed to meet EPA's objective for MEQ for the following reasons:

- The discharge of brine is located in a highly disturbed area with existing high levels of mixing from port operations.
- The discharge will be located within an area designated as a low LEP, which is located within a disturbed area of seabed with no significant environmental values.

- The toxicity of the proposed discharge is expected to be considerably lower than the WET thresholds used to predict the LEP.
- Significant engineering work has been completed to ensure the toxicity of the discharge is minimised by ensuring the discharge is fully neutralised and proprietary chemicals are not disposed to the ocean.
- Residual impacts are not significant due to the environmental quality criteria being met at the boundaries of the revised Environmental Quality Plan (EQP) and the amendments to the existing EQP are minor and do not have a significant impact on other environmental factors.
- Monitoring is proposed to ensure that the revised LEP are maintained.
- No cumulative impacts are predicted.

Given the avoidance of potential impacts through siting of the project in disturbed areas and on existing infrastructure in an industrial port environment and the proposed mitigation and management, the Proponent considers that the Proposal can be managed to meet EPA’s objective for MEQ.

8 SOCIAL SURROUNDINGS

EPA's objective for social surroundings is to protect social surroundings from significant harm

The relevant policy and guidance for social surroundings is described in Appendix E.

Social surroundings under the EP Act refers to:

> "*the social surroundings of a person are their aesthetic, cultural, economic and social surroundings to the extent that those surroundings directly affect or are affected by a person's physical or biological surroundings.*"

As such, there is a specific focus on a clear linkage between the Proposal's potential impact on the physical or biological surroundings and the subsequent impact on a person's aesthetic, cultural, economic or social surroundings. In addition, an impact must be significant in terms of its effect on the physical or biological environment. Figure 8-1 provides a visual representation of how environmental and cultural aspects in this Proposal interact with social surroundings.

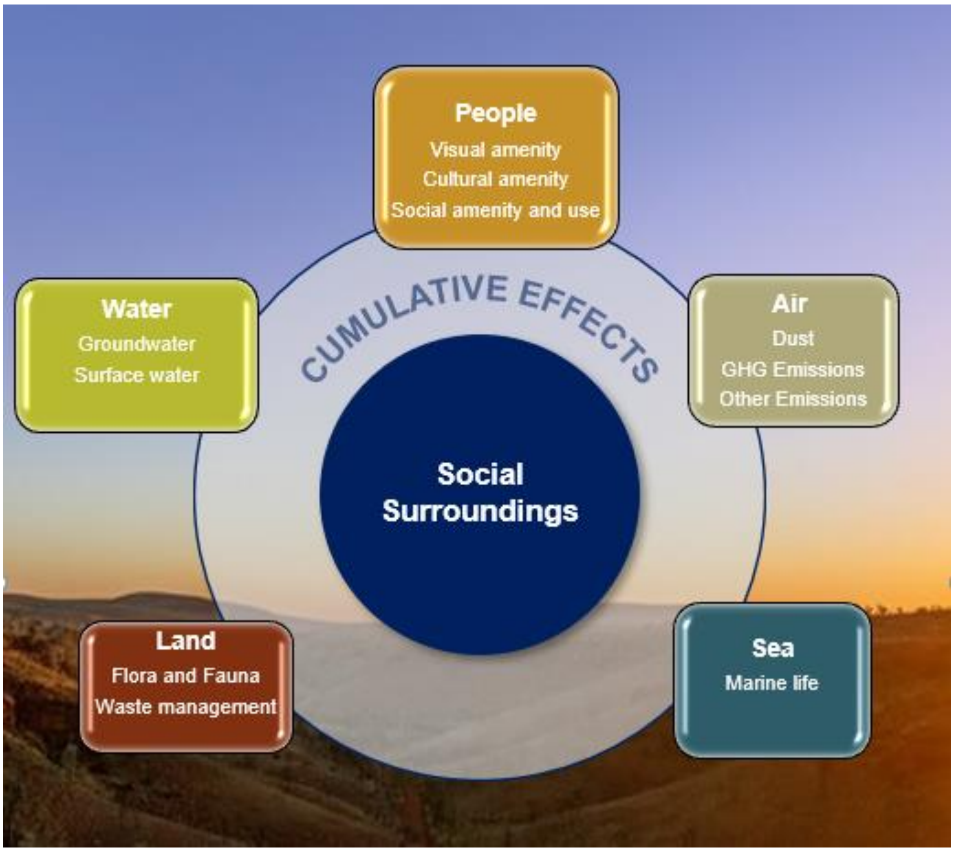

Figure 8-1: A visual representation of how environmental and cultural aspects in this Proposal interact with social surroundings

8.1 Receiving environment

8.1.1 Regional location

The Proposal is located at Parker Point, one of the two iron ore ship loading facilities managed by Rio Tinto within the Dampier Archipelago (Murujuga). It is located within the City of Karratha Local Government Authority (LGA) area. Parker Point is approximately 22 km north-west of the LGA's administrative centre of Karratha, which had a population greater than 15,000 in 2016 (ABS, 2016), and north-east of the town of Dampier. To the east of the development envelope is the southern portion of Murujuga National Park (approximately 2 km at the closest point) on the Burrup Peninsula (Figure 8-2).

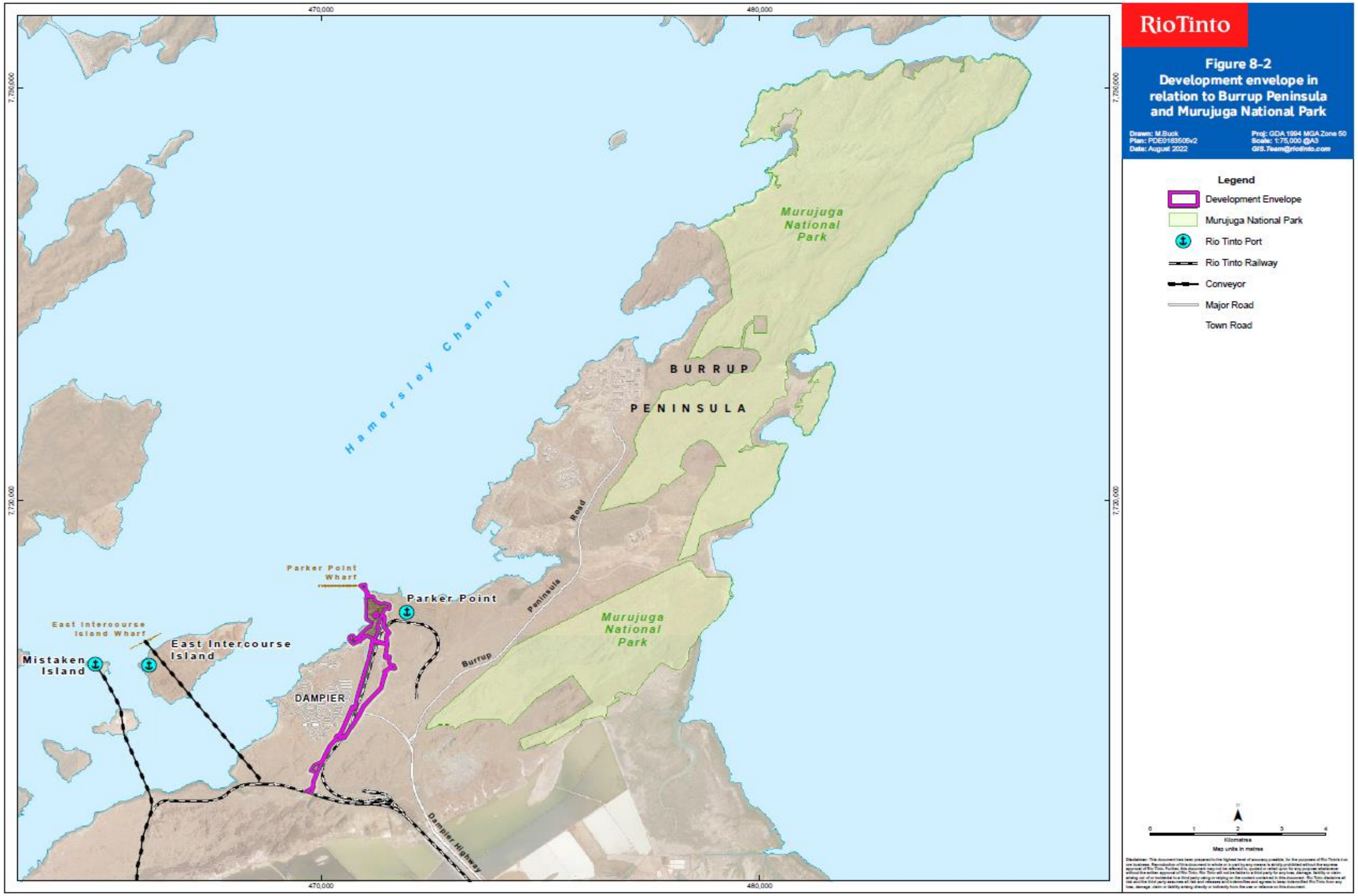

Figure 8-2: Development envelope in relation to Burrup Peninsula and Murujuga National Park area

8.1.2 Tourism, recreation and fishing

The natural, cultural, and historical attractions of the Burrup Peninsula make it a popular location for tourism, recreation and fishing. Hearson Cove, located approximately 7.8 km east north-east of the development envelope, is a popular recreational area for tourists and locals due to its beautiful, shallow beach and proximity to petroglyphs at *Nganjarli* (Deep Gorge). Other attractions in the area include Tidepole Island, a popular picnic and barbecue destination located 2 km south-west of the Proposal. The islands of the Dampier Archipelago are popular for both tourism and recreation, with some areas being set aside for day trips and camping, while others are sensitive seabird and turtle nesting areas (Australia's North West, 2021). Recreational fishing is popular within the coastal part of the Pilbara, with local residents fishing year-round (Williamson et al., 2006)

Commercial tourism activities in the region include charter fishing, cruising, diving, snorkelling, whale watching, and marine turtle and dolphin watching. These activities have grown substantially over recent years. There is a seasonal peak in winter (the cooler months) when significant numbers of tourists travel through the area and visit the Dampier Archipelago (Department of Primary Industries and Regional Development, 2021a).

A safety exclusion zone is in place around the port facilities, with only commercial vessels conducting business with the port permitted access to the exclusion zone (PPA, 2021b). This restricted area prevents tourism or recreational activities occurring in the proposed intake or outfall areas of the desalination plant. Impacts to tourism or recreational activities are not expected as part of this Proposal.

8.1.3 Aboriginal Heritage and Culture

The Dampier Archipelago contains one of the largest collections of Indigenous rock art in the world, with an estimated 1,000,000 or more individual petroglyphs, some of which are thought to be over 40,000 years old. The engravings show human images, cultural items and practises, extinct animal species such as megafauna and Thylacines (Tasmanian tiger), as well as existing avian, marine, and terrestrial animals, illustrated by their form and tracks. Murujuga also contains several rock shelters, ceremonial places, and stone arrangements, amongst other archaeological and sacred sites.

The Dampier Archipelago including Burrup Peninsula is the traditional land of the Yaburara people. Murujuga is the language name for the entirety of the area which encompasses the Burrup Peninsula. Colonial occupation and government policy made it extremely hard for Yaburara and adjacent Aboriginal groups to maintain traditional links and detailed totemic knowledge of Murujuga. This was exacerbated by the industrial developments of the 1960s. Today five Traditional Owner groups provide the sacred maintenance and cultural management of Murujuga.

There is a high level of commitment by Rio Tinto, Traditional Owners and Government to the management of Murujuga, to protect and promote the values of Murujuga and support the World Heritage listing. On 27 August 2018, a joint Letter of Support was signed between MAC and the State Government to begin the formal World Heritage listing process of Murujuga. In February 2020, the Tentative List Submission report for the Murujuga Cultural Landscape was provided by the Australian Government to the UNESCO World Heritage Centre and Murujuga was officially added to Australia's World Heritage Tentative List. A nomination Dosier is being prepared and cannot be considered for World Heritage listing by the UNESCO World Heritage Committee until a 'property' has been on the Tentative List for at least 12 months. The formal process takes time, with the earliest consideration for this area being listed is anticipated in 2024 (MAC, 2021c).

Public concern has been expressed in regard to the effect industrial emission have on the petroglyphs, which has prompted scientific research under the auspices of MAC to investigate this matter. The *Murujuga Rock Art Strategy* (DWER, 2019a) outlines a long-term framework to guide the protection of the petroglyphs. The Strategy describes a risk-based approach for the management of impacts to the rock art that is consistent with the State Government's responsibilities under the *Environmental*

Protection Act 1986 and provides the monitoring and analysis to determine whether accelerated change is occurring to the rock art.

8.1.3.1 National Heritage Place and Agreements

8.1.3.1.1 Dampier Archipelago (including Burrup Peninsula) National Heritage Place

The Dampier Archipelago (including Burrup Peninsula) was included in the National Heritage List as a National Heritage Place on 3 July 2007. The development envelope intersects the boundary of the Dampier Archipelago (including Burrup Peninsula) National Heritage Place with the existing Water Corporation water transfer pipelines north and south of the existing Kangaroo Hill tanks (Figure 8-3). Approximately 0.9 ha of the development envelope intercepts the NHP, including approximately 900 m of existing disturbed water pipeline corridors.

The existing water pipeline infrastructure was constructed in 1970-71, before the Dampier Archipelago (including Burrup Peninsula) was listed as a National Heritage Place in 2007, and the boundary was delineated to include this existing water infrastructure. As a result, the new water transfer pipeline upgrades in this section requires activities which are located within the National Heritage Place. As noted above, assessment has deemed that the proposed installation of the new water pipeline for the desalination plant along the existing infrastructure corridor will not further adversely impact any National Heritage values.

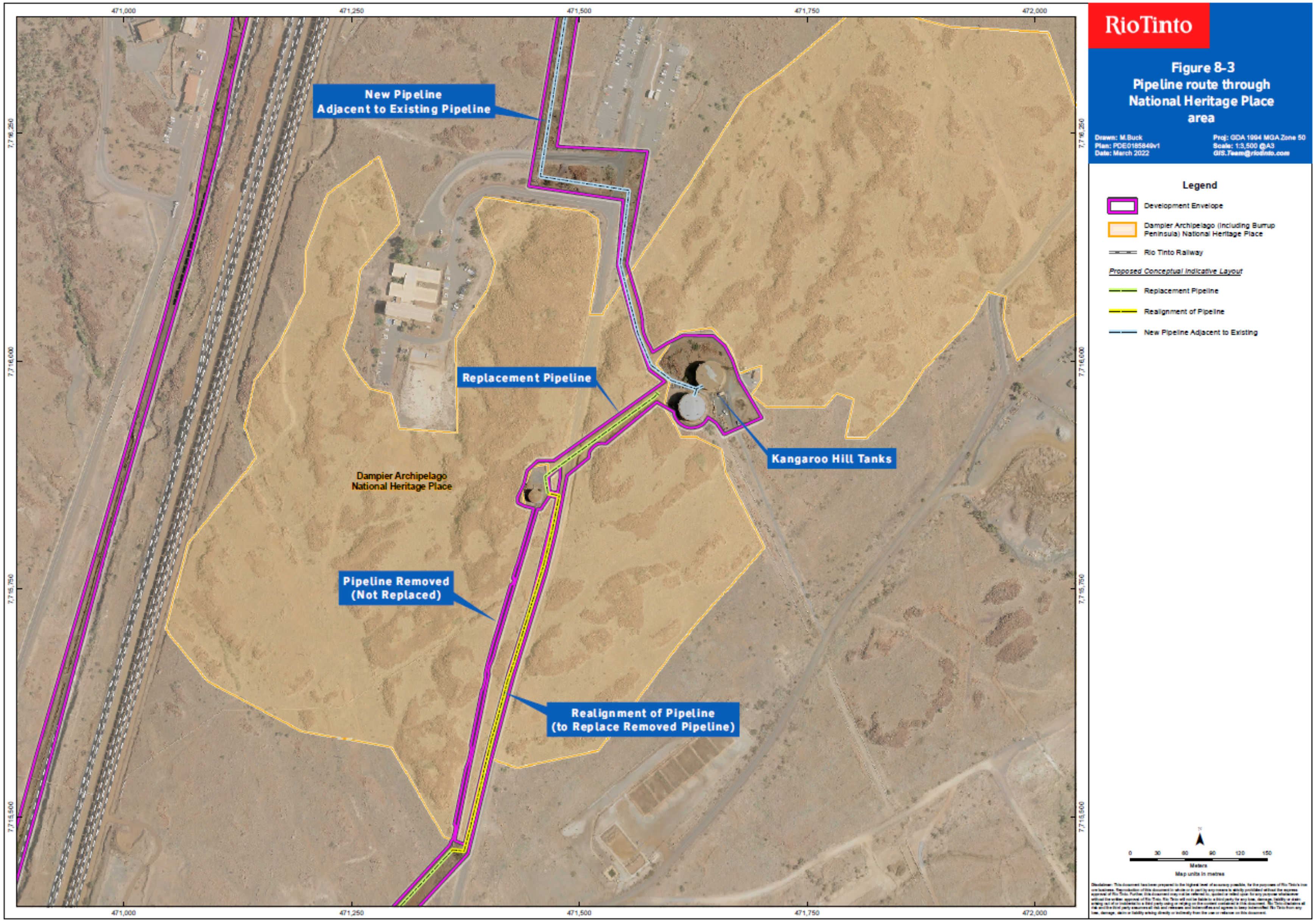

Figure 8-3: Pipeline route through the National Heritage Place area

8.1.3.1.2 Murujuga Aboriginal Corporation, Conservation Agreement and the Burrup and Maitland Industrial Estates Agreement

The traditional custodians of Murujuga comprise members of five traditional Aboriginal language groups, being the Ngarluma, Yindjibarndi, Yaburara, Mardudhunera and Wong-Goo-Tt-Oo People, collectively referred to as *Ngurra-ra Ngarli* (alt. *Ngarda-ngarli*), all of which were involved with three overlapping native title claims which were historically in place over the Dampier Archipelago, and adjacent mainland. In around 2002, the State Government entered into negotiations with the then native title claimant groups, which negotiations were completed in late 2002/early 2003, the end outcome of which was to allow for industrial development to progress across southern parts of the Burrup Peninsula, and which facilitated the development of a conservation estate and helped manage the protection of Aboriginal heritage. MAC is the approved body corporate established under the BMIEA and are the land holders and co-managers of the Murujuga National Park. MAC, which represents the three traditional Aboriginal language groups, is recognised as the consultative body in regard to cultural heritage issues within Dampier Archipelago (Murujuga). Under the BMIEA, in exchange for agreeing to the surrender and permanent extinguishment of their native title rights and interests to the Burrup and Maitland Industrial land, the three traditional Aboriginal language groups received a range of benefits from the WA Government, including fiscal and land grants.

A Conservation Agreement, signed between Rio Tinto operating companies and the Commonwealth Government in July 2007, is also in place which provides for management and permissible activities within the Dampier Archipelago (including Burrup Peninsula) National Heritage Place (NHP). This provides guidelines for assessing National Heritage values and means to mitigate impact on these values (i.e., the rock art and stone arrangements). It is through the Conservation Agreement and associated Commonwealth Government requirements that primary engagement is through MAC in regard to the development and associated tangible and non-tangible heritage values.

8.1.3.1.3 Ngarluma and the Rio Tinto Ngarluma Indigenous Land Use Agreement

The Proposal is also located within the contractual agreement area covered by the *Rio Tinto Ngarluma Indigenous Land Use Agreement (ILUA), 2011.* The Ngarluma people are represented by the Ngarluma Aboriginal Corporation (NAC), with formal engagement undertaken with the Proponent via the Ngarluma Rio Tinto Implementation Committee (NRIC), which meets at least twice a year. Based on the ILUA that is in place with Ngarluma, Rio Tinto consulted NAC regarding the Dampier Seawater Desalination Plant on several occasions (refer to Table 4-2) including the location of the desalination plant and pipelines to understand and discuss any concerns or sentiments NAC and the Ngarluma people have in relation to the Proposal. Any actions from these engagements are captured in a project register and continue to be followed up at regular intervals until the actions have been closed out.

8.1.3.2 Studies and information sources

8.1.3.2.1 Aboriginal Heritage Inquiry System

The Department of Planning, Lands and Heritage (DPLH) maintains the Aboriginal Heritage Inquiry System (AHIS). This system contains spatial information relating to recorded Aboriginal heritage surveys and site boundaries in WA. A search of the AHIS shows much of the development envelope is covered by pre-existing industry infrastructure and services and that the area has been extensively surveyed, as shown in Figure 8-4. It is important to note that not all surveys are listed on the AHIS.

The development envelope interacts with site boundaries contained within the publicly available AHIS database. These boundaries are based on geometric shapes and assigned dimensions (circles and squares; 200 m to 10,000 m) that do not necessarily reflect the location and extent of a site and its features. Rio Tinto have conducted heritage surveys over these regions to locate and define the characteristics and extent of their cultural features. These Aboriginal heritage sites have been avoided in the project design.

With the exception of one site (site ID 23323), these are all sites recorded by the Proponent and submitted to the DPLH. The Proponent's own database system retains the actual location and extent of these sites. The actual site boundaries do not intersect with the development envelope.

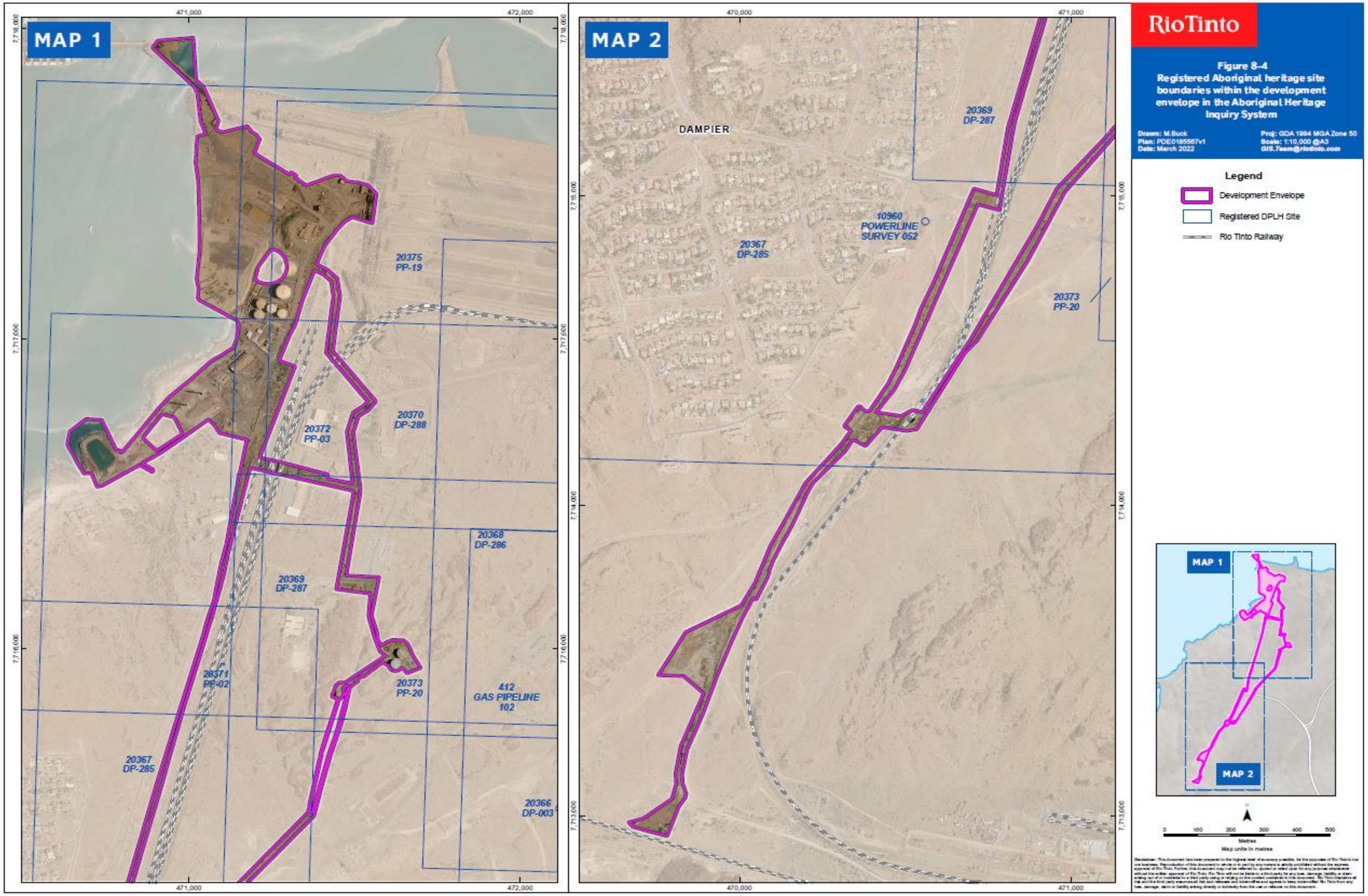

Figure 8-4: Registered Aboriginal heritage site boundaries within the development envelope in the Aboriginal Heritage Inquiry System

8.1.3.2.2 *Heritage assessments – archaeological and ethnographic*

The Proponent's awareness of social and cultural heritage values within the Parker Point area is based on a number of cultural heritage surveys and consultation with traditional owners. The Proponent acknowledges that MAC has been involved in these surveys since 2006 after it became the approved corporate body through the BMIEA.

The awareness of Murujuga's cultural heritage in the region has been heightened with both the advent of the National Heritage listing and the preparation of the World Heritage nomination dossier.

Table 8-1 provides a summary of archaeological and ethnographic surveys, and cultural values assessments undertaken within the proposed development envelope. Figure 8-5 shows the coverage of heritage surveys (includes both archaeological and ethnographic surveys).

During site walks with MAC representatives, site features were identified and proposed construction activities were discussed. Consultation with the relevant Aboriginal organisations and cultural knowledge holders is ongoing.

The vast majority of works associated with this Proposal have been designed to be located on previously disturbed areas and aligned with existing service corridors, including the proposed DSDP pipeline tie-in to East Intercourse Island (EII) which provides water for Rio Tinto operations on this island. The construction methods and pipeline alignment have been amended to avoid impacts to known cultural heritage sites, whether outside or within the NHP.

Table 8-1: Summary of in-field archaeological and ethnographic consultation and surveys within the development envelope

Traditional Owner group	Survey type	Year	Consultants	Study title
Ngarluma	Archaeological	1977	S. Brown, Department of Aboriginal Sites	Hamersley Iron Powerline Survey: a survey for Aboriginal sites on a transect through the Pilbara region in the vicinity of the Hamersley Iron 220 kV transmission line, Dampier to Paraburdoo
		2002	K. Morse Consultants	Report of an archaeological survey of a proposed power line route (Parker Point to 7 Mile) and a proposed power line access road realignment (EII to 2 Mile), Dampier, WA
		2003	R. G. Gunn Consultants	Parker Point Upgrade Project, Dampier, Western Australia: archaeological survey
		2004	R. G. Gunn Consultants	Parker Point Upgrade Project, Dampier, Western Australia: archaeological survey
		2004	R. G. Gunn Consultants	Detailed recording of petroglyphs at Parker Point, Dampier, WA
	Ethnographic	1976	K. Palmer, Department of Aboriginal Sites	Interim report on route of proposed powerline: Dampier to Paraburdoo
		1996	Nanga-Ngoona Moor-Joorga Land Council	Hamersley Iron ethnographic survey; report of desktop study
		2003	Pilbara Native Title Service	Results of an ethnographic heritage survey of Parker Point, Dampier (L3116 3469, L3116 3471, L3116 3807, L3116 4984)
		2004	Pilbara Native Title Service	Report of an ethnographic sites inspection at Parker Point: eastern bulking area

Traditional Owner group	Survey type	Year	Consultants	Study title
Wong-Goo-Tt-Oo	Archaeological	2003	R. O'Connor Consultants	Report on the Wong-Goo-Tt-Oo heritage survey of the proposed Parker Point upgrade area
	Ethnographic	2003	R. O'Connor Consultants	Report on the ethnographic survey with the WongGoo-Tt-Oo group of the proposed Parker Point project extension area
Yaburara/ Mardudhunera	Archaeological	2003	Ron Parker Consultants	Site avoidance ethnographic survey under the *Aboriginal Heritage Act* (1972) of PPT to 7 Mile power line development project & EII road to 2 Mile proposed power line access road alignment in Dampier
	Ethnographic	2004	Ron Parker Consultants	Site identification and section 18 consultation of the proposed bulking stockpile survey area
		2004	Ron Parker Consultants	Ethnographic site avoidance survey/section 18 consultation under the *Aboriginal Heritage Act 1972* of proposed Parker Point port upgrade area at Dampier, WA
Murujuga	Archaeological	2004	K. Mulvaney Pilbara Iron	Parker Point Upgrade Project: Rock art relocation programme
		2004	K. Mulvaney Pilbara Iron	Parker Point upgrade Project: supplementary Aboriginal sites survey
		2016	K. Mulvaney & Murujuga Aboriginal Corporation	Heritage Site Investigation Kangaroo Hill, Dampier
		2017	K. Mulvaney & Murujuga Aboriginal Corporation	Dampier transmission resilience project site confirmation
	Cultural Values Assessment	2021	Rio Tinto & Murujuga Aboriginal Corporation	Social Surrounds Cultural Values Assessment of Rio Tinto's Dampier Seawater Desalination Plant and Pipeline, 2022

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Figure 8-5: Aboriginal heritage survey coverage

8.1.3.2.3 *Heritage site walk – Pipeline alignment through National Heritage Place*

A targeted heritage site walk was undertaken in May 2021 with a MAC representative and Proponent representatives (engineering design team, surveyor, project manager, heritage advisor) (Mulvaney & Murujuga Aboriginal Corporation, 2021). The team walked the proposed alignment of replacement water transfer pipelines (i.e., existing Water Corporation pipeline route), including the section through the NHP that was identified as of particular importance as it passes in between rocky outcrops (Figure 8-3).

The focus of the survey was identifying areas where engineering design needed to be modified to avoid or minimise the potential for impacts to places of heritage value. The survey allowed direct feedback from the MAC representative about the cultural values of the area, and feedback from the engineering and design team about what was proposed and how construction works would likely occur.

One of the key outcomes of this site walk was the realignment of the section of pipeline south of the existing Kangaroo Hill tanks, from the existing route between the rocky outcrops to a new alignment along the road to the east. This corridor will be used for the installation of the pipeline within and near the boundary of the NHP. In accordance with the Conservation Agreement and in consultation with Traditional Owner representatives, the assessment deemed that the proposed installation of the new water pipeline for the desalination plant along the existing infrastructure corridor will not further adversely impact any National Heritage values. Furthermore, the existing pipeline at this location will be removed manually (i.e., cut into smaller pieces using handheld equipment and either carried out by hand or lifted out by crane to reduce the risk of damage to the outcrops). In summary, the engineering pipeline design amendments in response to MAC feedback include:

- Section immediately north of the existing Kangaroo Hill tanks – new pipeline will be installed immediately adjacent to an existing pipeline and entirely within existing disturbed corridor, avoiding impacts to heritage sites.
- Replacement of the section of existing pipeline south of the NHP boundary to the booster pump station will occur entirely within the existing disturbed corridor, avoiding impacts to heritage sites.
- The section of new pipeline from the booster pump station to tie in with existing pipeline to East Intercourse Island will run alongside the existing rail access track, minimising impacts on undisturbed areas.

8.1.3.2.4 *Social surrounds cultural values assessments*

<u>Murujuga Aboriginal Corporation social surroundings cultural values assessment</u>

A social surroundings cultural values assessment was conducted on 27 November 2021 by MAC and Dr Heather Builth to identify and discuss landscape cultural values in the vicinity of the proposal and associated pipeline corridor (MAC, 2022). Seven MAC representatives, including at least one representative from each of the five Traditional Owner groups, attended this consultation.

The consultation commenced with a discussion on the purpose of the project and the proposed location of the desalination plant and associated pipeline corridor. Rio Tinto representatives and MAC elders and representatives visited various points of interest within the development envelope, including travelling the length of the pipeline route, and visiting East Intercourse Island.

<u>Ngarluma Aboriginal Corporation on-Country consultation</u>

An on-Country consultation was held with five Ngarluma representatives on the 30 November 2021. Ngarluma representatives did not raise any concerns regarding the Proposal, however indicated interest in the following:

- **How the water from the desalination plant is to be used**. In response, Rio Tinto indicated that water would be used for washdowns, Parker Point port operations and supplied to Dampier town.

Rio Tinto advised that there would also be the capacity to pump the desalination plant water to East Intercourse Island. For an expansion to an 8 GL/a desalination plant, Rio Tinto indicated that it is liaising with Water Corporation regarding how the desalination plant could provide water to Karratha town and that this would require minor changes to Water Corporation pipelines.

- **The diameter of the pipelines**. In response, Rio Tinto explained that in most cases the new pipelines would be around 10cm larger in diameter than the existing pipeline, however it would sit the same height off the ground.

Summary of social surrounds cultural values assessment

- There are long held concerns regarding the current industrial use of water from the Bungaroo aquifer and Millstream deep aquifer for West Pilbara Water Supply Scheme (WPWSS). MAC indicated that this concern is shared by all the West Pilbara language groups, including Yindjibarndi, Ngarluma, the three Kuruma/Guruma groups (Robe River Kuruma, Eastern Guruma and Puutu Kunti Kurrama and Pinikura), and neighbouring Yinhawangka and Banjima peoples. These are sacred places, joining the groups through song-lines which emanate from or travel to the place now known as Millstream. The use and transfer of water from these aquifers and the resulting water table decline in recent years has caused great anguish. Therefore, measures that reduce this water use, which this Proposal will do, is a preferable option for Ngarda-ngarli representatives and the Robe River Kuruma.
- Several MAC representatives continued to express concern about marine fauna being accidentally impacted during the intake of water from the sea. Rio Tinto representatives provided guidance to those present that there would be safeguards to limit fish entering the water intake to the desalination plant.
- It was pointed out that there are natural walkways and rock art within the nearby gullies which teach people who go on the journey through it, identifying safe routes, restricted locations, and suitable resources, including animals, water, and plants. The rock art is like signposts to people with traditional knowledge, who understand the landscape and totemic geography through the rock art signs and symbols.
- The primary concern of MAC representatives in relation to this Proposal is the rock art that is recorded within the Rio Tinto lease and in proximity to the proposed development. Rio Tinto were able to clarify through the consultation that the project has been designed to avoid all rock art and the outcrops on which rock art is located. MAC informants were confident in Rio Tinto’s physical protection of rock art sites in proximity to the project area but expressed some residual concern about broader cultural restrictions that might be inferred from the rock art subjects and design. Despite MAC having been supplied all relevant data, representatives indicated they were not familiar with the motifs recorded at these sites and that the cultural meaning of these engravings is not known. Informants further explained that it is not possible for Ngarda-ngarli representatives to decode the meaning of this rock art without understanding the landscape context in which the engravings occur. MAC representatives were not comfortable commenting on the intangible cultural values of the area without a better understanding of how these sites would have appeared to ancestors navigating and utilising the landscape. However, MAC did not see this as an issue to this Proposal progressing.
- In reference to the above, the senior men present suggested that the most likely navigational route that would allow Ngarda-ngarli to interpret the meaning of this rock art is through the gullies to the south and east of the development envelope. This was discussed in detail with reference to three particular sites, and the likely travel route associated with these sites being along a creek line to the south. It is recommended that any comment on the intangible cultural values for this area would

require a physical inspection of certain sites noted by MAC representatives. MAC representatives indicated they supported undertaking this inspection with Rio Tinto staff to ensure that any development within the Rio Tinto lease remains sensitive to the cultural context of the rock art within the lease. Rio Tinto was able to confirm that the art and engravings in this area had been surveyed and recorded, with relevant information supplied to MAC.

MAC recommendations

Following the Social Surroundings on-Country consultation, MAC provided RTIO with the Report titled*: Social Surrounds Cultural Values Assessment of Rio Tinto's Dampier Seawater Desalination Plant and Pipeline, 2022* compiled by the MAC Heritage Advisor (MAC, 2022). This report details the consultation with MAC on identification of tangible and intangible cultural values beyond that contemplated in heritage surveys. The report provides a discussion of these values and provides recommendations for Rio Tinto's consideration. Key recommendations included:

- That the Circle of Elders be invited to inspect the desalination plant once it is operational so that they can be confident in the safeguards
- That any comment on the intangible cultural values for this area would require a physical inspection of particular sites noted by MAC representatives and their context as part of a navigational route between the coast and significant landmarks on the island interior
- That RTIO provide MAC with detailed spatial data for sites in proximity to the development envelope.

Response to Recommendations

Rio Tinto will provide a formal response to recommendations in the *Social Surrounds Cultural Values Assessment of Rio Tinto's Dampier Seawater Desalination Plant and Pipeline Report* and has provided MAC with detailed spatial data and information about the cultural heritage content for sites in proximity to the development envelope.

Rio Tinto commits to:

- Inviting the Circle of Elders to inspect the desalination plant once it is operational
- Providing further explanation of the safeguards to protect fish entering the water intake pond in a future consultation
- Inspecting the three sites identified by MAC with them, with a view to understanding their context as part of a navigational route between the coast and significant landmarks on the island interior.

8.1.3.3 Air emissions and cultural sites

Air emissions resulting from the Proposal will be directly generated through the combustion of hydrocarbons (e.g., vehicles/equipment and generators), and indirectly generated through the consumption of electricity from the Rio Tinto Pilbara Power Generation Network. This power network comprises predominantly gas-powered turbines across several sites between Karratha, Cape Lambert, and Hope Downs (see Figure 13-1 in Section 13). Therefore, any increase of load on this network is distributed between these disparate generation points and any resulting increase in air emissions will also be distributed across the generation points rather than being confined to the location of the Proposal. On this basis, the development of the Proposal is predicted to result in a negligible increase in air emissions in the local airshed.

8.1.4 Submerged heritage

8.1.4.1 Cultural heritage

The three-year Deep History of Sea Country (DHSC) Project funded by the Australian Research Council (DP170100812), aimed to better understand the potential for submerged cultural heritage sites at Dampier Archipelago (Murujuga) (DHSC, 2021). Where archaeological remains have survived inundation, they can be investigated by underwater and airborne remote sensing, survey, and ground truthing. Underwater archaeological sites can offer substantial insights into past lifeways and adaptations to rapidly changing environments (Ward et al., 2013). Veth et al. (2020) note the most likely submerged sites include:

- Compacted middens associated with rock pools and estuarine features
- Stone structures with associated middens on limestone pavements or with granophyre and basalt boulder fields
- Buried midden and other occupation deposits on protected sand sheets
- Quarry outcrops, extraction pits and associated reduction debris in areas of fine-grained granophyre and basalt
- Middens in consolidated calcarenite shoreline contexts to the north and west of the volcanic sites of the Dampier Archipelago.

Priority survey areas were based on paleo-environmental contexts determined from previously recorded Aboriginal heritage sites datasets from terrestrial surveys. Remote sensing was used to identify seabed composition and indicators of paleo-landscapes where there was a high potential for human occupation and site preservation. These target locations were surveyed by scientific divers to test for the presence of archaeological material (Wiseman et al., 2021).

Two confirmed submerged Aboriginal archaeological sites dating back 7,000 and 8,500 years were identified at Flying Foam Passage (approx. 20km north-east of the development envelope) and off Cape Bruguieres in 2019 (approx. 27km north-east of the development envelope) (Wiseman et al., 2021). The site at Flying Foam Passage is associated with a submerged freshwater spring at 14 m. The site at Cape Bruguieres comprises more than 260 lithic artefacts at depths down to 2.4 m below sea level, situated in the channel between Middle and North Gidley Islands (Benjamin et al., 2020). These two locations afforded very specific conditions which allowed for their preservation and subsequent identification as submerged archaeological sites.

Due to construction and subsequent use over the past 55 years of the Parker Point jetty and shipping channels there is no insitu submerged archaeological sites in this area. The design layout and functioning of the Proposal will have no impact on any submerged cultural heritage sites.

8.1.4.2 Shipwrecks and maritime archaeology

Australia protects its shipwrecks and their associated relics that are older than 75 years through the *Historic Shipwrecks Act 1976* and *Heritage (Historical Shipwrecks) Regulations 2007*. A search of the Australasian Underwater Cultural Heritage database and the State Maritime Archaeology database did not identify historic shipwrecks or maritime archaeological sites within the development envelope.

8.1.5 State Register of Heritage Places

The InHerit database contains detailed information about cultural heritage places entered in the State Register of Heritage Places, local government inventories, the Australian Government's heritage list, and other non-government lists and surveys. The InHerit database (2021) was searched and found that there are three known heritage places/items within or adjacent to the development envelope (Table 8-2). The Proposal is not anticipated to impact on any of these locations.

Table 8-2: Heritage items and places near the development envelope

Item/place	Listing	Location relative to development envelope (closest distance)
Dampier Archipelago (including Burrup Peninsula)	National Heritage Place City of Karratha Municipal Inventory	Within and adjacent
Dampier Archipelago Rock Art Precinct	State Heritage List nominated City of Karratha Municipal Inventory	Adjacent
Sam's Island	City of Karratha Municipal Inventory	1.1 km to the west

8.1.6 Noise

Noise impacts from the Proposal have the potential to affect noise-sensitive receptors within the town of Dampier, which are already exposed to noise emissions from the Proponent's existing port operations at Parker Point and EII. Parts of the town of Dampier are currently exposed to noise from rail operations as trains approach and depart the port, and as the ore cars are pulled through the car dumper. This existing rail noise can dominate the noise environment, particularly at locations close to the rail tracks. The *Environmental Protection (Noise) Regulations 1997* do not apply to these emissions.

The Proponent engaged technical specialists to undertake project specific noise modelling and environmental noise impact assessment (Table 8-3; Appendix J).

Table 8-3: Noise study for the Proposal

Author	Study
Wood, 2021	Environmental noise impact assessment of Rio Tinto's proposed desalination plant in Dampier (Appendix J)

As outlined in the environmental noise impact assessment by Wood (2021), the noise objectives for the Proposal are:

- To ensure noise emissions from the desalination plant do not exceed the Assigned Levels prescribed by the Environmental Protection (Noise) Regulations 1997.
- To ensure cumulative emissions from the desalination plant and existing iron ore operations at Rio Tinto's port facilities do not result in an increase in noise impacts to the community at noise sensitive premises in the town of Dampier.

The assessment methodology for environmental noise impact assessment conducted by Wood (2021) included:

- Quantification of the predicted noise impacts associated with the desalination plant at nearby noise-sensitive premises and to determine the extent of the area affected by noise emissions from the desalination plant
- Assessment of predicted noise levels against the Assigned Levels specified by the Environmental Protection (Noise) Regulations 1997
- Determination of the likely change in received noise levels compared to current noise emissions associated with iron ore operations at the port
- Where appropriate, identification of noise mitigation measures to achieve compliance with the project noise objectives, including noise controls and design of the desalination plant, as well as defining the requirements for noise reduction within the iron ore operations, to offset any increase in noise from the desalination plant which cannot practicably be reduced.

A noise model was developed and used in accordance with the *Environmental Protection (Noise) Regulations 1997* to investigate noise emissions from the Proposal during normal operations. The model was also used to investigate noise emissions from significant construction activities which could potentially affect noise-sensitive residential premises.

Three locations were selected for assessing noise impacts from the Proposal (Figure 8-6):

- R1 – a location representative of noise-sensitive premises on Patterson Crescent, which is strongly affected by noise emissions from the Proponent's existing port operations at Parker Point.
- R12 – a location representative of noise-sensitive premises on Hampton Drive, which is strongly affected by noise emissions from the Proponent's existing port operations at EII.
- PS1 – a location on Hill Road which is close to the proposed pump station.

The locations on Patterson Crescent and Hampton Drive are the same locations used by the Proponent to monitor noise emissions from its existing port operations. In recent years, the Proponent has not received any noise complaints relating to its port operations (Wood, 2021).

Statistical analysis of noise monitoring data presented in recent annual noise monitoring reports has estimated the Proponent's contribution to received noise levels to be approximately 48 dB(A) and 46 dB(A) at Patterson Crescent and Hampton Drive respectively under worst-case conditions (Wood, 2021).

To assess potential noise from operational activities:

- An initial model representing normal plant operations was developed to identify the noise sources which most significantly contribute to received levels at noise-sensitive receivers and to determine the noise reductions required to achieve the Proposal's noise objectives
- A subsequent modelling scenario was developed incorporating noise controls to the major noise-emitting sources to demonstrate how the Proposal's noise objectives may be achieved.

The full survey methodology is included in the noise impact assessment (Wood, 2021).

The study concluded that the Proposal will comply with the *Environmental Protection (Noise) Regulations 1997* and can be constructed and operated without any discernible increase in received noise levels in the Town of Dampier (Wood, 2021).

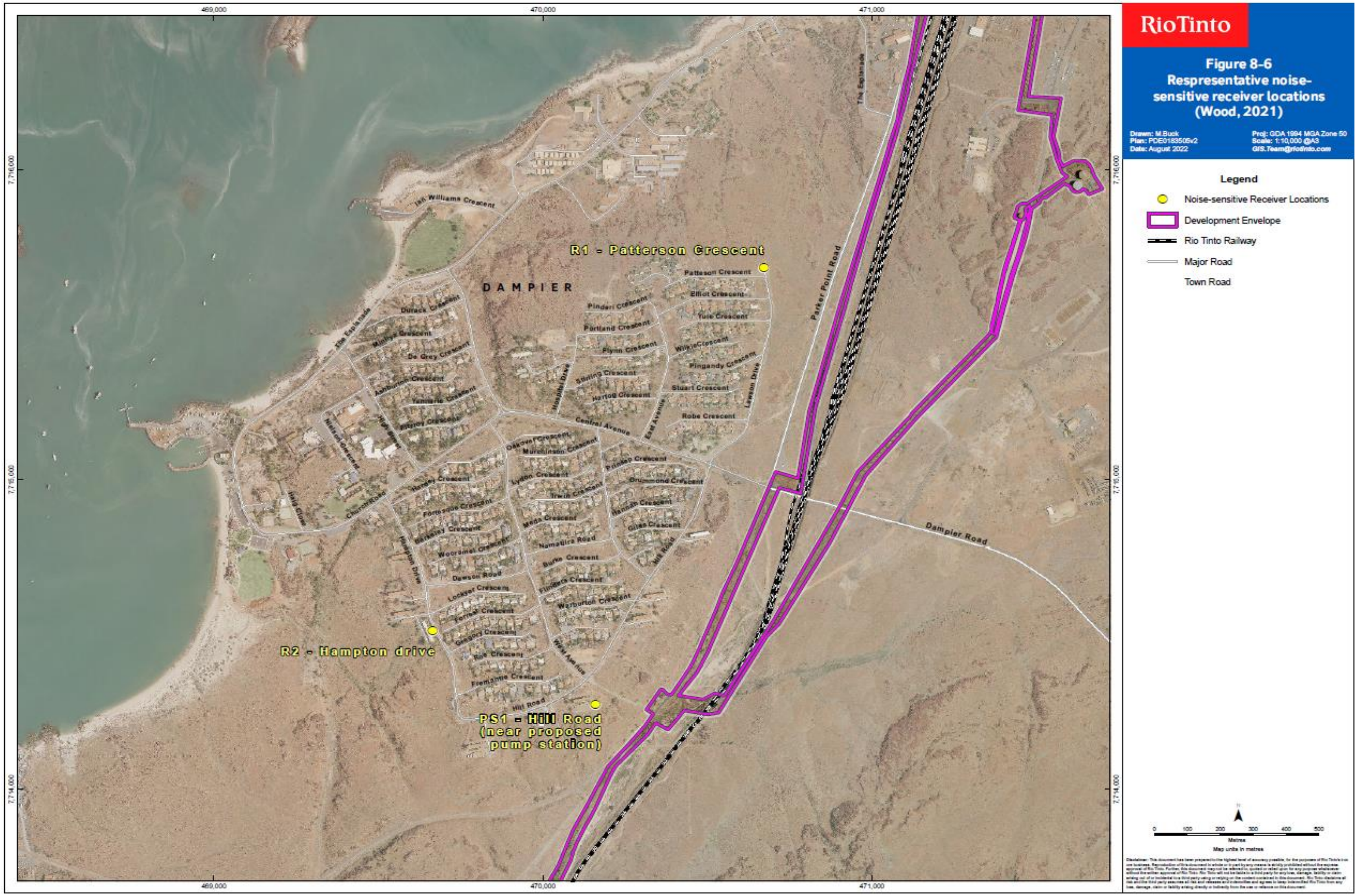


Figure 8-6: Representative noise-sensitive receiver locations (Wood, 2021)

8.1.7 Visual amenity

The Proposal sits within an area that supports an urban and industrial landscape, situated within Parker Point port facilities, Dampier town to the south-west, and the Hamersley Iron rail line and access roads surrounding. Adjacent to the pipeline route there are areas of rocky outcrops. Photos of the current environment surrounding the Proposal are shown in Table 2-3.

A viewshed analysis was undertaken in 2021 by the Proponent, with the objective of understanding the direct line of sight visibility of the Proposal from different vantage points (Table 8-4).

Table 8-4: Viewshed analysis for Proposal

Author	Study
RTIO, 2021	Viewshed analysis to identify areas of direct line of sight of the Proposal

The methodology used for the viewshed analysis is summarised below.

The study involved a desktop assessment based on the development of a digital terrain model (topography) and viewshed analysis, which uses the spatial information to determine all areas where Proposal infrastructure can be seen.

Six locations within the viewshed that people might visit were then selected and photographs taken as a baseline for impact assessment (Figure 8-7). The image location selection was based on:

- Proximity to known significant heritage or environmental values
- Line of sight to known significant heritage or environmental values
- Proximity to areas with public access.

Photographic montages were then generated, with Proposal components rendered onto the images based on current topography. The locations and associated images include:

- Parker Point Wharf (Figure 8-8)
- East Intercourse Island (Figure 8-9)
- Dampier Town (Figure 8-10)
- Water tank near Kangaroo Hill (Figure 8-11)
- On Burrup Peninsula Road (Figure 8-12)
- Within Murujuga National Park (Figure 8-13).

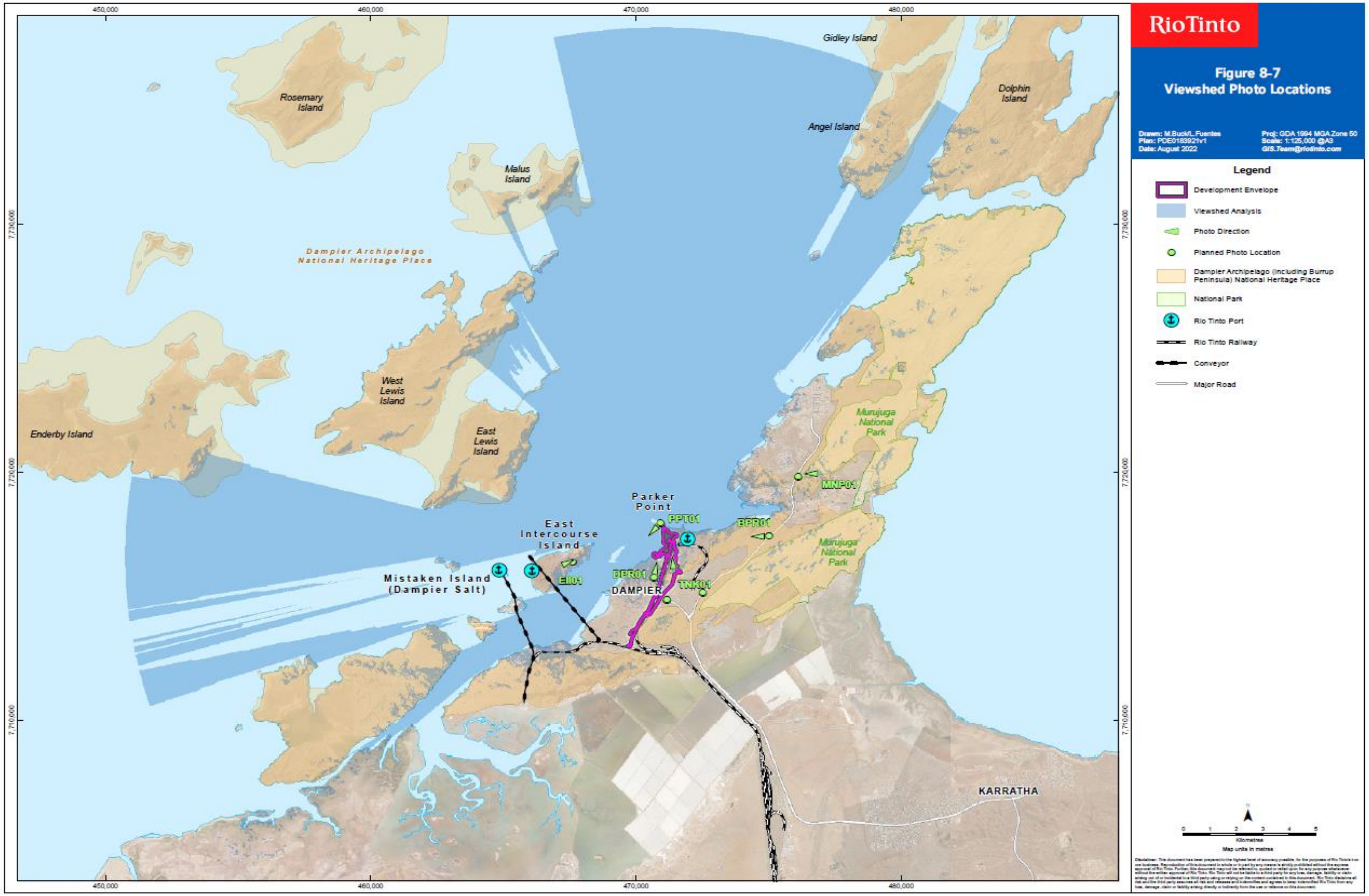
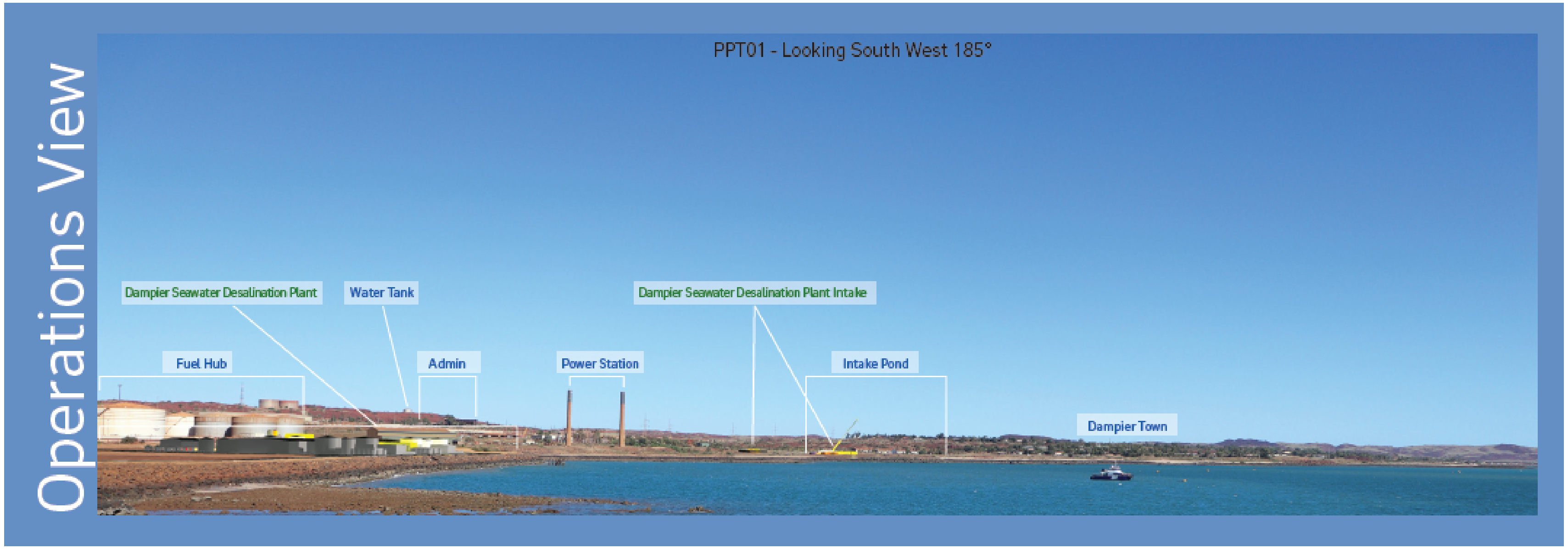


Figure 8-7: Viewshed photo locations

RioTinto

Figure 8-8: Current and Proposed Operations View - Parker Point Wharf

Drawn: T.Linklater/L.Fuentes
Plan: PDE0183921v1
Date: August, 2021
gis.team@riotinto.com



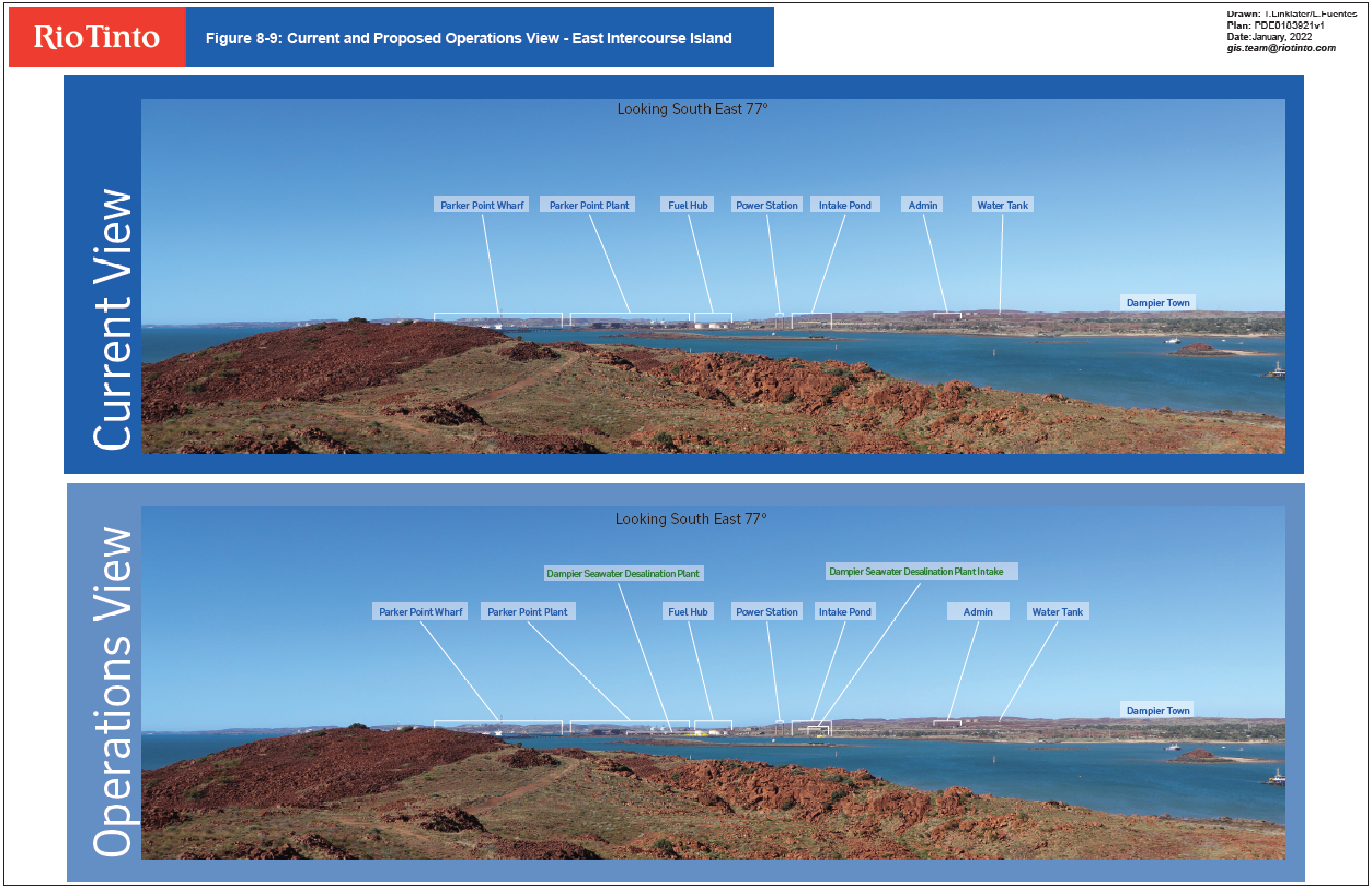


Figure 8-9: Current and proposed operations view – East Intercourse Island

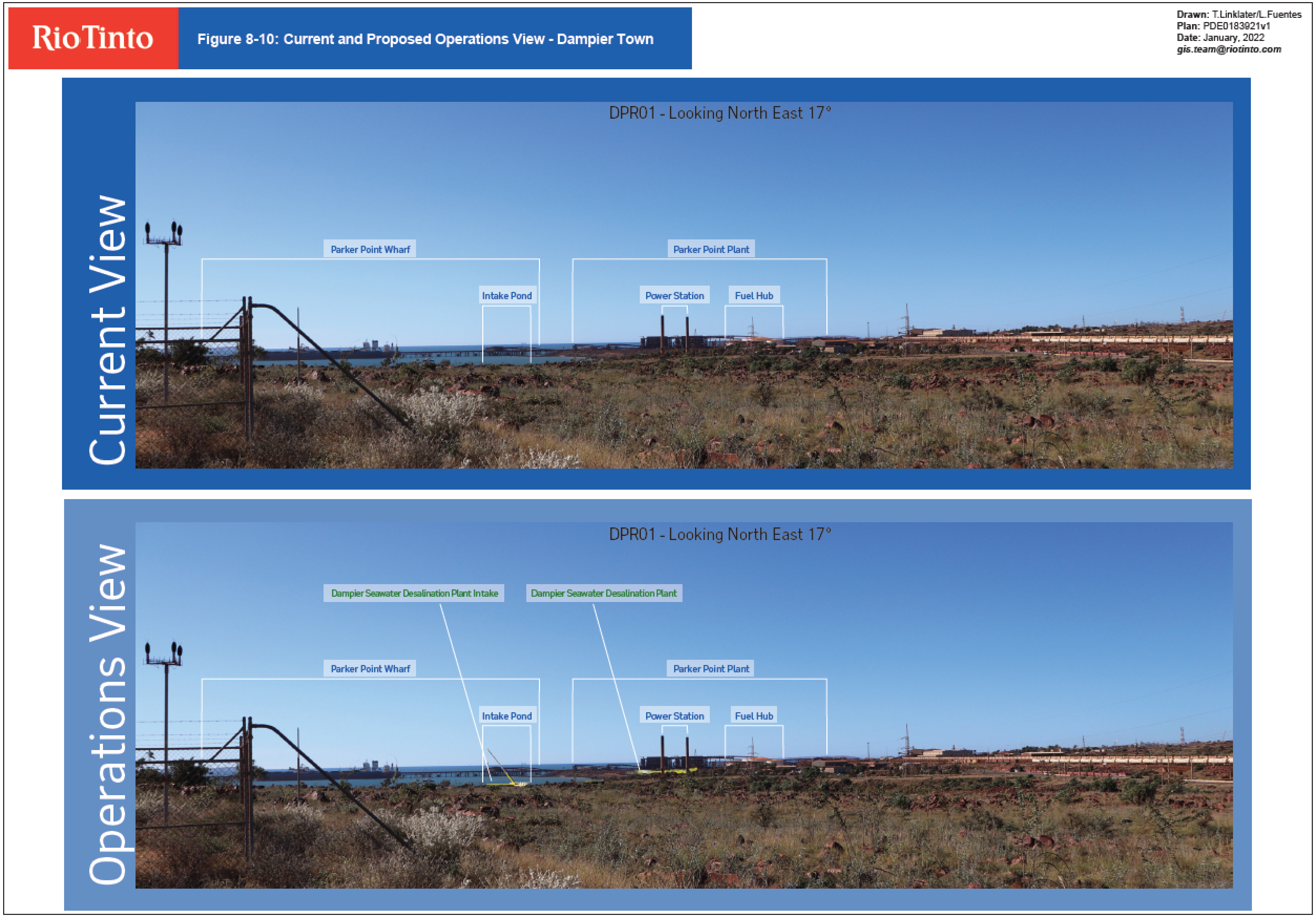


Figure 8-10: Current and proposed operations view – Dampier town

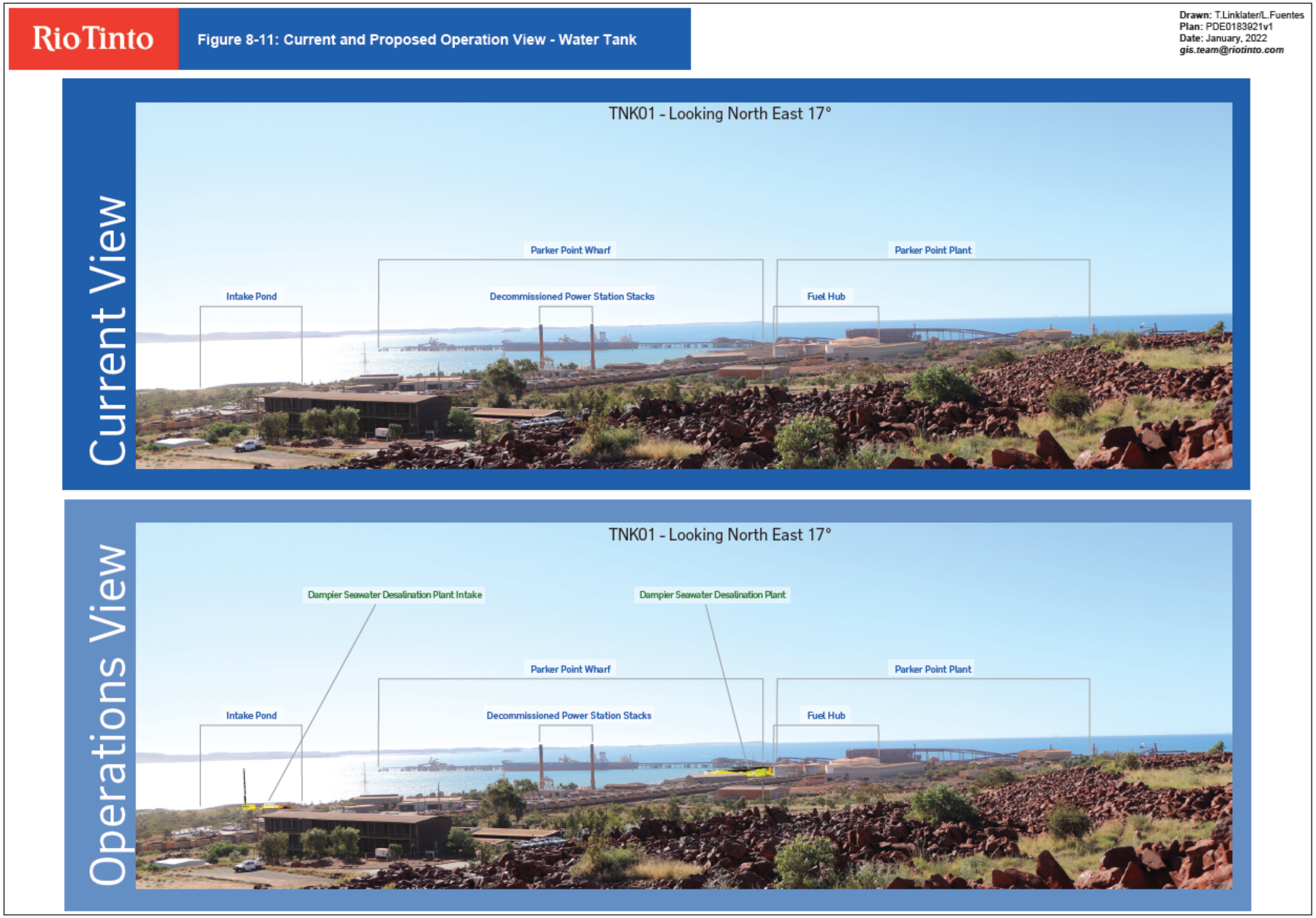


Figure 8-11: Current and proposed operations view – Water Tank

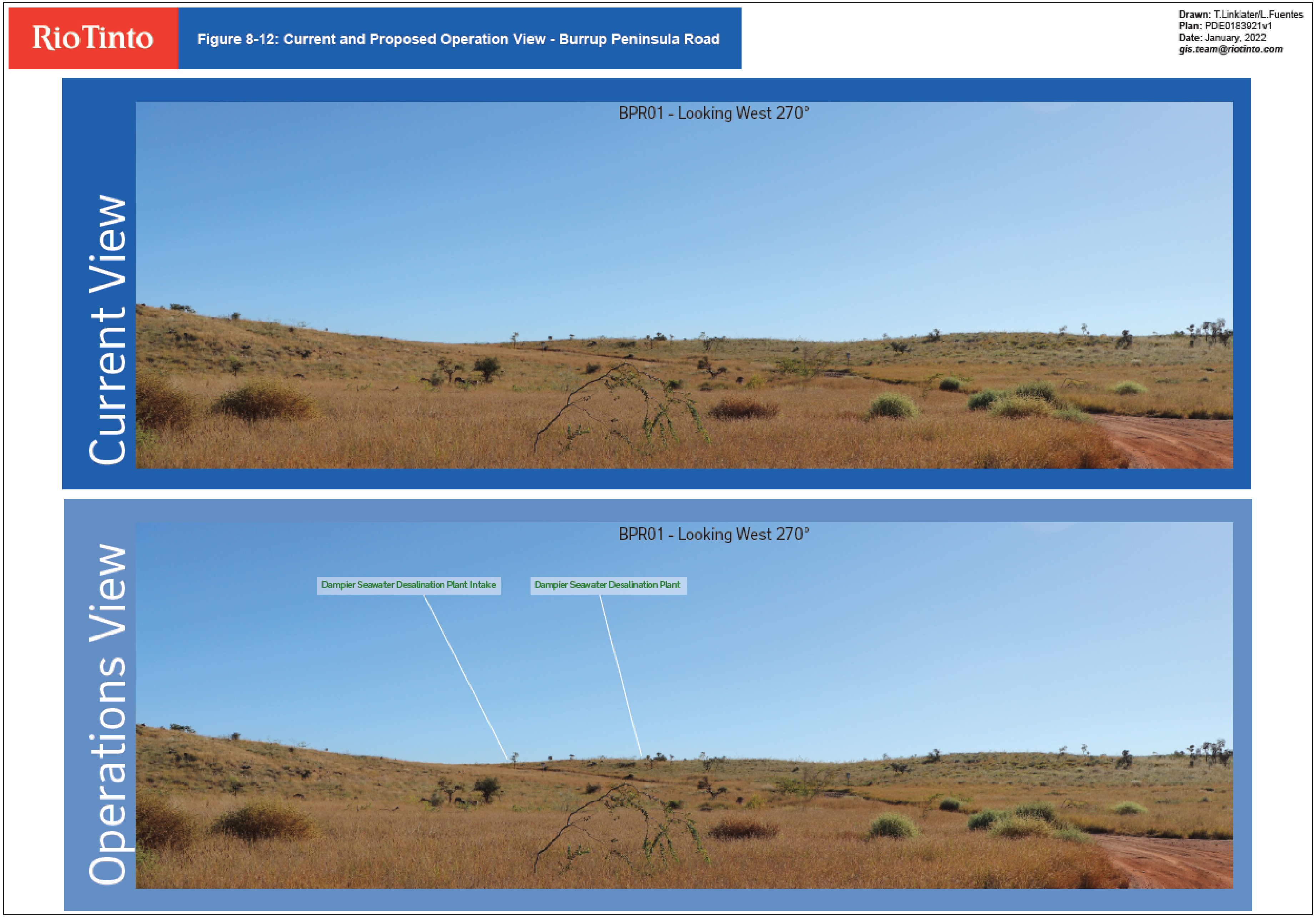


Figure 8-12: Current and proposed operations view – Burrup Peninsula Road

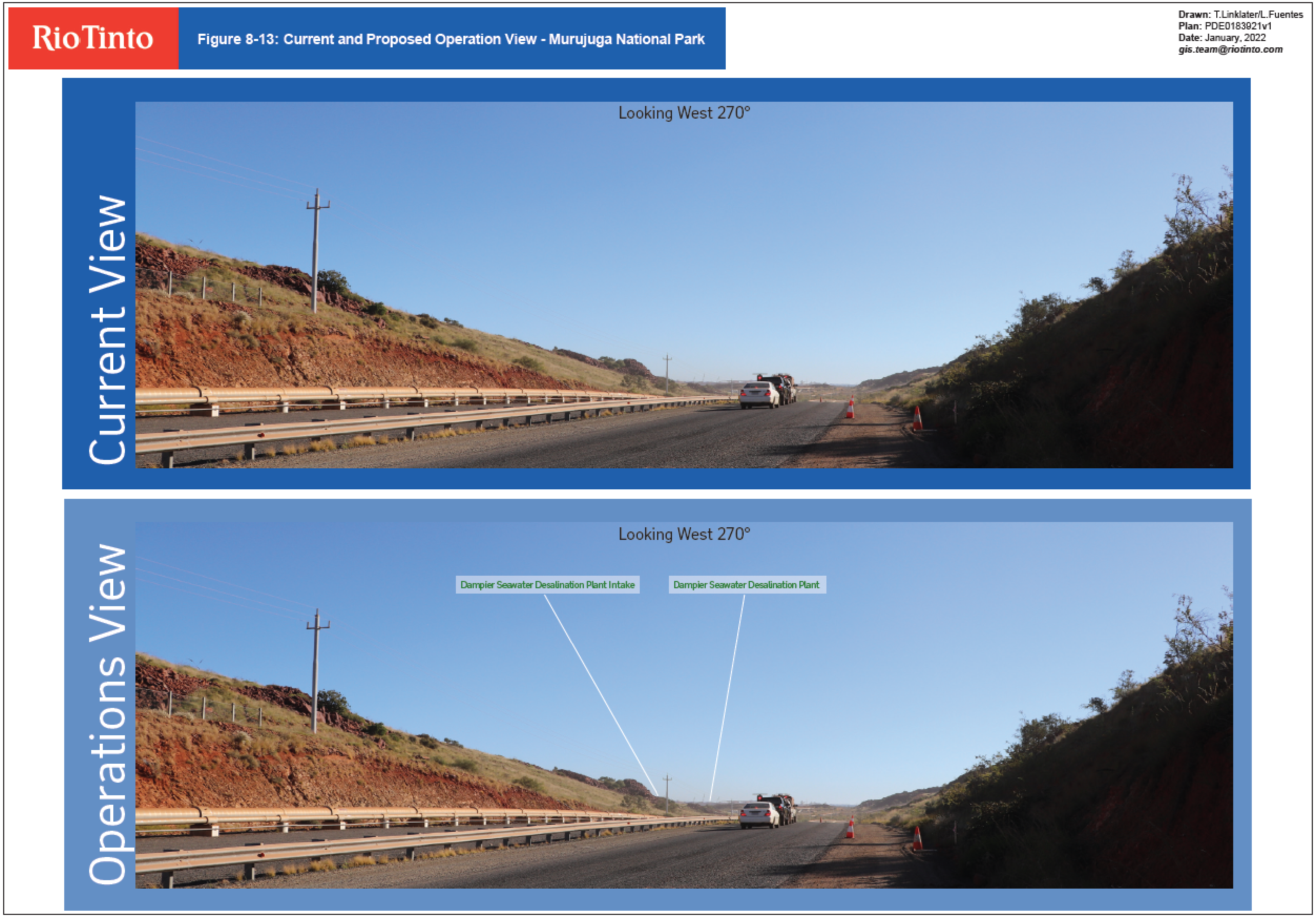


Figure 8-13: Current and proposed operations view – Murujuga National Park

8.2 Potential environmental impacts

A number of potential impacts have been avoided and/or mitigated through the Proposal development and engineering design process (as detailed in section 2.4). Potential direct and indirect impacts to social surrounds are described in the following sections. Mitigation measures to ensure potential impacts are not significant are detailed in section 8.3.

8.2.1 Direct impacts

Potential direct impacts of the Proposal to social surroundings during construction, commissioning and operation have been identified in Table 8-5.

Table 8-5: Potential direct environmental impacts

Potential impacts	Stage of Proposal	Activities with potential to have impact
Clearing and ground disturbance in areas of cultural significance, including the Dampier Archipelago National Heritage Place (NHP).	Construction of the plant, pipelines and intake infrastructure	Excavation of trenches. Construction of desalination plant and intake infrastructure pads. Construction and refurbishment of pipelines.
Direct impact associated with light emissions and visual amenity	Construction Commissioning Operation	Construction of desalination plant Use of lights during construction, commissioning and operation
Direct impacts to Dampier residents associated with noise levels	Construction Operation	Noise associated with construction and operation of the desalination plant

8.2.2 Indirect impacts

Potential indirect impacts of the Proposal to social surroundings have been identified in Table 8-6.

Table 8-6: Potential indirect environmental impacts

Potential impacts	Stage of Proposal	Activities with potential to have impact
Dust deposition on sites and places of cultural significance	Construction of the desalination plant, pipelines and intake infrastructure	Excavation of material at borrow pits. Use of heavy machinery during construction activities.
Dust for Dampier residents		

8.3 Mitigation

8.3.1 Existing documentation to identify and mitigate impacts

The Proposal's cultural heritage management framework includes the following management plans to ensure cultural heritage sites and other ethnographic values within the DSDP development envelope are managed during construction and operation:

- A project specific DSDP Cultural Heritage Management Plan (CHMP) (2022) has been prepared in consultation with MAC, to provide robust management provisions and controls for construction activities associated with implementing the Proposal. The DSDP CHMP is informed by objective-based provisions that clearly define management objectives, supported by management targets, management actions, adaptive management and reporting protocols (Appendix C).

- The DSDP Construction Environmental Management Plan (CEMP), which contains specific management measures to address all relevant environmental factors and impact pathways, and mitigate potential impacts associated with construction activities (Appendix A).
- An Operational Environmental Management Plan (OEMP), which sets out an appropriate monitoring and management approach (guided by trigger and threshold criteria) to ensure the environmental values of Burrup Peninsula are maintained during operation of the Proposal (Appendix B).

As noted above, the DSDP CHMP has been specifically prepared to identify and mitigate potential impacts to cultural heritage while undertaking construction activities. The overarching objective of the DSDP CHMP is to "*Manage and avoid inadvertent impact to cultural heritage sites and values through strong systems, controls and awareness*".

Management actions listed in the DSDP CHMP to inform the management approach and ensure management targets and the EPA's environmental objective for Social Surroundings are met, include (but not limited to):

1) Conservation zones are to be identified around known heritage sites and petroglyphs that include the immediate visual setting of the particular feature as well as the feature itself and to a minimum distance of 10m from the features recorded boundary as per the Proponents internal site recording processes.
2) Complete pre-clearance monitoring inspections documenting pre-construction site conditions.
3) Install site delineation and signage for all heritage sites within 50m of construction activities per the Proponent's Heritage Delineation Procedure (RioTinto, 2021)
4) Cultural heritage inductions are completed with all project personnel.
5) Apply RTIO's internal process Ground Disturbance Approval Request procedure to advise approved work areas and follow, as a minimum, the detailed ground disturbance strategies.
6) No development is to occur in undisturbed land areas that have not been subject to cultural heritage surveys and assessments.
7) Any changes to the project footprint or infrastructure layout are to be discussed and agreed with MAC prior to implementation.

8.3.2 Mitigation measures

This section describes the mitigation measures that have been applied to the potential impacts to mitigate the risks of significant residual impacts. To develop these mitigation measures, the mitigation hierarchy of 'avoid, minimise and rehabilitate' has been applied, with a focus on avoiding impacts where possible. The implementation of mitigation measures significantly reduces impacts to the environment and enables the Proposal to meet EPA's objective for social surroundings, namely "*to protect social surroundings from significant harm*".

Table 8-7 sets out the technically feasible mitigation measures that have been applied to each potential impact and arranges those mitigation measures by where they sit within the mitigation hierarchy. Given the importance of the NHP, works within the boundary of this area are discussed in detail below and summarised in Table 8-7.

Works within the boundary of National Heritage Place

The development envelope intersects with the boundary of the NHP (Figure 2-2). Cultural values and places of heritage value have been identified through previous surveys and site walks along the proposed pipeline alignment through the Dampier Archipelago (including Burrup Peninsula) NHP.

The water transfer pipeline is a duplication or replacement of existing water transfer pipelines which connect into Water Corporation’s existing Kangaroo Hill water tanks. The existing water pipeline infrastructure was constructed in 1970-71, before the NHP was listed in 2007, and the boundary was delineated to exclude the existing water tanks but not the associated water pipelines. As a result, any new refurbishments or tie-in to the existing infrastructure requires activities which are now located within the NHP.

Within the development envelope, the sections of pipeline that intersect the NHP are described as those north (Figure 8-14) and south (Figure 8-15) of the Kangaroo Hill tanks:

- North of Kangaroo Hill tanks

  In the area immediately north of the existing Kangaroo Hill tanks, the existing water transfer pipeline passes between two rock outcrops (Figure 8-14). Although no petroglyphs or features of National Heritage values are present on the rock slopes adjacent to the pipeline, to avoid impacts to these outcrops, a duplicate pipeline will be installed immediately adjacent and parallel to the existing pipeline extending north from Kangaroo Hill. Management measures will be in place to ensure the rock slopes are not impacted through the implementation of the CHMP and CEMP. Construction and ongoing operations will be completed entirely within the existing corridor between the outcrops.

- South of Kangaroo Hill tanks

  South-west of Kangaroo Hill, there is a 400 m long section where the existing pipeline passes between rock outcrops (Figure 8-15). These rock outcrops were mapped in early 2021 by a surveyor under the direction of the Rio Tinto Heritage Advisor in the presence of a ranger from MAC. Upgrading this current pipeline on this existing alignment would be difficult to complete without potentially adversely impacting the rock outcrops. As such, the proposed pipeline replacement has been re-routed to run under the adjacent road shoulder to the east and potential impacts to significant cultural heritage values will be avoided. For the removal of the existing pipeline, it will be cut into smaller pieces using hand-held equipment, and either carried out by hand or lifted out by crane to avoid damage to the outcrops.

Figure 8-14: Pipeline route through the National Heritage Place area to the existing Kangaroo Hill tanks

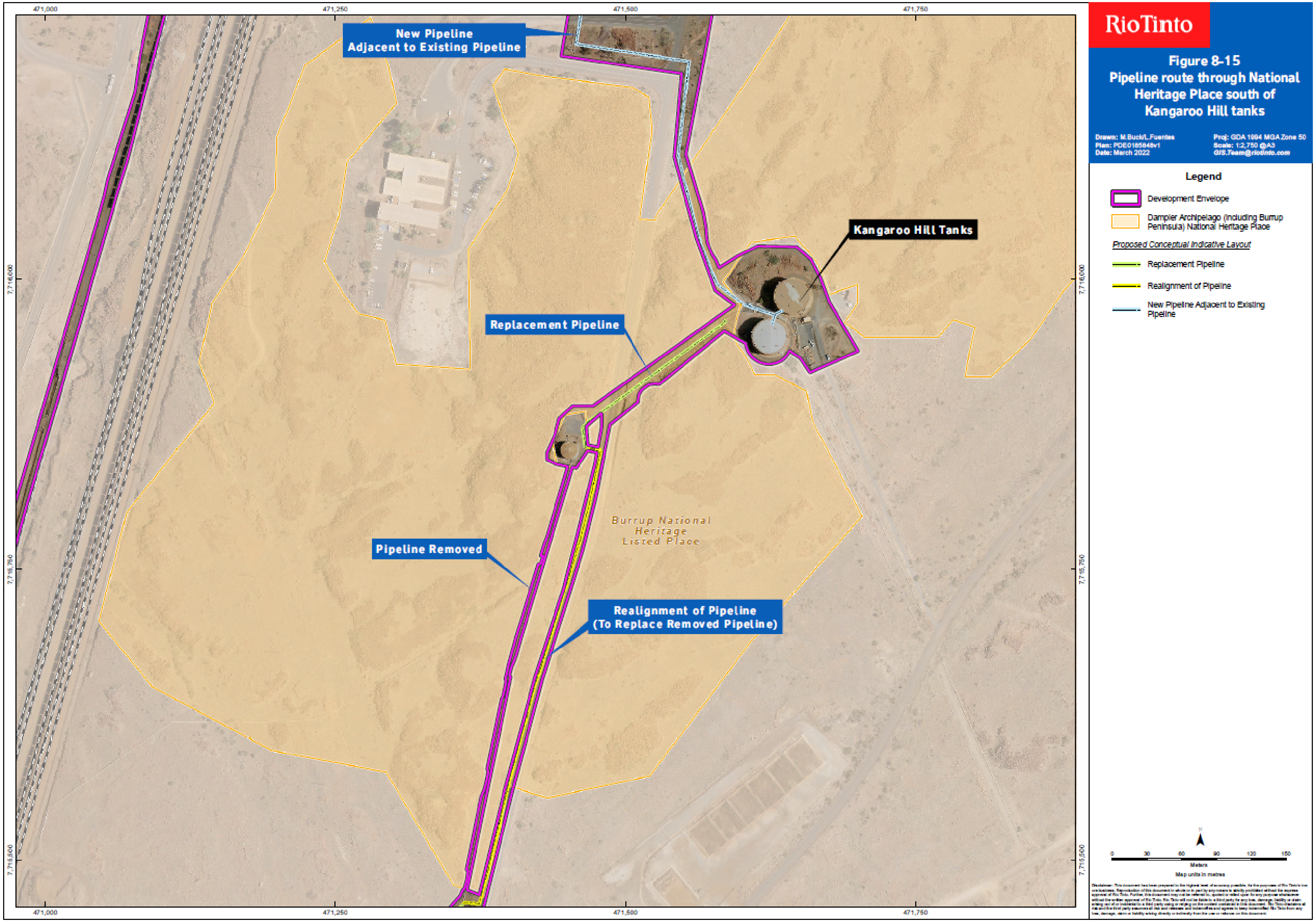


Figure 8-15: Where the pipeline leaves the existing Kangaroo Hill tanks area

Table 8-7: Mitigation of potential impacts to social surroundings

<table>
<tr><th>Potential impact</th><th>Applicable proposal phases</th><th>Mitigation measures</th></tr>
<tr><td colspan="3">EPA objective: To protect social surroundings from significant harm</td></tr>
<tr><td>Clearing and ground disturbance in areas of cultural significance, including the Dampier Archipelago National Heritage Place (NHP).</td><td>Construction</td><td>Avoid
The following design initiatives have been taken to avoid potential impacts to social surroundings values:
• The development envelope and proposed disturbance footprint has primarily been located on previously disturbed land, including a dredge reclamation area near Parker Point. The design of the development envelope has specifically avoided areas of known heritage and cultural value by utilising already disturbed areas.
• The Proposal’s water transfer pipeline is a replacement of existing pipelines which connect into Water Corporation’s existing Kangaroo Hill water tanks. In the area immediately north of the existing water tanks, the existing pipeline passes between two rock outcrops which form part of the NHP (Figure 8-14). To avoid impacts to these outcrops, the replacement pipeline will be installed immediately adjacent and parallel to the existing pipeline. Construction and ongoing operations will be completed entirely within the existing corridor and contact with the rock outcrops will be avoided.
• South-west of the existing Kangaroo Hill tanks, there is an area where the existing pipeline passes close to rock outcrops (Figure 8-15). Following a site inspection by Rio and MAC personnel in 2021, it was decided that upgrading the pipeline along the existing alignment would be difficult to complete without potentially impacting the rock outcrops. As such, the proposed pipeline replacement has been re-routed to run under the adjacent road shoulder and potential impacts to significant cultural heritage values will be avoided.
• Works within the boundary of Parker Point Port are on reclaimed land. There are no surface or buried cultural heritage features at this location. All associated pipeline routes to and from the desalination plant are within previously disturbed ground and have been designed to be situated where no heritage places are located.
• For the remainder of the pipeline route as far as the booster pump station, the pipe will be replaced on the existing alignment. For the section downstream of the existing rail access track, the pipeline will predominantly run alongside the existing rail access track, minimising impacts on undisturbed areas. No heritage impacts are expected on this section.
• The potential for disturbance to submerged archaeological heritage has been avoided by limiting the Proposal’s marine disturbance to existing disturbed and dredged areas of the Port which are already heavily modified.
Minimise
A project specific DSDP CHMP has been prepared specifically for the development area to identify and mitigate potential impacts to cultural heritage sites. The DSDP CHMP will be used in conjunction with the Construction EMP to ensure that potential impacts are minimised. Management actions listed in the DSDP CHMP include (but not limited to):
1) Conservation zones are to be identified around known heritage sites and petroglyphs that include the immediate visual setting of the particular feature as well as the feature itself and to a minimum distance of 10m from the features recorded boundary as per the Proponents internal site recording processes.</td></tr>
</table>

Potential impact	Applicable proposal phases	Mitigation measures
		2) Complete pre-clearance monitoring inspections documenting pre-construction site conditions. 3) Install site delineation and signage for all heritage sites within 50m of construction activities per the Proponent's Heritage Delineation Procedure (RioTinto, 2021) 4) Cultural heritage inductions are completed with all project personnel. 5) Apply RTIO's internal process Ground Disturbance Approval Request procedure to advise approved work areas and follow, as a minimum, the detailed ground disturbance strategies. 6) No development is to occur in undisturbed land areas that have not been subject to cultural heritage surveys and assessments. 7) Any changes to the project footprint or infrastructure layout are to be discussed and agreed with MAC prior to implementation. For further details, refer to Table 4 in the DSDP CHMP (Appendix C). **Rehabilitate/Monitor/Manage** No rehabilitation of heritage sites is expected to be required as there is no anticipated disturbance to heritage sites. Monitoring will occur pre, during and post-construction.

Potential impact	Applicable proposal phases	Mitigation measures
Direct impact associated with light emissions and visual amenity	Construction Commissioning Operations	**Avoid** Impacts to visual amenity have been avoided through locating the desalination plant within the existing port industrial area. The plant adds minimal additional visible infrastructure from the view from Dampier town (Figure 8-10). Lighting activities are not feasible to avoid; however they are situated within an already high illumination ports facility. During construction, all lights will be switched off when not in use. During operations, lights that are not required to be continually lit for safety purposes will be switched off or activated by motion sensors. **Minimise** The desalination plant has been designed so that it minimises disruption in the landscape and has a reduced impact to visual amenity. The plant itself has a low profile, with a lot of the processing equipment housed within buildings. The existing intake pond will be refurbished instead of a new water intake being constructed, therefore minimising the visual impact. The intake and outfall pipelines to and from the desalination plant will also be buried, where possible, minimising the visual impact. The majority of water transfer pipelines (from the plant to the water supply network) will be installed within the existing disturbed corridors with Water Corporation pipelines (either replaced or installed directly adjacent). This minimises the visual impact of installing additional pipelines. All permanent outdoor lighting will consist of either low-pressure sodium-vapour and/or amber LED (595 nm) luminaries or similar. Directional lighting will be installed to minimise skyglow. All lamps will be shielded to prevent upward and outward light spill. **Monitor/Manage** Pre-construction communication will occur with nearby residents, including provision of contact details for the Site Supervisor and the Proponent's community feedback details.

Direct impact associated with noise levels for Dampier residents	Construction
	Commissioning
	Operation
		Avoid
		Noise activities are not feasible to avoid.
		Minimise
		<u>Construction noise</u>
		The contractor must prepare a Noise Management Plan which would meet the requirements of Regulations 7 and 13 in advance of any construction work.
		Intake pond and the desalination plant site – As predicted, noise levels for construction activities at the existing intake pond and the desalination plant site are below the daytime Assigned Levels. Therefore, no remediation or management measures are required, provided construction is restricted to between 0900 and 1900 on Sundays and public holidays and 0700 and 1900 hours on any other day.
		Pump station – To reduce potential noise during ground preparation activities at the pump station, the provisions in Regulation 13 of the Environmental Protection (Noise) Regulations 1997 apply.
		For any construction work which may need to be completed outside daytime hours or on Sundays and public holidays, if noise emissions are likely to exceed the Assigned Levels then:
		• Nearby occupants or other sensitive receptors who are likely to receive noise levels which fail to comply with the standard under Regulation 7, should be notified of the work to be done at least 24 hours before it begins.
		• The contractor must show it was reasonably necessary for the work to be done out of hours.
		• The contractor must submit an approved Noise Management Plan at least seven days before the work starts that includes:
		  o the need and management for the work to be done outside of the work hours referenced above
		  o types of activities that could be noisy
		  o predictions of the noise levels
		  o control measures for noise
		  o procedures to be adopted for monitoring noise emissions
		  o complaint management and response procedures to be adopted.
		<u>Operations noise</u>
		To reduce potential operational noise from the Proposal at the **Dampier township**, the following controls will be implemented:
		• Enclosure of seawater intake pumps in a building or close-fitting acoustic enclosure capable of reducing noise levels to 50 dB(A) at 1 m from the building/enclosure façades.
		• Relocation of the externally located pumps to take advantage of shielding provided by tanks and buildings within the plant site[1], particularly:
		  o Low-pressure pumps
		  o Ultra-filtration backwash pumps
		  o Reject discharge pumps.
		Monitor/Manage

Potential impact	Applicable proposal phases	Mitigation measures
		Pre-construction communication to occur with nearby residents, including contact details for Site Supervisor and the Proponent's community feedback details. Noise impacts during construction and operations shall be monitored to ensure compliance with the Regulations.
Indirect impacts associated with dust for Dampier residents	Construction	**Minimise** Dust mitigation measures will be used in areas that have the potential to generate dust. This includes the use of water carts on unsealed access roads and haul roads. Visual dust assessments will be included in the Health, Safety and Environment (HSE) Checklist. Assessment of dust controls at construction sites will be included in the Engineer's Audit and Inspection Program. **Rehabilitate/Monitor/Manage** All areas that have been cleared for construction and commissioning purposes and which are not required for operations will be rehabilitated as soon as practicable after construction. Pre-construction communication will occur with nearby residents, including provision of contact details for the Site Supervisor and the Proponent's community feedback details.
Indirect impact associated with dust deposition on places of cultural significance	Construction	**Minimise** Dust mitigation measures will be used in areas that have the potential to generate dust. Visual dust assessments will be included in the HSE Checklist. Assessment of dust controls at construction sites will be included in the Engineer's Audit and Inspection Program. **Rehabilitate/Monitor/Manage** All areas that have been cleared for construction and commissioning purposes and which are not required for operations will be rehabilitated as soon as practicable after construction. Pre-construction communication will occur with nearby residents, including provision of contact details for the Site Supervisor and the Proponent's community feedback details.

[1] This noise controls relies on eliminating the line of sight between the noise source and noise-sensitive receptors within the town of Dampier. The design of the desalination plant is still at an early stage and, therefore, the specific pumps identified may change as the design progresses. However, the principle of eliminating line of sight must be maintained in order to achieve ALARP noise impacts.

8.4 Assessment and significance of residual impacts

This section provides an assessment of the potential residual impacts to social surroundings resulting from the construction, commissioning and operational phases of the Proposal. The following impact assessment assumes the mitigation measures listed in Section 7) are implemented, and therefore only the residual impact is discussed.

To identify whether impacts have the potential to have a significant impact on social surroundings, the Statement of Environmental Principles, Factors and Objectives (EPA, 2021b) has been considered.

8.4.1 Direct impacts

8.4.1.1 Direct disturbance of sites and places of cultural significance including the NHP

The development envelope and proposed disturbance footprint has primarily been located on previously disturbed land, including a dredge reclamation area near Parker Point. The design of the development envelope has specifically avoided areas of known heritage and cultural value and areas that have been previously disturbed have been prioritised for use.

Archaeological and ethnographic surveys have been completed over the entirety of the area. For the purposes of this Proposal, previous surveys have been reviewed and heritage surveys and site walks have occurred with MAC representatives.

Land disturbance within the development envelope will be undertaken during construction. This includes clearing of areas and some excavation to allow for construction and installation activities. Given the implementation of mitigation measures outlined in Table 8-7, no significant impacts to cultural heritage will occur within the development envelope, including works within the NHP.

8.4.1.2 Direct impacts associated with noise levels for Dampier residents

Noise management in WA is implemented through *the Environmental Protection (Noise) Regulations 1997* (the Regulations), which operate under the EP Act. The Regulations specify the prescribed standard for noise emissions in terms of Assigned Levels, which are the highest noise levels that can be received at noise-sensitive, commercial and industrial premises. Noise emitted from a premise must not cause, or significantly contribute to, a level of noise which exceeds the Assigned Levels.

Assigned Levels are set differently for noise-sensitive premises, commercial premises, and industrial premises. The Regulations define three types of Assigned Level:

- LAmax Assigned Level means a noise level which is not to be exceeded at any time.
- LA1 Assigned Level, which is not to be exceeded for more than 1% of the time.
- LA10 Assigned Level, which is not to be exceeded for more than 10% of the time.

The LA_{10} Assigned Level is representative of continuous noise emissions from the Proposal.Noise impacts from the Proposal have the potential to affect noise-sensitive receptors within the town of Dampier. Noise modelling was conducted by Wood (2021) (section 8.1.6). Three locations were selected for noise level predictions as they are representative of highly sensitive areas within noise-sensitive premises (Figure 8-6). Table 8-8 presents the L_{A10} Assigned Levels at the selected receptors.

Table 8-8: L_{A10} assigned levels at selected receptors (A-weighted)

Time of Day	Assigned Level – L_{A10} dB(A)		
	R1 (Patterson Crescent)	R12 (Hampton Drive)	PS1 (Hill Road)
0700 to 1900 hours Monday to Saturday	48	45	48
0900 to 1900 hours Sunday and public holidays	43	40	43
1900 to 2200 hours all days	43	40	43
2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	38	35	38

Construction noise

During construction, noise will be generated throughout the development envelope from ground preparation, the operation of construction machinery and installation of piles.

Three construction scenarios considered to represent worst-case noise impacts were modelled, being:

- Construction at the existing intake pond, including installation of piles to secure the seawater intake pumps
- Ground improvement and installation of stone columns, and digging of trenches for services for the Proposal
- Ground preparation at the location of the pump station.

The predicted noise levels associated with these construction scenarios are presented in Table 8-9.

Table 8-9: A-weighted noise level predictions for construction scenarios

Location of construction activities	Predicted noise level dB(A)		
	R1 Patterson Crescent	R12 Hampton Drive	PS1 Hill Road
Intake pond	36.7	28.4	25.0
Plant site	39.2	29.7	29.8
Pump station	29.5	22.6	52.0

With the exception of ground preparation activities at the pump station near Hill Road, predicted noise levels for construction activities for the Proposal are below the daytime Assigned Levels. No remediation or management measures are required, provided construction is restricted to 0900 and 1900 on Sundays and public holidays and 0700 and 1900 hours on any other day.

Regulation 13 of the *Environmental Protection (Noise) Regulations* addresses noise from construction sites. Noise from ground preparation activities at the pump station is likely to exceed the Assigned Levels at the nearest residential buildings, so the provisions in Regulation 13 will apply, specifically:

- The construction work is performed in accordance with control of noise practices set out in Section 6 of Australian Standard 2436–1981 Guide to noise control on construction, maintenance and demolition sites.
- The equipment used for the construction is the quietest reasonably available.

This activity is expected to be short-lived and will only have a localised impact over a small area.

If mitigation and management measures described in Table 8-7 are implemented, residual noise impacts are not anticipated.

Operational noise

Operational noise may be associated with equipment operating at the desalination plant site (from pumps), the pump station and the seawater intake pond.

Table 8-10 presents two pre- and post-mitigation scenarios:

- Baseline plant operating scenario – predicted noise levels which assumes no noise controls other than those required to minimise occupational noise exposure.
- ALARP plant operating scenario, which assumes the mitigation and management measures described in Table 8-7 are in place.

Table 8-10: A-weighted noise level predictions for baseline and post-mitigation as-low-as-reasonably-practicable operating scenarios

Receptor	Receptor location	Baseline operating scenario predicted noise level dB(A)	Post mitigation ALARP predicted noise level dB(A)
R1	Patterson Crescent	32.8	20.6
R12	Hampton Drive	21.3	14.5
PS1	Hill Road	24.5	22.1

Table 8-10 shows that R1 is the most affected receptor, with the dominant noise coming from the seawater intake pumps and some of the larger, externally located pumps at the desalination plant site.

Predicted noise emissions from Rio Tinto's proposed desalination plant are below the Assigned Levels at the nearest noise-sensitive residential locations in the town of Dampier.

Predicted noise levels are also considerably lower than existing ambient noise levels. Consequently, any intrusive noise characteristics, such as tonality, impulsiveness or modulation, are unlikely to be evident at any noise-sensitive residential location.

Without noise mitigation, noise emissions from the desalination plant are likely to contribute to noise exceeding the Assigned Levels at the nearest noise-sensitive residences on Patterson Crescent. If mitigation and management measures described in Table 8-7 are implemented, then it is anticipated noise will not adversely impact residents in Dampier during operations, as predicted noise emissions from the Proponent's proposed desalination plant are below the Assigned Levels.

8.4.1.3 Direct impacts associated with light emissions and visual amenity

As discussed in Section 8.1.7, the development envelope is located in an area with a large existing industrial footprint. The landscape and visual environment were assessed through photomontages as described in six locations based on consideration of the potential for visibility and appearance of the Proposal.

Due to the presence of existing infrastructure in this area and the associated topography, the visual impacts of the Proposal are expected to be limited. While the infrastructure around the desalination plant and the existing intake pond can be viewed from Dampier town and offshore, the Proposal obscures only existing industrial development. Other than a small part of the existing intake pond infrastructure, the horizon is unchanged when viewed from Dampier town. Additionally, the Proposal is not visible from the Burrup Peninsula Road or Murujuga National Park (Figure 8-12 and Figure 8-13 respectively). As such, residents of Dampier are not expected to be visually impacted by the Proposal.

Given the minimum distance of 1.6km from the development envelope to residential areas, additional lighting associated with the Proposal will not result in light spill on residential areas. During all phases, lighting will be kept to the minimum level required for safe access and usage of working areas. The use of amber lighting for outdoor operational lighting will reduce scattering of light, and shielding of lamps will reduce upward light spill, minimising skyglow. As a result, impacts of artificial light on the social surroundings will not be significant.

8.4.2 Indirect impacts

8.4.2.1 Indirect impact to sites and places of cultural significance from dust deposition

The Pilbara region is naturally dusty. During construction, dust may be temporarily generated above natural, background levels and this could deposit on to nearby heritage sites. However, this dust is inert and does not physically damage the rock art or have a chemical reaction with the rock surface. The frequency of high winds and cyclonic rains will remove any dust build-up once construction is complete. Any potential dust generation is expected to be of a short duration and not result in permanent impacts to heritage places. Nevertheless, the Proponent will implement dust management measures to suppress and minimise airborne dust and will progressively rehabilitate borrow pits that are no longer required for construction purposes, to minimise the extent of exposed surfaces. Management measures to address potential impacts to cultural heritage from dust are addressed in the CHMP and Construction EMP.

8.4.2.2 Indirect impact to Dampier residents from dust deposition

Any potential dust generation is expected to be of a short duration and the Proponent will implement dust management measures to suppress and minimise airborne dust. Prevailing wind patterns are such that any dust generated from the construction and use of the desalination plant will not significantly impact Dampier. The proposal will not result in permanent or cumulative dust impacts for Dampier residents.

8.5 Summary of the significance of residual impacts

This section summarises the significance of residual impacts for social surroundings in accordance with the Statement of Environmental Principles, Factors and Objectives (EPA, 2021b). The connections and interactions between other environmental factors are considered in the holistic impact assessment (Section 15). The remaining matters as outlined in Section 6 of the Statement of Environmental Principles, Factors and Objectives (EPA, 2021b) are considered in Table 8-11.

Mitigation measures have been built into the project design to mitigate potential impacts to cultural heritage values. Impacts from noise, dust, artificial light and visual impacts are not expected to significantly affect nearby communities, including the town of Dampier, due to the Proposal being situated within the existing operational port facilities of Parker Point and implementation of the additional mitigation measures proposed.

In summary, Table 8-11 demonstrates that by implementing the DSDP CHMP and mitigations in Table 8-7, the Proposal can meet EPA's objective for social surroundings.

Table 8-11: Assessment of significance for social surroundings

Residual impact	Consideration of key EPA (2021) matters	Significance of residual impacts	Recommended conditions and DWER regulation for significant residual impacts
Disturbance of sites and places of cultural significance, including within the NHP	**Values, sensitivity and quality of the environment** Much of the development envelope is covered by pre-existing industry infrastructure and services. The construction activities associated with the desalination plant will occur on reclaimed land within the Parker Point port facilities. It would be improbable that buried cultural heritage features are found at this location. All associated pipeline routes are within previously disturbed ground and has been designed to be situated in places where no heritage places are located. The development envelope intersects with the boundary of the Dampier Archipelago (including Burrup Peninsula) National Heritage Place. There are rock outcrops adjacent to the development envelope, and the presence of the petroglyphs have been mapped and have been found to be outside the development envelope. **Extent of the likely impacts** As above. **Resilience of the environment** Given no significant impacts are expected, the environment is expected to be resilient to the change. **Consequence of mitigation hierarchy** The mitigation hierarchy will minimise the potential impact by reducing the likelihood and consequence of an impact to potential heritage sites and places of cultural significance within the NHP. **Cumulative effects** Given no significant impacts are expected, no cumulative impacts are expected. **Level of confidence in the prediction of residual impacts and the success of proposed mitigation** There is a high level of confidence in this prediction as studies have been completed to support the assessment of heritage sites. Cultural values and places of heritage value have been identified through previous surveys and site walks along the proposed pipeline alignment through the Dampier Archipelago (including Burrup Peninsula) NHP. Boundaries of the development envelope have been mapped and the pipeline route has been designed to avoid these areas. **Public interest** See Section 4.	Due to the proposed mitigation measures, including avoidance of heritage sites along the pipeline route, there are not expected to be any significant negative impacts.	The Proponent will implement the DSDP Cultural Heritage Management Plan and Construction Environmental Management Plan in consultation with relevant Traditional Owner groups and appropriate knowledge holders.

Residual impact	Consideration of key EPA (2021) matters	Significance of residual impacts	Recommended conditions and DWER regulation for significant residual impacts
Light emissions and visual amenity	**Values, sensitivity and quality of the environment** The development envelope is located in an area with a large existing industrial footprint. **Extent of the likely impacts** Localised. Mitigation measures in place are expected to reduce the extent of light spill and skyglow to the extent that light emissions from the Proposal are not expected to be detectable above existing light levels. **Resilience of the environment** While the infrastructure around the seawater intake pond and the desalination plant can be viewed from Dampier town and offshore, the Proposal obscures only existing industrial development. Other than a small part of the seawater intake pond infrastructure, the horizon is unchanged when viewed from Dampier town. Additionally, the Proposal is not visible from the Burrup Peninsula Road or Murujuga National Park. The Proposal is not expected to result in light levels above the existing level on the Burrup Peninsula, nor is it expected to impact visual amenity. As such, no significant impacts are expected and the environment is expected to be resilient to the change. **Consequence of mitigation hierarchy** The mitigation hierarchy will minimise the potential impact by reducing the extent of light spill and skyglow from the Proposal. **Cumulative effects** The Proposal will result in an additive, albeit negligible, increase in the spatial extent of the artificial light footprint on the Burrup Peninsula. However, the intensity of artificial light emissions is expected to be insignificant when compared to existing light sources on the Burrup Peninsula and cumulative impacts to social surroundings are not expected. **Level of confidence in the prediction of impacts and the success of proposed mitigation** There is a high level of confidence in this prediction as studies have been completed to support the assessment of lighting and visual amenity impacts. **Public interest** See Section 4.	**Not significant** Not considered significant due to the localised nature of the impact and the nature of the existing landscape. Impacts from artificial light and visual impacts are not expected to significantly affect nearby communities, including the town of Dampier.	No conditions proposed.
Impacts to residents from	**Values, sensitivity and quality of the environment** The town of Dampier is currently exposed to noise emissions from the Proponent's existing port operations at Parker Point and East Intercourse Island, as well from rail operations as	Impacts from noise, are not expected to significantly affect nearby communities,	No conditions proposed.

Residual impact	Consideration of key EPA (2021) matters	Significance of residual impacts	Recommended conditions and DWER regulation for significant residual impacts
construction and operation noise	trains approach and depart the port, and as the ore cars are pulled through the car dumper. This rail noise can dominate the noise environment, particularly at locations close to the rail tracks. **Extent of the likely impacts** *Construction noise* Three noise-sensitive receptors were identified for modelling. With the exception of ground preparation activities at the pump station near Hill Road, predicted noise levels for construction activities for the Proposal are below the daytime Assigned Levels. No remediation or management measures are required, provided construction is restricted to 0900 and 1900 on Sundays and public holidays and 0700 and 1900 hours on any other day. Noise from ground preparation activities at the pump station is likely to exceed the Assigned Levels at the nearest residential buildings, so the provisions in Regulation 13 will apply. This activity is expected to be short-lived and will only have a localised impact over a small area. *Operational noise* Operational noise may be associated with equipment operating at the desalination plant site (from pumps), the pumping station and the existing intake pond. While R1 is the most affected receptor, with the dominant noise coming from the seawater intake pumps and some of the larger, externally located pumps at the desalination plant site, predicted noise emissions are below the Assigned Levels at the nearest noise-sensitive residential locations in the town of Dampier. The resultant increase in noise associated with the desalination plant would be less than 0.01 dB for this scenario. Predicted noise levels are also considerably lower than existing ambient noise levels; consequently, any intrusive noise characteristics such as tonality, impulsiveness or modulation are unlikely to be evident at any noise-sensitive residential location. **Resilience of the environment** Predicted noise levels are considerably lower than existing ambient noise levels; consequently, any intrusive noise characteristics such as tonality, impulsiveness or modulation are unlikely to be evident at any noise-sensitive residential location. The environment is expected to be resilient to the change. **Consequence of mitigation hierarchy** If mitigation and management measures described in Table 8-7 are implemented, then residual noise impacts are not anticipated. **Cumulative effects**	including the town of Dampier, once mitigation and management measures have been put into place.	

Residual impact	Consideration of key EPA (2021) matters	Significance of residual impacts	Recommended conditions and DWER regulation for significant residual impacts
	Cumulative impacts from noise are considered unlikely if the mitigation and management measures described in Table 8-7 are implemented. **Level of confidence in the prediction of residual impacts and the success of proposed mitigation** There is a high level of confidence in this prediction as studies have been completed to support the assessment of noise. **Public interest** See Section 4.		
Dust deposition on sites and places of cultural significance	**Values, sensitivity and quality of the environment** Construction dust may be generated above normal port operating levels, and this could be deposited on the nearby heritage sites. **Extent of the likely impacts** As above. **Resilience of the environment** Any potential dust is inert, does not physically damage the rock art or have a chemical reaction with the rock surface. Frequency of high winds and cyclonic rains will remove any dust build-up once construction is complete. Given no significant impacts are expected, the environment is expected to be resilient to the change. **Consequence of mitigation hierarchy** The mitigation hierarchy will minimise the potential impact by minimising the potential for dust deposition. **Cumulative effects** Given no significant impacts are expected, no cumulative impacts are expected. **Level of confidence in the prediction of residual impacts and the success of proposed mitigation** There is a high level of confidence in this prediction as studies have been completed to support the assessment of heritage sites. Cultural values and places of heritage value have been identified through previous surveys and site walks along the proposed pipeline alignment through the Dampier Archipelago (including Burrup Peninsula) NHP. Boundaries of the development envelope have been mapped and the pipeline route has been designed to avoid these areas. **Public interest**	**Not significant** Impacts from dust are not expected to be significant due to the localised nature and short timeframe.	No conditions proposed.

Residual impact	Consideration of key EPA (2021) matters	Significance of residual impacts	Recommended conditions and DWER regulation for significant residual impacts
	See Section 4.		
Dust impacts on nearby residents	**Values, sensitivity and quality of the environment** The Burrup Peninsula is inherently a dusty environment. The primary potential source of dust is the borrow pits, near the town of Dampier. **Extent of the likely impacts** The areas surrounding the borrow pits. **Resilience of the environment** Frequency of high winds and cyclonic rains will remove any dust build-up once construction is complete. Given no significant impacts are expected, the environment is expected to be resilient to the change. **Consequence of mitigation hierarchy** The mitigation hierarchy will minimise the potential impact by reducing the potential for nuisance dust from the Proposal. **Cumulative effects** Following implementation of mitigation measures, no significant contribution to existing impacts is expected. **Level of confidence in the prediction of residual impacts and the success of proposed mitigation** There is a high level of confidence in this prediction due to the localised nature and brief duration associated with the potential impact. **Public interest** See Section 4.	**Not significant** Impacts from dust are not expected to significantly affect nearby communities.	No conditions proposed.

8.6 Environmental outcomes

The Proposal will be managed in accordance with the Proponent's project specific DSDP Cultural Heritage Management Plan (CHMP) (2022) which has been prepared in consultation with MAC, to provide robust management provisions and controls for construction activities associated with implementing the Proposal. The DSDP CHMP is informed by objective-based provisions that clearly define management objectives, supported by management targets, management actions, adaptive management and reporting protocols. The DSDP CHMP will be implemented in conjunction with the CEMP to ensure that potential impacts are minimised.

Information sharing on the status of the Proposal with MAC and NAC will be ongoing, predominantly through Rio Tinto's existing forums. The Proposal is not expected to have significant impacts on amenity as a result of noise, light or traffic and changes to the visual landscape (visual amenity). This is on the basis impacts will be avoided where possible and, where impacts cannot be avoided, the level of impact will be mitigated as far as practicable.

The Proposal is expected to result in negligible impacts to the recreational or community uses of the area as the development envelope is situated within an industry-controlled area that is not accessible to the public. The Proposal has a limited marine footprint and is located within an existing port industrial area where recreational fishing is not possible.

The Proposal is unlikely to have a significant residual impact on social surroundings.

The Proposal will be implemented to meet the following objectives for social surroundings:

> *"Avoid, where possible, and minimise direct and project-attributable indirect impacts to:*
>
> - *social, cultural, heritage and archaeological values within and surrounding the development envelope*
> - *visual and amenity impacts to social and cultural places and activities*
> - *potential loss of access to traditional lands."*

And

> "*No direct or indirect impacts to cultural, heritage, and archaeological values within the project area and no direct or indirect impacts to National Heritage Values within the Dampier Archipelago (including Burrup Peninsula) National Heritage Place"*

The proposed commitment for social surroundings is:

> *"The Proponent will implement the DSDP Cultural Heritage Management Plan (2022) and Construction Environmental Management Plan in consultation with relevant Traditional Owner groups and appropriate knowledge holders."*

8.6.1 Proposed controls and monitoring

Control measures are outlined in Table 8-7. Monitoring of the proposed environmental outcomes is detailed in the CHMP, CEMP and OEMP.

8.6.2 Conclusion

After the application of the avoid and mitigate steps of the mitigation hierarchy (Table 8-7), and with ongoing consultation with local stakeholders and Traditional Owners, together with a project specific DSDP CHMP, the Proponent considers the Proposal will meet EPA's objective for social surroundings.

9 OTHER ENVIRONMENTAL FACTOR – BENTHIC COMMUNITIES AND HABITATS

EPA's objective for benthic communities and habitats is *to protect benthic communities and habitats so that biological diversity and ecological integrity are maintained*

The relevant policy and guidance for benthic communities and habitats (BCH) is described in Appendix E.

9.1 Receiving environment

9.1.1 Studies and information sources

Table 9-1 lists the relevant studies and publications for BCH. These have helped inform the description of the existing environment and assessment of impacts for the Proposal.

Table 9-1: Relevant studies used to inform the assessment of benthic communities and habitats

Author	Study (date)	Technical Guidance requirements (EPA, 2016a)
MScience	Memo: Parker Point benthic community and habitat survey (MScience, 2021a; Appendix H)	Proponents are encouraged to use rectified aerial photography or other remote sensing techniques, coupled with targeted field work to ground-truth the interpretation of remote sensing, to produce full-coverage benthic habitat maps. Remote sensing and expert knowledge have been used to prepare the habitat map. It has also been ground-truthed through this field program.
MScience	Proposed Dampier and Cape Lambert desalination plants gap analysis: Review of available data (MScience, 2020a)	Not directly applicable to the Technical Guidance requirements but provided an understanding of additional study requirements.
MScience	Assessment of marine impacts (MScience, 2021c; Appendix I)	Not directly applicable to the Technical Guidance requirements.
Advisian	*Baseline water quality monitoring report* (Advisian, 2022a)	Not directly applicable to the Technical Guidance requirements but the work was completed to understand marine water quality within the vicinity of the proposed discharge.
Advisian	Water Quality Monitoring report (Advisian, 2022b; Appendix F)	Modelling was used to predict areas of potential loss.

9.1.2 Regional and local context

The composition of BCH within the Dampier Archipelago (Murujuga) has been well documented by a variety of studies during the past 20 years. The distribution of BCH around the Dampier Archipelago (Murujuga) is shown at a broad scale in Figure 9-1. The spatial distribution of BCH within the revised moderate levels of ecological protection (LEP) was validated with a towed camera system (MScience, 2021a). The only BCH potentially affected by the Proposal are sparse (less than 10% cover) mixed communities south of the discharge. The nearest coral community is an artificial reef approximately 1.2 km east of the discharge (Figure 9-3). This artificial reef is not expected to be impacted by the Proposal, given the distance from the proposed discharge. The nearest seagrass is more than 5 km west of East Intercourse Island and the nearest mangroves are more than 3.5 km west of the discharge in King Bay and due to distance are not expected to be impacted by the Proposal.

The BCH composition and distribution identified in the study were consistent with previous studies and broadly align with the existing habitat map (MScience, 2018) (Figure 9-1). Additional areas surveyed outside existing mapped BCH showed habitat depauperate or at early stages of community development that typically consisted of disturbed, bioturbated, uncolonised and unconsolidated silt and fine sand (MScience, 2021a).

Nearby coral communities surveyed comprised:

- Approximately 25% coral cover at Tidepole Island (roughly 1.5 km south-west of the proposed discharge outfall), with the most common coral groups found being Pavona species and faviids.
- Five to 70% coral cover at the fringing reef 700 m south-west of the existing intake pond (roughly 2 km southwest of the proposed discharge outfall). This area was alongside larger coral communities dominated by *Turbinaria* spp. with hard coral cover of up to 100% but typically 5 to 70% (MScience, 2021a).

The location of the outfall area was chosen to be under the existing Parker Point wharf, which is subjected to regular dredging to maintain depth of the port for shipping. A restricted isolated patch (approx. 1 ha) of sparse mixed assemblage community is located on a shallow rock outcrop approximately 120 m south of the proposed discharge outfall. The mixed community habitat type found in this small area is widespread across the turbid nearshore environments of the Pilbara region, and characteristic of disturbed areas with high turbidity, thus it does not represent habitat of conservation significance.

Photos of the location of the rock outcrop and the sparse mixed community are shown in Figure 9-2 and the location is mapped on Figure 9-3.

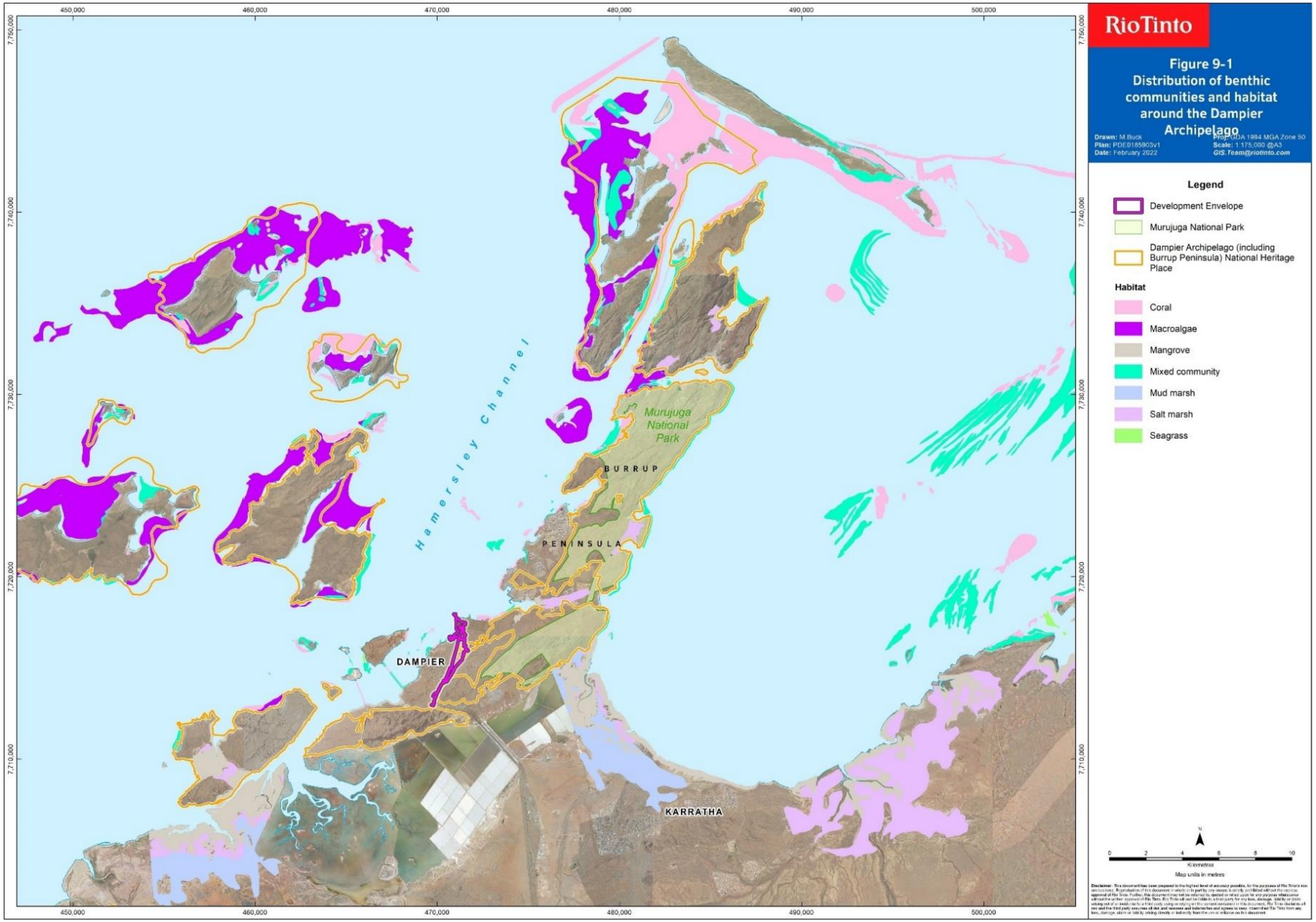


Figure 9-1: Habitat map

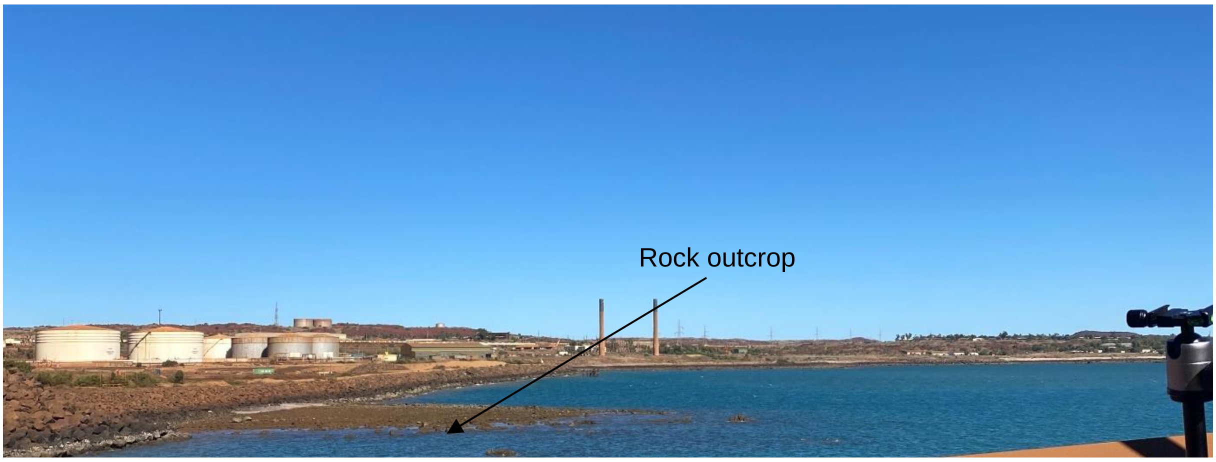


Figure 9-2: Rock outcrop location 120 m south of outfall (photo taken from the Parker Point wharf looking south-east) and photo of patch of sparse mixed community (MScience, 2021a)

Figure 9-3: Benthic community habitat study survey locations and habitat mapping

9.2 Potential environmental impacts

A number of potential impacts have been mitigated through the Proposal development and engineering design process (Section 2.3). No direct impacts to BCH from the Proposal are likely. Indirect impacts during construction and operation are described below.

9.2.1 Indirect impacts

Potential indirect impacts to BCH from construction and operation of the Proposal have been identified in Table 9-2.

Table 9-2: Potential indirect environmental impacts from the Proposal

Potential impacts	Proposal element	Activities with potential to have impact
Degradation of BCH from smothering and/or a reduction in light due to a change in marine water quality (Turbidity)	Construction of the intake infrastructure	• Replacement of the culvert screens and removal of sediments blocking the culvert generating localised elevations of TSS, impacting BCH through a reduction in light at the seabed and smothering.
Degradation of BCH due to a change in marine water quality due to brine discharge	Discharge of water through the diffuser during operations	• Discharge of water through the diffuser during operations

9.3 Mitigation

This section describes the mitigation measures that have been applied to the potential impacts to mitigate the risks of significant residual impacts. To develop these mitigation measures, the mitigation hierarchy of ‘avoid, minimise and rehabilitate’ has been applied, with a focus on avoiding impacts where possible. The implementation of mitigation measures significantly reduces impacts to the environment and enables this Proposal to meet EPA’s objective for BCH.

Table 9-3 sets out the technically feasible mitigation measures that have been applied to each potential impact and arranges those mitigation measures by where they sit within the mitigation hierarchy.

Table 9-3: Benthic communities habitat mitigation measures

Potential impact	Applicable proposal phases	Mitigation method
EPA objective: To protect benthic communities and habitats so biological diversity and ecological integrity are maintained (EPA, 2021b)		
Indirect impacts resulting in the degradation of BCH from smothering and/or a reduction in light due to a change in marine water quality during construction of the intake pond (Turbidity)	Construction	**Avoid** Construction work has been designed to occur inside the existing intake pond as far as possible to avoid the potential for elevated TSS outside of the seawater intake pond**.** **Minimise** A silt curtain will be used on the ocean side of the culverts to minimise the potential for elevated TSS beyond the existing intake pond during the replacement of the existing culvert screens and removal of sediments blocking the culverts. Material removed from the existing culverts will be directed back towards the existing intake pond. The existing culverts connecting the existing intake pond with the ocean will be blocked during activities that may result in elevated levels of TSS in the seawater intake pond, such as the placement and removal of the temporary causeway. A sediment trap will be used in the construction of new drainage surrounding the intake infrastructure pad. **Rehabilitate** Before the culverts are unplugged, the seawater intake pond water quality will be tested to ensure it is suitable for exchange with open ocean waters. The requirements for monitoring of the seawater intake pond water and potential management measures are contained within the EMP (Rio Tinto, 2022b).
Indirect impacts associated with the degradation of BCH due to a change in marine water quality from brine discharge	Commissioning Operations	**Avoid** Some neutralised reverse osmosis clean-in-place (CIP) waste[7] will be discharged to a dedicated wastewater tank and transported offsite to a suitable disposal facility due to the nature of the CIP chemicals. Solid wastes associated with the DAF unit when operating with the use of coagulant and flocculant will be taken to an appropriate waste disposal facility, rather than the ocean, to mitigate the risk of flocculants and coagulants entering the marine environment. Coagulants commonly used in drinking water treatment include aluminium-based chemicals (alum, ACH, etc); such chemicals have not been selected for use in this Proposal because of the known toxicity associated with aluminium. **Minimise** Excavated material from the existing intake pond will be stockpiled in a lined and bunded area and water will be discharged back into the seawater intake pond. The culvert between the existing intake pond and ocean will be blocked during this activity. Sediments removed from the existing intake pond will be taken to a licenced waste management facility. The diffuser has been designed and located in an area that facilitates rapid mixing of the discharge.

[7] Note: this refers to the reverse osmosis CIP waste. The neutralised CIP waste from the pre-screening and ultra-filtration unit will be combined with the discharge through the diffuser.

Potential impact	Applicable proposal phases	Mitigation method
		Monitoring will be completed as per the EMP (Rio Tinto, 2022b) to confirm the predicted performance of the diffuser and maintenance of the LEP. CIP chemicals from the pre-screening and ultra-filtration screens will be completely neutralised before discharge through the diffuser. Ultra-filtration has been selected over more traditional multi-media filters because it is chemical-free during operations. Air-only would be the predominant mode of operation for the DAF unit throughout the desalination plant's operating year, while the influent seawater TSS is below 30 to 50 mg/L. Considering seawater sampling over 12 months suggests the TSS at Parker Point is typically below 10 mg/L, it is expected this would be the normal operating mode and this mode has no associated chemicals. The primary cationic coagulant, if required in the DAF unit, will be inorganic compounds such as ferric sulfate or ferric chloride, both of which are commodity chemicals that have good biodegradability profiles. Whole effluent toxicity (WET) testing will be completed as per the EMP (Rio Tinto, 2022b). The testing will confirm the number of dilutions used to define the LEP remain appropriate. **Rehabilitate** Before the culverts are unplugged, the seawater intake pond water quality will be tested to ensure it is suitable for exchange with open ocean waters. The requirements for monitoring of the seawater intake pond water and potential management measures are contained within the EMP (Rio Tinto, 2022b). If a spill occurs remediation will be managed in accordance with Oil Spill Contingency Plan – Cape Lambert and Dampier Ports.

9.4 Assessment and significance of residual impacts

The cumulative impacts to BCH have been assessed as per the approach for determining cumulative impacts and losses recommended in the *Technical guidance – Protection of benthic communities and habitats* (EPA, 2016a).

Between 2012 and 2014, Dampier Port Authority (DPA, now PPA) engaged MScience to assess the status of benthic primary producer habitat (BPPH) within port limits, establish potential LAUs and undertake an initial assessment of historic loss of each BPPH by LAU (Woodside, 2019). In developing these LAUs, MScience and DPA considered the EPA guidelines, the previous use of management zones for development projects within the port's jurisdiction, current and planned usages (e.g., establishing safe anchorages/moorings), and the natural ecology and physical characteristics of the Dampier Archipelago (Murujuga) (Woodside, 2019). For consistency, these LAUs have been used for the Proposal. LAU number 11 is the unit that covers the outfall location and area of potential marine impacts for this Proposal. The historical area of BCH within LAU number 11 was 76 ha and the current area is 59.8 ha (Woodside, 2019).

Benthic community habitat loss assessment

The closest mapped BCH to the development envelope is a 1 ha patch classified as a sparse mixed assemblage community (less than 5% cover), located approximately 120 m south from the outfall, and is of low ecological value. The community consists of turf algae and occasional small (<30 cm) corals dominated by *Turbinaria* with sparse sponges and zoanthids on highly disturbed substrate.

The percentage of live coral cover on the 1 ha patch of highly disturbed substrate is estimated at 3 to 5% (MScience, 2021a). The mixed community habitat type found in this patch is widespread across the turbid nearshore environments of the Pilbara region, and characteristic of disturbed areas with high turbidity; as such, it does not represent habitat of conservation significance. Therefore, the loss of this BCH is not considered to be significant.

The potential loss of the area of BCH approximately 120 m south of the proposed discharge is considered in the context of historical and current coverage in Table 9-4. Due to the uncertainty associated with WET testing and that this area of BCH falls within the revised moderate LEP, it is considered there is the potential for irreversible loss of this mixed community.

Table 9-4: Benthic community habitat loss in Local Assessment Unit 11[8]

LAU	Historical area (ha)	Irreversible loss associated with this Proposal (ha)	Irreversible loss % associated with this Proposal	Historic loss %	Cumulative loss % (inclusive off loss predicted from this Proposal)
11	76	1	1.3%	21.3%	22.6%

9.5 Environmental outcomes

The residual impact of the Proposal is the potential indirect impact of the loss of 1 ha sparsely populated mixed community habitat type 120 m south of the proposed outfall location. This impact is not considered to be significant.

[8] The figures for historical loss and current coverage are taken from the Scarborough Dredging and Spoil Disposal Management Plan (Woodside, 2019)

As the predicted impacts to benthic communities and habitats are not significant, no environmental conditions or monitoring/management are required other than those outlined in Section 7. The Proponent will ensure the EQC defined in the EMP (Rio Tinto, 2022b) are met and the monitoring plan for marine environmental quality within the EMP is implemented.

9.5.1 Proposed controls and monitoring

Ensuring the EQC are met at the boundaries of the LEP will ensure the environmental outcome for BCH is achieved; therefore, no further proposed controls and monitoring are required.

9.5.2 Conclusion

The EPA objective for benthic communities and habitats is considered to have been met for the following reasons:

- The intake and outfall are located in areas devoid of BCH.
- The potential indirect impact of the loss of a one-hectare, sparsely populated mixed community will not affect the biological diversity of BCH within Mermaid Sound as the habitat is well represented.
- The ecological integrity of the BCH within Mermaid Sound will not be affected through the loss of the one-hectare sparsely populated mixed community.
- The loss of the one-hectare area of sparse BCH 120 m to the south of the discharge is not expected to result in indirect impacts to other environmental factors.

10 OTHER ENVIRONMENTAL FACTOR – MARINE FAUNA

EPA's objective for marine fauna is *to protect marine fauna so that biological diversity and ecological integrity are maintained*

The relevant policy and guidance for marine fauna is described in Appendix E.

10.1 Receiving environment

10.1.1 Studies and information sources

Table 10-1 lists the relevant databases and studies to inform this section. These have helped inform the description of the existing environment and assessment of impacts for the Proposal.

Table 10-1: Relevant studies undertaken that support the Proposal

Author	Study (Date)	Technical Guidance requirements (EPA, 2016e)
DAWE	EPBC Act Protected Matters Search Tool for the coastline from the existing intake pond to the discharge outlet, including a 1 km and 20 km buffer (April 2021)	Not directly applicable to the Technical Guidance requirements but provided a consolidated list of marine fauna species for consideration in relation to the Proposal.
DBCA	WA Department of Biodiversity, Conservation and Attractions NatureMap tool for the coastline from the existing intake pond to the discharge outlet, including a 1 km and 20 km buffer (April 2021)	
DBCA	Threatened and Priority Fauna List (April 2021)	
Atlas of Living Australia database	Atlas of Living Australia database for the coastline from the midway point between the wharf and the existing intake pond, including a 1 km buffer 20 km buffer (October 2021)	
AECOM	Flora and fauna assessment: Dampier Seawater Desalination Plant (AECOM, 2021; Appendix K)	Fauna surveys included a basic terrestrial fauna assessment in accordance with Terrestrial Vertebrate Fauna Survey Technical Guide (EPA, 2020). This level of survey is appropriate, given the high level of existing disturbance within the development envelope. The survey included habitat assessment, photography and mapping as per the Technical Guidance. Opportunistic fauna observations and low intensity sampling was also completed as per the Technical Guidance.
MScience	Assessment of marine impacts (July 2021c; Appendix I) Proposal-specific assessment	Not directly applicable to the Technical Guidance requirements but provided an understanding of additional study requirements.
RTIO	Viewshed analysis to identify areas of direct line of sight of the Proposal (RTIO, 2021) Proposal-specific assessment	Not directly applicable to the Technical Guidance requirements but provided an understanding of the spatial extent of potential impacts.

Author	Study (Date)	Technical Guidance requirements (EPA, 2016e)
JASCO Applied Sciences Pty Ltd	Pile Drilling Underwater Noise Estimation Technical Memo (JASCO, 2022; Appendix K)	Not directly applicable to the Technical Guidance requirements but provided an expert review and analysis of the proposed pile driving activities within the intake pond to understand the potential to generate problematic underwater noise and to inform the management required.

10.1.2 Regional context

The Dampier Archipelago (Murujuga) is a chain of 42 coastal islands, islets and rocks. The shallow and inshore waters within this island chain provide habitat for a variety of marine fauna species, including protected species listed under the EPBC Act and/or the WA *Biodiversity Conservation Act 2016* (BC Act).

The intertidal zone of the Dampier Archipelago is characterised by wide sandflats and mudflats, rocky shores, coral reefs and mangroves (CALM, 1990). These habitats support an extremely abundant and diverse invertebrate fauna (CALM, 1990), providing foraging habitats for shorebirds. Sandy beaches provide nesting habitat for marine turtles and roosting habitat for shorebird and seabird species. On the islands, the rocky outcrops and spinifex vegetation provide nesting habitat for seabirds.

10.1.3 Conservation significant marine fauna

Protected species that may occur within the vicinity of the development envelope (plus 1 km buffer) and the wider region (plus 20 km buffer) were identified through the searches outlined in Table 10-1. For the purposes of this chapter, only marine fauna species are discussed; terrestrial fauna species are discussed in Chapter 12.

The searches identified 66 protected marine species of bird, mammal, fish and reptiles (**Table 10-2**). Based on available information regarding habitat use, the likelihood of occurrence of these species in the development envelope was assessed.

Of these, 23 species were considered expected or likely to occur in the development envelope. These include:

- Three seabird species (Gull-Billed Tern *Gelochelidon nilotica*, Caspian Tern *Hydroprogne caspia*, Crested Tern *Thalasseus bergii*)
- Sixteen shorebird species (Common Sandpiper *Actitis hypoleucos*, Ruddy Turnstone *Arenaria interpres*, Sharp-Tailed Sandpiper *Calidris acuminate*, Sanderling *Calidris alba*, Red Knot *Calidris canutus*, Curlew Sandpiper *Calidris ferruginea*, Oriental Pratincole *Glareola maldivarum*, Long-Toed Stint *Calidris subminuta*, Greater Sand Plover *Charadrius leschenaultii*, Bar-Tailed Godwit *Limosa lapponica*, Little Curlew *Numenius minutus*, Whimbrel *Numenius phaeopus*, Pacific Golden Plover *Pluvialis fulva*, Grey-Tailed Tattler *Tringa brevipes*, Common Greenshank *Tringa nebularia*, Marsh Sandpiper *Tringa stagnatilis*)
- Four marine turtle species (Loggerhead Turtle *Caretta caretta*, Green Turtle *Chelonia mydas*, Hawksbill Turtle *Eretmochelys imbricata*, Flatback Turtle *Natator depressus*).

No protected fish or marine mammal species were considered expected or likely to occur; however, an additional 23 species were assessed as may occur, including:

- Three marine mammal species (Dugong *Dugong dugon*, Indo-Pacific Humpback Dolphin *Sousa chinensis*, Spotted Bottlenose Dolphin *Tursiops aduncus*)
- Six fish species (Narrow Sawfish *Anoxypristis cuspidate*, Grey Nurse Shark *Carcharias taurus*, Reef Manta Ray *Manta alfredi*, Giant Manta Ray *Manta birostris*, Dwarf Sawfish *Pristis clavata*, Green Sawfish *Pristis zijsron*)

- Eight seabird species (Common Noddy *Anous stolidus*, Wedge-Tailed Shearwater *Ardenna pacifica*, Lesser Frigatebird *Fregata ariel*, Bridled Tern *Onychoprion anaethetus*, Roseate Tern *Sterna dougallii*, Australian Fairy Tern *Sternula nereis*, Common Tern *Sterna hirundo*, Little Tern *Sternula albifrons*)
- Six shorebird species (Pectoral Sandpiper *Calidris melanotos*, Lesser Sand Plover *Charadrius mongolus*, Oriental Plover *Charadrius veredus*, Northern Siberian Bar-Tailed Godwit *Limosa lapponica menzbieri*, Eastern Curlew *Numenius madagascariensis*, Australian Painted Snipe *Rostratula australis*).

The remainder of species identified from database searches were considered either unlikely or not expected to occur in the development area or immediate surrounds.

Marine fauna species identified in the EPBC Act PMST are discussed in more detail in the following sections.

Table 10-2: Listed Threatened and Migratory marine fauna species which may be present within 1 km and 20 km of the development envelope [9]; species with biologically important areas overlapping the development envelope are highlighted grey

Species name	Common name	Status EPBC Act	Status under the WA BC Act	Presence within 1 km development envelope	Presence within 20 km of development envelope
Seabirds					
Anous stolidus	Common Noddy	Migratory	Migratory	May fly through but area is not expected to represent significant foraging habitat.	May fly through and/or forage within the area but breeding not recorded at the Dampier Archipelago (Murujuga).
Ardenna pacifica	Wedge-Tailed Shearwater	Migratory	Migratory	May fly through but area is not expected to represent significant foraging habitat.	Expected to occur during breeding season (Sep to Apr), given known breeding on islands and overlapping designated breeding BIA.
Calonectris leucomelas	Streaked Shearwater	Migratory	Migratory	Not expected based on lack of breeding within Australia and pelagic nature of this species.	May fly through and/or forage within the area in low numbers but breeding not recorded in Australia.
Fregata ariel	Lesser Frigatebird	Migratory	Migratory	May fly through but area is not expected to represent significant foraging habitat.	May fly through and/or forage within the area but breeding not recorded at the Dampier Archipelago (Murujuga).
Gelochelidon nilotica	Gull-Billed Tern	Migratory	Migratory	Marginal habitat recorded within development envelope; individuals are likely to occur but in low numbers.	Expected to occur since four observations recorded. Breeding may occur on some islands, but records are lacking.
Hydroprogne caspia	Caspian Tern	Migratory	Migratory	Expected to occur as suitable habitat recorded in development envelope and 30 observations have been recorded.	Expected to occur during breeding season (Jul to Oct), given known breeding on islands.
Onychoprion anaethetus	Bridled Tern	Migratory	Migratory	May fly through but area is not expected to represent significant foraging or breeding habitat.	Breeding is known to occur on islands of the Dampier Archipelago and therefore presence is expected.

[9] For migratory shorebirds, the survey area delineated in AECOM (2021) was used to inform their presence. The survey area is larger than the development envelope and is therefore considered conservative for this assessment.

Species name	Common name	Status EPBC Act	Status under the WA BC Act	Presence within 1 km development envelope	Presence within 20 km of development envelope
Sterna dougallii	Roseate Tern	Migratory	Migratory	May fly through but area is not expected to represent significant foraging habitat.	Expected to occur during breeding season (Aug to Dec), given known breeding on islands and overlapping designated breeding BIA.
Sternula nereis	Australian Fairy Tern	Vulnerable	Vulnerable	May fly through but area is not expected to represent significant foraging habitat.	Expected to occur during breeding season (Aug to Nov), given known breeding on islands and overlapping designated breeding BIA.
Sterna hirundo	Common Tern	Migratory	Migratory	May fly through but area is not expected to represent significant foraging habitat.	Expected to occur based on previous observations of two records, but in low numbers.
Sternula albifrons	Little Tern	Migratory	Migratory	May occur as suitable habitat recorded in development envelope; however, no previous observations have been recorded.	Expected to occur based on previous observations of seven records.
Thalasseus bergii	Crested Tern	Migratory	Migratory	Expected to occur as suitable habitat recorded in development envelope and 24 observations have been recorded.	Expected to occur. Breeding may occur on some islands, but records are lacking.
Macronectes giganteus	Southern Giant Petrel	Endangered	Migratory	Not expected based on lack of breeding within Dampier Archipelago and pelagic nature of this species.	May fly through and/or forage within the area in low numbers, but large numbers not expected.
Shorebirds					
Actitis hypoleucos	Common Sandpiper	Migratory	Migratory	Expected to occur as suitable habitat recorded in development envelope and 25 observations have been recorded.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.
Arenaria interpres	Ruddy Turnstone	Migratory	Migratory	Expected to occur as suitable habitat recorded in development envelope and 28 observations have been recorded.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.

Species name	Common name	Status EPBC Act	Status under the WA BC Act	Presence within 1 km development envelope	Presence within 20 km of development envelope
Calidris acuminate	Sharp-Tailed Sandpiper	Migratory	Migratory	Likely to occur as marginal habitat recorded.	Expected to occur foraging and roosting due to 15 observations recorded. Non-breeding visitor to Australia.
Calidris alba	Sanderling	Migratory	Migratory	Likely to occur as marginal habitat recorded.	Expected to occur foraging and roosting due to seven observations recorded. Non-breeding visitor to Australia.
Calidris canutus	Red Knot	Endangered, Migratory	Endangered	Likely to occur as marginal habitat recorded.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.
Calidris ferruginea	Curlew Sandpiper	Critically Endangered, Migratory	Critically Endangered	Likely to occur as marginal habitat recorded.	Expected to occur foraging and roosting due to five observations recorded. Non-breeding visitor to Australia. Dampier Saltworks identified Important Bird Area for this species.
Calidris melanotos	Pectoral Sandpiper	Migratory	Migratory	May occur but in low numbers.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.
Calidris ruficollis	Red-Necked Stint	Migratory	Migratory	Not expected to occur.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.
Glareola maldivarum	Oriental Pratincole	Migratory	Migratory	Likely to occur as marginal habitat recorded.	Expected to occur foraging and roosting due to three observations recorded. Non-breeding visitor to Australia. Dampier Saltworks identified Important Bird Area for this species.
Calidris subminuta	Long-Toed Stint	Migratory	Migratory	Likely to occur as marginal habitat recorded.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.

Species name	Common name	Status EPBC Act	Status under the WA BC Act	Presence within 1 km development envelope	Presence within 20 km of development envelope
Calidris tenuirostris	Great Knot	Critically Endangered, Migratory	Critically Endangered	Not expected to occur, not identified in EPBC Act PMST report.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.
Charadrius leschenaultii	Greater Sand Plover	Vulnerable, Migratory	Vulnerable	Expected to occur as 22 observations have been recorded.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.
Charadrius mongolus	Lesser Sand Plover	Endangered, Migratory	Endangered	May occur but in low numbers as suitable habitat recorded.	Expected to occur foraging and roosting due to eight observations recorded. Non-breeding visitor to Australia.
Charadrius veredus	Oriental Plover	Migratory	Migratory	May occur but in low numbers.	Expected to occur foraging and roosting due to four observations recorded. Non-breeding visitor to Australia.
Limicola falcinellus	Broad-Billed Sandpiper	Migratory	Migratory	Not expected to occur, not identified in EPBC Act PMST report.	Expected to occur foraging and roosting due to five observations recorded. Non-breeding visitor to Australia.
Limosa lapponica	Bar-Tailed Godwit	Migratory	Migratory	Expected to occur as suitable habitat recorded in development envelope and 26 observations have been recorded.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.
Limosa lapponica menzbieri	Northern Siberian Bar-Tailed Godwit	Critically Endangered	Critically Endangered, Migratory	May occur but in low numbers.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.
Limosa limosa	Black-Tailed Godwit	Migratory	Migratory	Not expected to occur, not identified in EPBC Act PMST report.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.
Numenius madagascariensis	Eastern Curlew	Critically Endangered, Migratory	Critically Endangered	May occur but in low numbers.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.

Species name	Common name	Status EPBC Act	Status under the WA BC Act	Presence within 1 km development envelope	Presence within 20 km of development envelope
Numenius minutus	Little Curlew	Migratory	Migratory	Expected to occur as marginal habitat recorded in development envelope and 26 observations have been recorded.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.
Numenius phaeopus	Whimbrel	Migratory	Migratory	Suitable habitat recorded.	Expected to occur foraging and roosting due to 27 observations recorded. Non-breeding visitor to Australia.
Phalaropus lobatus	Red-Necked Phalarope	Migratory	Migratory	Not expected to occur, not identified in EPBC Act PMST report.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.
Pluvialis fulva	Pacific Golden Plover	Migratory	Migratory	Expected to occur as suitable habitat recorded in development envelope and five observations have been recorded.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.
Pluvialis squatarola	Grey Plover	Migratory	Migratory	Not expected to occur, not identified in EPBC Act PMST report.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.
Tringa brevipes	Grey-Tailed Tattler	Migratory	Priority 4	Expected to occur as 33 observations have been recorded.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.
Tringa nebularia	Common Greenshank	Migratory	Migratory	Expected to occur as marginal habitat recorded in development envelope.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.
Tringa stagnatilis	Marsh Sandpiper	Migratory	Migratory	Expected to occur as marginal habitat recorded in development envelope.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.
Tringa totanus	Common Redshank	Migratory	Migratory	Not expected to occur, not identified in EPBC Act PMST report.	Expected to occur foraging and roosting. Non-breeding visitor to Australia.
Rostratula australis	Australian Painted Snipe	Endangered	Endangered	May occur but breeding not recorded for Dampier Archipelago (Murujuga).	May occur but breeding not recorded for Dampier Archipelago (Murujuga).

Species name	Common name	Status EPBC Act	Status under the WA BC Act	Presence within 1 km development envelope	Presence within 20 km of development envelope
Xenus cinereus	Terek Sandpiper	Migratory	NA	Not expected to occur, not identified in EPBC Act PMST report.	Expected to occur foraging and roosting due to four observations recorded. Non-breeding visitor to Australia.
Mammals					
Dugong dugon	Dugong	Migratory	Other specially protected fauna	May traverse the area but foraging or aggregating individuals not expected due to absence of seagrasses.	Expected to occur in areas of seagrass habitat.
Megaptera novaeangliae	Humpback Whale	Migratory	Conservation-dependent	Unlikely to occur, given water depths.	May occur migrating through waters of the outer islands of the Dampier Archipelago (Murujuga). Migration BIA overlaps but large numbers of migrating individuals not expected.
Sousa chinensis	Indo-Pacific Humpback Dolphin	Migratory	NA	May occur in low numbers since shallow nearshore waters are favoured.	Likely to occur since in shallow nearshore waters.
Stenella longirostris	Spinner Dolphin	NA	Priority 4	Not expected to occur, given preference for deeper waters.	May occur in deeper waters.
Tursiops aduncus	Spotted Bottlenose Dolphin	Migratory	NA	May occur in low numbers since shallow nearshore waters are favoured.	Likely to occur since in shallow nearshore waters.
Balaenoptera musculus brevicauda	Pygmy Blue Whale	Endangered, Migratory	Endangered	Not expected to occur, given water depths.	Although a distribution BIA overlaps, individuals are not expected to occur given water depths.
Balaenoptera edeni	Bryde’s Whale	Migratory	NA	Not expected to occur, given preference for deeper waters.	Expected to occur in deeper waters.
Orcinus orca	Killer Whale	Migratory	NA	Not expected to occur, given preference for deeper waters.	Expected to occur in deeper waters.

Species name	Common name	Status EPBC Act	Status under the WA BC Act	Presence within 1 km development envelope	Presence within 20 km of development envelope
Reptiles					
Aipysurus apraefrontalis	Short-Nosed Seasnake	Critically Endangered	Critically Endangered	Not expected to occur, not identified in EPBC Act PMST report.	May occur in coral reef habitat.
Caretta	Loggerhead Turtle	Endangered, Migratory	Endangered	Loggerhead internesting BIA overlaps the Proposal; however, it is outside of their key nesting range so no nesting/internesting is expected.	Foraging and migrating individuals expected to occur.
Chelonia mydas	Green Turtle	Vulnerable, Migratory	Vulnerable	Foraging and migrating individuals expected to occur but in low numbers. Internesting and dispersing individuals not expected, given distance to nearest notable nesting beach (Enderby Island, 17 km).	Breeding, internesting, foraging, migrating and dispersing individuals known to occur. Internesting BIA overlaps the area.
Dermochelys coriacea	Leatherback Turtle	Endangered, Migratory	Vulnerable	Not expected given absence of breeding and shallow waters.	Foraging and migrating individuals may occur.
Eretmochelys imbricata	Hawksbill Turtle	Vulnerable, Migratory	Vulnerable	Foraging and migrating individuals expected to occur but in low numbers. Internesting and dispersing individuals not expected, given distance to nearest notable nesting beach (Angel Island, 15 km).	Breeding, internesting, foraging, migrating and dispersing individuals known to occur. Internesting BIA overlaps the area.
Natator depressus	Flatback Turtle	Vulnerable, Migratory	Vulnerable	Foraging and migrating individuals expected to occur in low numbers. Low numbers of internesting and dispersing individuals associated with low density nesting at EII may occur. Nearest notable nesting beaches are 17 km from the development envelope (Dolphin and Enderby islands)	Breeding, internesting, foraging, migrating and dispersing individuals known to occur. Internesting BIA overlaps the area.

Species name	Common name	Status EPBC Act	Status under the WA BC Act	Presence within 1 km development envelope	Presence within 20 km of development envelope
Fish					
Anoxypristis cuspidate	Narrow Sawfish	Migratory	NA	May occur in low numbers since shallow nearshore waters are favoured.	May occur in shallow nearshore waters.
Carcharias taurus	Grey Nurse Shark	Vulnerable	Vulnerable	May occur but in low numbers, given lack of favoured habitat.	May occur in areas of favoured habitat.
Carcharhinus longimanus	Oceanic Whitetip Shark	Migratory	NA	Not expected to occur, given preference for deeper waters.	Likely to occur in deeper waters.
Carcharodon carcharias	Great White Shark	Vulnerable, Migratory	Vulnerable	Not expected due to preference of temperate waters and lack of favoured prey.	Not expected due to preference of temperate waters and lack of favoured prey.
Manta alfredi	Reef Manta Ray	Migratory	NA	May occur but in low numbers, given lack of favoured habitat.	May occur in areas of favoured habitat.
Manta birostris	Giant Manta Ray	Migratory	NA	May occur but in low numbers, given lack of favoured habitat.	May occur in areas of favoured habitat.
Pristis clavata	Dwarf Sawfish	Vulnerable, Migratory	NA	May occur in low numbers since shallow nearshore waters are favoured.	May occur in shallow nearshore waters.
Pristis zijsron	Green Sawfish	Vulnerable, Migratory	Vulnerable	May occur in low numbers since shallow nearshore waters are favoured.	May occur in shallow nearshore waters.
Rhincodon typus	Whale Shark	Vulnerable, Migratory	Other specially protected fauna	Not expected, given water depths and absence of significant zooplankton populations.	Not expected, given absence of significant zooplankton populations.

10.1.4 Seabirds

Several seabird species listed as Threatened and/or Migratory may occur in the waters of the Dampier Archipelago (**Table 10-2**). Some species, such as the Streaked Shearwater, are non-breeding visitors to Australian waters; for others, such as the Southern Giant Petrel, Lesser Frigate Bird and Common Noddy, breeding occurs in Australia but has not been recorded at the Dampier Archipelago (Murujuga). For these species, the waters of the Dampier Archipelago may provide foraging habitat during non-breeding periods or for juvenile birds yet to reach sexual maturation.

Suitable or marginal habitat was identified within the development envelope for the Little Tern, Crested Tern and Gull-Billed Tern. Suitable habitat also exists for the Caspian Tern and it was observed within the development envelope (AECOM, 2021).

Four seabird species – the Wedge-Tailed Shearwater, Caspian Tern, Roseate Tern and Australian Fairy Tern – are known to breed on islands of the Dampier Archipelago (Table 10-3). BIAs based on known breeding activity have been identified for the Wedge-Tailed Shearwater, Roseate Tern and Australian Fairy Tern for the Dampier Archipelago (Figure 10-1). These species are described below, and seasonality of likely presence in the Dampier Archipelago is summarised in Table 10-3.

Table 10-3: Seasonal presence of seabird species breeding in the Dampier Archipelago

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Australian Fairy Tern[1]	Non-breeding presence							Breeding known to occur				
Wedge-Tailed Shearwater[1,2]	Breeding known to occur									Breeding known to occur		
Caspian Tern[1]	Non-breeding presence						Breeding known to occur					
Roseate Tern[3]								Breeding known to occur				
[1]**CALM, 1990**			[2]Nicholson, 2002					[3]Higgins & Davies, 1996				

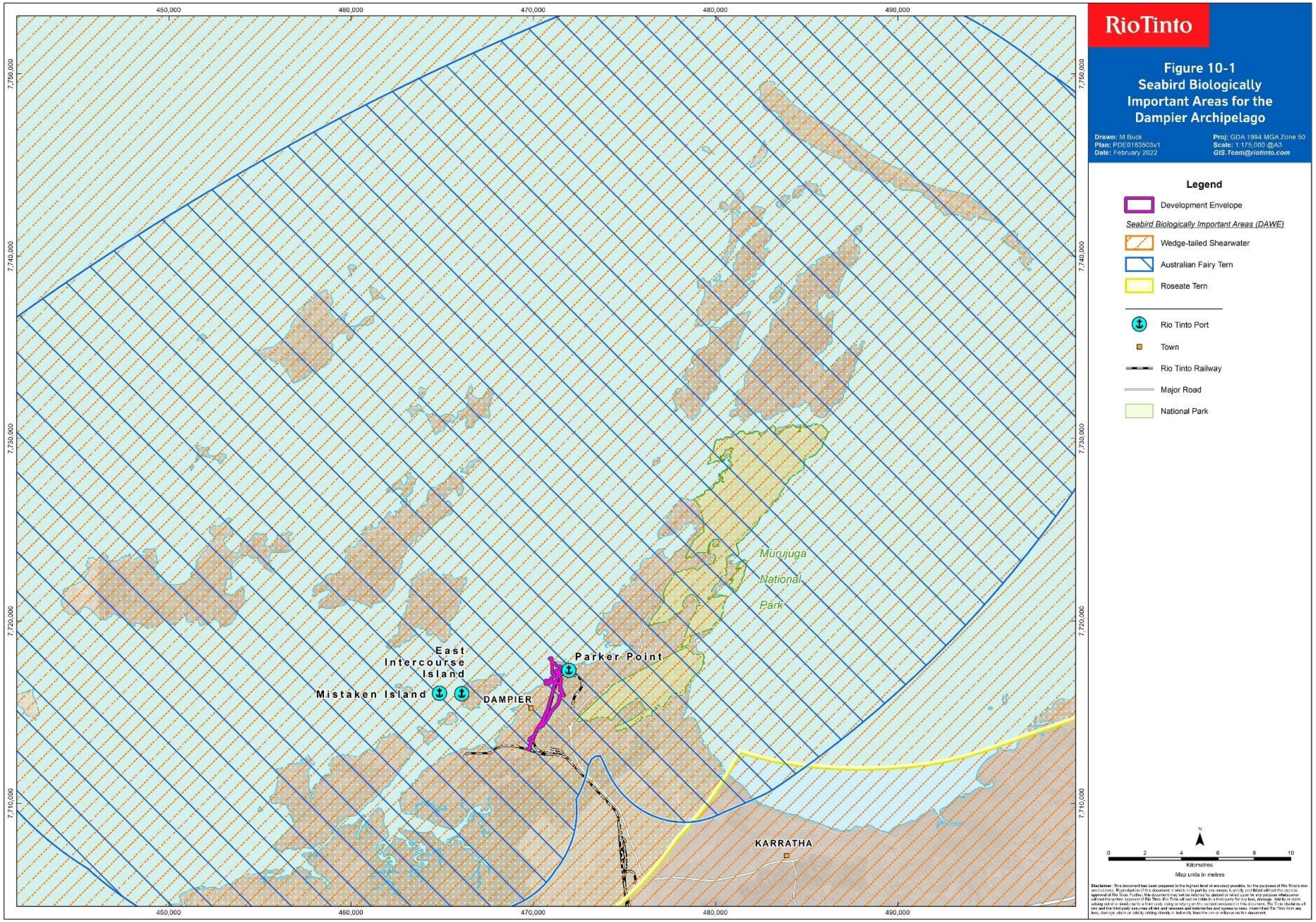


Figure 10-1: Seabird biologically important areas

Wedge-Tailed Shearwater – Ardenna pacifica

The Wedge-Tailed Shearwater (*Ardenna pacifica)* is listed as Migratory under the EPBC Act and BC Act, is a common breeding visitor to the Pilbara (Johnstone et al., 2013) and has been recorded breeding on several islands of the Dampier Archipelago (Table 10-3). Adults are absent from their breeding colonies during the interbreeding period and return from their tropical Indian Ocean over-wintering grounds from late June onwards to re-excavate their burrows. This species is highly synchronous in timing of breeding; typically, all eggs within a colony are laid within a ten-day period in early November. The egg is incubated for approximately 53 days until hatching in early January. Once hatched, adults leave the burrows to forage during the day, returning at night to feed chicks until they are ready to fledge in mid-April (Nicholson, 2002; Table 10-3). However, adults may not return to feed chicks each night.

Wedge-Tailed Shearwater foraging trips have been recorded at one to three days in Australia (Peck, 2006). The species potentially exhibits dual foraging strategies whereby parents alternate or mix short trips in local waters and longer trips at greater distances from the breeding colonies. This foraging strategy has been recorded in several shearwater species: Sooty Shearwaters (Weimerskirch, 1998), Little Shearwaters (Booth et al., 2000), Cory's Shearwaters (Granadeiro et al., 1998; Magalhães et al., 2008), Streaked Shearwaters (Ochi et al., 2010) and Manx Shearwaters (Shoji et al., 2015). It is possible Wedge-Tailed Shearwaters breeding within the Dampier Archipelago also exhibit dual foraging strategies. The Wedge-Tailed Shearwater feeds mostly on fish, with some cephalopods and crustaceans, catching prey mainly on the wing by dipping but also by surface-seizing or pursuit-plunging (Commonwealth of Australia, 2019).

The nearest breeding colony for Wedge-Tailed Shearwaters is Conzinc Island, 13 km north of the development envelope. It is possible that during breeding, adults will forage in the waters adjacent to the development envelope, as indicated by the overlap of a BIA. However, due to low abundance of prey species, large numbers are not expected. Individuals may pass through the area en route to more optimal foraging areas.

Australian Fairy Tern – Sternula nereis

The Australian Fairy Tern (*Sternula nereis nereis*) is listed as Vulnerable under both the EPBC Act and BC Act and has been recorded breeding at several islands of the Dampier Archipelago (CALM, 1990), though none within 20 km of the development envelope. Eggs are laid in late July to early September (Johnstone et al., 2013) and incubated for approximately 18 days (Higgins & Davies, 1996). Once hatched, chicks are guarded by at least one parent continually until approximately 14 to 15 days of age (Higgins & Davies, 1996). Australian Fairy Tern colonies tend to occupy areas rather than specific sites, and nest sites are often abandoned after one year, regardless of success (Saunders & de Rebeira, 1985). However, if breeding fails at one area, the birds will often move to new locations to attempt re-laying within the same season (Higgins & Davies, 1996). During non-breeding, Australian Fairy Terns favour sheltered inshore waters and appear to be present around breeding sites throughout the year (Johnstone et al., 2013).

Although a BIA for breeding overlaps the development envelope, no breeding colonies are located within 20 km of the development envelope. However, breeding and non-breeding individuals may pass through the area (CALM 1990).

Caspian Tern – Hydroprogne caspia

The Caspian Tern (*Hydroprogne caspia*) is listed as Migratory under the EPBC Act and WA BC Act and has been recorded breeding on several islands of the Dampier Archipelago (CALM, 1990, Table 10-3). The typical breeding season is shown in Table 10-3 (CALM, 1990). Following egg laying, incubation takes about 22 days, with chicks fledging after about 35 days (Commonwealth of Australia, 2019). Although the species may forage up to 60 km from their nesting site (Commonwealth of Australia, 2019), they favour sheltered seas, flooded coastal samphire flats, brackish pools on lower courses of rivers and saltwork ponds (Johnstone et al., 2013) and therefore are likely to forage within the waters of the

Dampier Archipelago (Murujuga). Within the development envelope, disturbed artificial wetlands (4.5 ha within the development envelope) were identified as suitable foraging habitat for the Caspian Tern (Figure 10-2), which were directly observed within this habitat (AECOM, 2021). In previous surveys undertaken in 2017, 30 records of Caspian Tern were recorded within the development envelope (AECOM, 2021).

The nearest breeding colony for Caspian Terns is Conzinc Island, 13 km north of the development envelope. Although nesting is expected to be absent within the development envelope, based on previous records, it is likely breeding and non-breeding individuals will be present in the development envelope, either passing through, roosting or foraging.

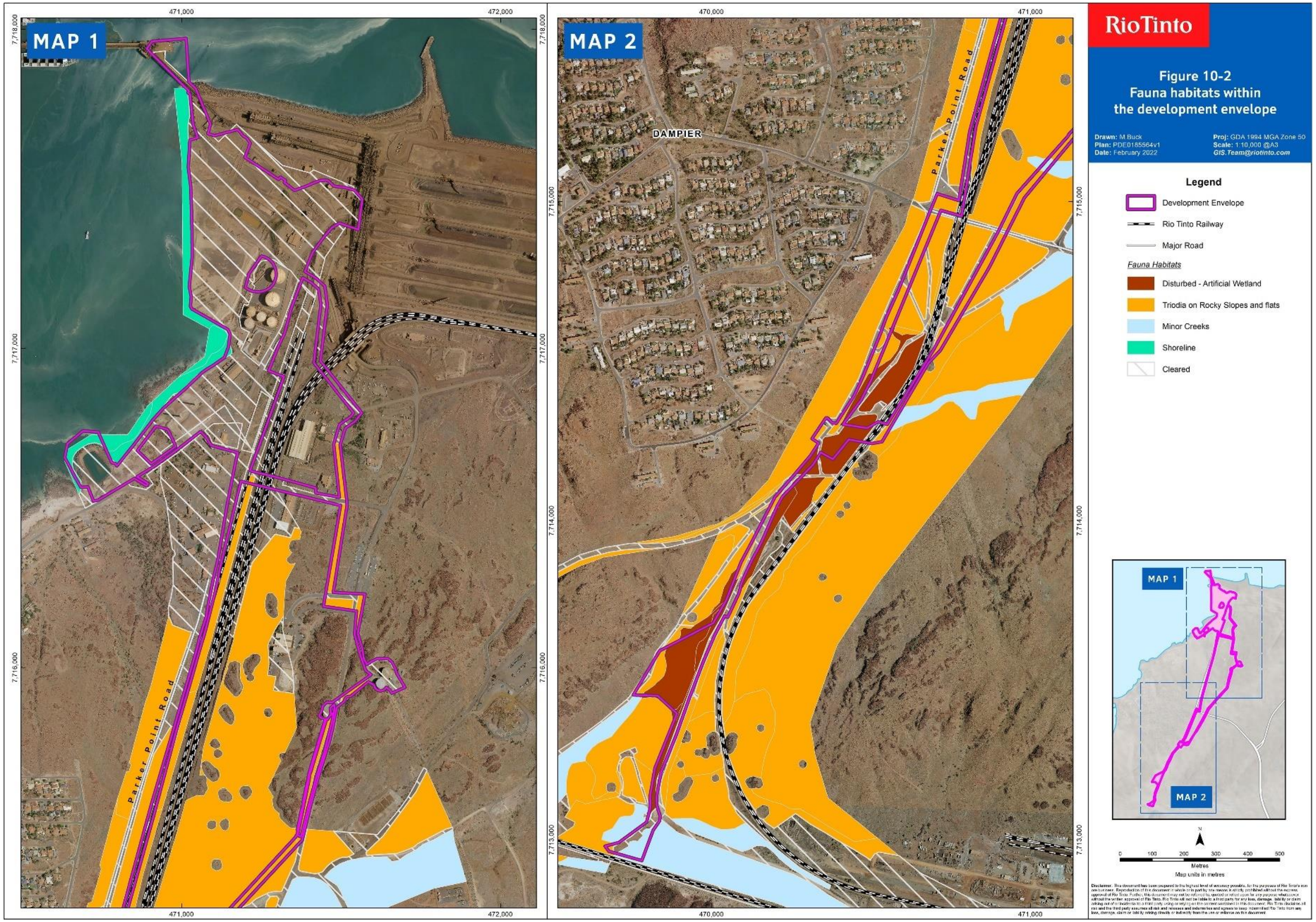


Figure 10-2: Fauna habitats

Roseate Tern – Sterna dougallii

The Roseate Tern (*Sterna dougallii*) is listed as Migratory under both the EPBC Act and BC Act and has been recorded breeding on Goodwyn Island (Higgins & Davies, 1996). In WA, egg laying occurs between April and November, with hatching occurring about 25 days later (Higgins & Davies, 1996). Following breeding, Roseate Terns are known to move away from breeding colonies but their non-breeding range is not well defined (Higgins & Davies, 1996). They are usually associated with coral reefs and may also forage around islands on the continental shelf. They are rarely recorded foraging in shallow sheltered inshore waters, usually only venturing into these areas when nesting islands are nearby (Higgins & Davies, 1996). Therefore, Roseate Terns may forage within waters of the Dampier Archipelago, but are expected to be less common than other tern species described above.

Although a BIA for breeding overlaps the development envelope, and breeding has been recorded on Goodwyn Island, foraging is seldom recorded in shallow inshore waters, such as those of the development envelope. BIAs for this species are defined by adding a 20 km buffer around known breeding locations and do not account for habitat heterogeneity within that buffer (DAWE, 2021). As such, the BIA encompasses sheltered inshore waters of the development envelope which do not provide optimal foraging habitat. As a result, individuals may be encountered occasionally within the development envelope, but are not expected in large numbers.

Table 10-4: Sightings (s) and breeding (b) of EPBC listed Threatened/Migratory seabirds on islands of the Dampier Archipelago within 20 km of the development envelope (CALM, 1990; BirdLife International, 2019; Higgins and Davies, 1996)

Island/Location	Conzinc Island	Dolphin Island	Enderby Island	Malus Island	Rosemary Island	West Lewis Island
Distance to development envelope (km)	13	17	17	14	20	10
Wedge-Tailed Shearwater	b			b		
Caspian Tern	b	s	b	s	b	s
Roseate Tern		s	s			

10.1.5 Shorebirds

Australia is situated within the East Asian–Australian (EAA) Flyway, a geographic region supporting populations of migratory shorebirds throughout their annual cycle. Although exact timing varies between species (Bamford et al., 2008), an approximate annual cycle for shorebirds in the EEA Flyway has been identified as: breeding (May to August); southward migration (August to November); non-breeding (December to February); and northward migration (March to May).

Of the shorebirds identified in **Table 10-2**, only the Australian Painted Snipe breeds in Australia. This species has been recorded at wetlands in all states of Australia (Barrett et al., 2003; Blakers et al., 1984; Hall, 1910b); however, it is most common in eastern Australia, and there are no records of this species breeding within the Dampier Archipelago. The species is considered highly unlikely to occur within the development envelope and is not considered further.

All other shorebird species are non-breeding visitors (Bamford et al., 2008). During the non-breeding period in Australia, these migratory shores are typically found in coastal and inland habitats where adult birds build up the energy reserves necessary to support northward migration and subsequent breeding (Commonwealth of Australia, 2017).

Within the EEA Flyway, wetlands that regularly support 1% of the individuals in a population of one species or subspecies of waterbird are identified as internationally important (Ramsar Convention Bureau, 2000). The Dampier Saltworks, approximately 2 km from the development envelope, has been recognised as such a site for two species: the Oriental Plover and the Curlew Sandpiper (Bamford et al., 2008), the latter of which is listed as Critically Endangered under the EPBC Act and BC Act. The Dampier Saltworks also supports large numbers of Sharp-Tailed Sandpipers and is recognised by BirdLife International as an Important Bird Area (BirdLife International, 2019).

The intertidal areas of the Burrup Peninsula and Dampier Archipelago have a range of intertidal habitats, including sandy beaches, rocky beaches, sand and mudflats and shallow rock platforms, providing habitat for numerous migratory and resident shorebirds. Terrestrial surveys undertaken specifically for the Proposal found intertidal areas immediately adjacent or within the development envelope are predominantly rocky/boulder shorelines sloping from existing infrastructure (port) into subtidal areas (AECOM, 2021). While suitable and marginal habitat was identified in the development envelope, as described in Table 10-5 and shown in Figure 12-1**,** no sand/mudflats or rocky platform habitats were observed; therefore, shorelines within the development envelope provide minimal foraging areas for most migratory shorebird species.

Table 10-5: Key Habitat suitability within the development envelope for listed shorebirds species (AECOM, 2021)

Habitat type	Description	Species
Disturbed artificial wetlands	Seasonal standing water with occasional mature tree, sedges, herbs and low shrubs provide moderate ground cover. Moderate complexity when water is present. This habitat is a result of historical earthworks (likely for sourcing fill). It would be expected that surface water would be temporary and these areas would be dry for much of the year. Area: 4.5 ha	Suitable habitat for: • Common Sandpiper Marginal habitat for: • Sharp-Tailed Sandpiper • Red Knot • Curlew Sandpiper • Long-Toed Stint • Oriental Pratincole • Little Curlew • Wood Sandpiper • Common Greenshank • Marsh Sandpiper
Shorelines	Rocky/boulder shoreline sloping from existing infrastructure (port) into subtidal areas. Intertidal areas were dominated by oyster-encrusted rocks and there were no low tidal sand or mud mudflats exposed seaward of the rocky shoreline (i.e., no mudflat habitat suitable as foraging areas for shorebirds). Isolated patches of mangroves occurred on mid-upper levels of the rocky shoreline. Complexity is low with minimal ground cover. Area: 0.5 ha	Suitable habitat for: • Common Sandpiper • Ruddy Turnstone • Sanderling • Bar-Tailed Godwit • Whimbrel • Pacific Golden Plover.

10.1.6 Marine mammals

Cetaceans (whales and dolphins) and Dugongs may occur within or adjacent to the development envelope, including species classified as Threatened and Migratory under the EPBC Act or specially protected under the BC Act (**Table 10-2**).

The marine and coastal environment of the Dampier Archipelago includes a unique combination of inshore reef and seagrass habitats and deeper water within channels between offshore islands, providing diversity in habitats able to support a variety of marine mammal species. These include inshore dolphins, Dugongs and the larger Baleen Humpback Whale. Species that may occur within 20 km of the development envelope are described in the following sections.

Dugong – Dugong dugon

Dugongs (*Dugong dugon*) are listed as Migratory under the EPBC Act and specially protected under the BC Act. As herbivores that feed on seagrass, their distribution is strongly associated with seagrass habitat distribution. The Dugong's reproductive cycle is sensitive to food availability; breeding is delayed if sufficient food is not available (UNEP, 2002).

Within the North West Marine Region, the distribution of Dugong is widespread. Within the Dampier Archipelago (Murujuga), they have been recorded near various islands, including Rosemary Island, East Lewis Island, West Lewis Island, Keast Island, Legendre Island and Little Rocky Island (CALM, 2005; URS, 2000). Dugongs have also been sighted in shallow, sheltered bays of the Burrup Peninsula and mainland, such as Regnard Bay and Nickol Bay (CALM, 2005).

Due to the absence of seagrass habitat in waters within or adjacent to the development envelope, Dugongs are highly unlikely to occur regularly or in large numbers in the development envelope. Individuals may infrequently transit between suitable foraging habitats.

Pygmy Blue Whale – Balaenoptera musculus brevicauda

The Pygmy Blue Whale (*Balaenoptera musculus brevicauda*) is listed as Endangered and Migratory under the EPBC Act and Endangered under the BC Act. A distribution BIA overlaps the area within 20km of the Proposal. Although Pygmy Blue Whales are reported to have been sighted in Dampier Archipelago waters (CALM, 2005), general distribution is typical in water depths over 200 m and commonly over 1000 m (Double et al., 2012). In the wider region, Pygmy Blue Whales migrate along the 500 m to 1000 m depth contour on the edge of the slope and are likely to feed opportunistically on ephemeral Krill aggregations (DEWHA, 2008b).

Given the water depths of the Dampier Archipelago (Murujuga), particularly in the waters within and adjacent to the development envelope, the likelihood of Pygmy Blue Whales is remote and this species is not considered further.

Humpback Whale – Megaptera novaeangliae

Humpback Whales (*Megaptera novaeangliae*) are listed as Migratory under the EPBC Act, and conservation-dependent under the BC Act.

Breeding and calving grounds are located between Broome and the northern end of Camden Sound, with breeding typically occurring between August and September (DEWHA, 2012b). Following calving, Humpback Whales migrate southwards to summer feeding grounds in Antarctic waters, with Krill forming the main component of their diet (DEWHA, 2012b). A BIA for migration has been identified on the inner shelf, including within 20 km of the development envelope (Figure 10-3). According to Jenner et al. (2001) and Prince (2001), migrating Humpback whales remain well offshore, typically in waters equal to or exceeding 20 m depth and are therefore not expected in the vicinity of project area.

Figure 10-3: Humpback Whale biologically important area

In contrast to Pygmy Blue Whales, the migratory routes for Humpback Whales are closer to shore. During the northbound migration, individuals are typically found travelling along the continental shelf in water depths of approximately 200 m (Jenner et al., 2001). But during the southbound migration, individuals (particularly cow/calf pairs) stay closer to the coast (Double et al., 2010). It is during the southbound migration that individuals or cow/calf pairs may be traversing Dampier Archipelago waters, either circumventing the islands or travelling into the Mermaid Sound proper (Jenner et al., 2001). The peak of the northward migration in Dampier Archipelago waters is during July, while the southern migration peaks in late August/early September.

Although Humpback Whales have been recorded within Mermaid Sound, and a BIA for migration overlaps the development envelope, sightings would be a rare event, given the shallow water depth (<10 m) within and adjacent to the development envelope and proximity to existing industry. According to Jenner et al. (2001) and Prince (2001), migrating whales remain well offshore, typically in waters equal to or exceeding 20 m depth.

Indo-Pacific Humpback Dolphin – Sousa chinensis

The Indo-Pacific Humpback Dolphin (*Sousa chinensis*) is listed as Migratory under the EPBC Act. The species is thought to be widely distributed along the northern Australian coastline from about the Queensland–New South Wales border to Shark Bay, WA (Raudino et al., 2018).

While sightings of Indo-Pacific Humpback Dolphins have been recorded within the Dampier Archipelago (Allen et al., 2012), there is a paucity of studies into its distribution in the region or across WA more broadly. Site-specific intensive studies have been conducted in the coastal waters of the Kimberley (Brown et al., 2016a, 2016b) and around the North West Cape in the Pilbara (Hunt et al., 2017). Results of the surveys found sightings within a few kilometres of the mainland coast and nearshore islands. However, survey effort at greater water depths was lacking. While these studies have confirmed habitat use within shallow inshore waters, sightings up to 60 km offshore during Dugong surveys near Barrow Island and the Lowendal Islands (Hanf, 2015) suggest distribution likely extends to deeper waters. Furthermore, Prince (2001) suggested that large cetaceans off the Pilbara coast are unlikely to be found in waters less than 20 m deep and are therefore not expected in the vicinity of project area.

Although location-specific information is lacking, the waters within and adjacent to the development envelope are consistent with habitats of known presence, and therefore, individuals may traverse the area.

Spinner Dolphin – Stenella longirostris

The Spinner Dolphin is listed as priority 4 under the BC Act. The species has a broad distribution in Australia, from as far south as Bunbury, WA, as well as the Northern Territory and along the east coast from Queensland to New South Wales (Bannister et al., 1996), including the Great Barrier Reef (Marsh, 1990).

Spinner Dolphins are primarily pelagic but may occur over the continental shelf and, less frequently, in shallower waters approximately 100 m deep (Ross, 2006). Populations on the Great Barrier Reef have shown diurnal movement patterns, resting close inshore within protected reefs and then moving offshore to feed at night (Reilly, 1990). There is no evidence to suggest these diurnal movements occur in WA populations, and sightings within the waters of the Dampier Archipelago are lacking.

Considering their primarily pelagic distribution, individuals are unlikely to occur within the waters adjacent to the development envelope.

Spotted Bottlenose Dolphin/Indian Ocean Bottlenose Dolphin – Tursiops aduncus

The Indian Ocean Bottlenose Dolphin (*Tursiops aduncus*), or Spotted Bottlenose Dolphin, is listed as Migratory under the EPBC Act. This species is known to occur in four main regions around Australia: eastern Indian Ocean, Tasman Sea, Coral Sea and Arafura/Timor Seas. It is restricted to inshore areas such as bays and estuaries, nearshore waters, open coast environments, and shallow offshore waters including coastal areas around oceanic islands (Hale et al., 2000; Möller & Beheregaray, 2001).

Prince (2001) reported that Pilbara coastal waters support small populations of dolphins, with the majority being Bottlenose (Tursiops sp.) and Humpbacked Dolphins (Sousa spp.) Frequent sightings of Indian Ocean Bottlenose Dolphins in the waters of the Dampier Archipelago are reported in Allen et al. (2012). Given the known sightings of this species, combined with its preference to inshore habitat, Indian Ocean Bottlenose Dolphins may occur in waters adjacent to the development envelope.

Bryde's Whale – Balaenoptera edenil

The Bryde's Whale (*Balaenoptera edenil*) is listed as Migratory under the EPBC Act. It is the least migratory species of its genus, with its presence restricted between the equator to approximately 40°N and 40°S (Kato, 2002). Bryde's Whales occur in both oceanic and inshore waters (Bannister et al., 1996) and have been recorded in waters of the Dampier Archipelago (IMMA, 2021), though they typically occur in water depths of 200 m (Best et al., 1984). Considering the favoured water depths of this species, individuals are unlikely to occur in waters adjacent to the development envelope.

Killer Whale – Orcinus orca

The Killer Whale (*Orcinus orca*) has a widespread distribution from polar to equatorial regions of all oceans and has been recorded in waters off all states of Australia (Bannister et al., 1996). Killer Whales appear to be more common in cold, deep waters; however, they have been observed along the continental slope and shelf (Bannister et al., 1996), as well as in shallow coastal areas including waters of the Dampier Archipelago (IMMA, 2021).

Given the wide distribution of Killer Whales and their preference for colder, deeper waters, individuals are unlikely to occur in waters adjacent to the development envelope.

10.1.7 Marine reptiles

The EPBC Act PMST report identified six species of marine reptile that may occur within 20 km of the development envelope: Short-Nosed Seasnake (*Aipysurus apraefrontalis*), Loggerhead Turtle (*Caretta caretta*), Green Turtle (*Chelonia mydas*), Leatherback Turtle (*Dermochelys coriacea*), Hawksbill Turtle (*Eretmochelys imbricate*) and Flatback Turtle (*Natator depressus*).

The *Recovery plan for marine turtles* (Commonwealth of Australia, 2017) outlines habitat critical to the survival of a species ('habitat critical') for marine turtle genetic stocks. At the time of writing, all marine turtle BIAs were inclusive of areas identified as habitat critical. One key difference between BIAs and habitat critical is the size of the internesting buffer around Flatback Turtle nesting beaches; BIAs include an 80 km buffer whereas habitat critical is 60 km. For all other species, the internesting buffer is 20 km for both habitat critical and BIAs.

Short-Nosed Seasnake – Aipysurus apraefrontalis

The Short-Nosed Seasnake (*Aipysurus apraefrontalis*) is endemic to WA and is listed as Critically Endangered under the EPBC Act and BC Act. This species of seasnake is considered a pelagic species and is known to inhabit reef flats and shallow water of around 10 m depth. Most specimens have been collected from Ashmore and Hibernia reefs. There are a small number of records of Short-Nosed Seasnakes along the WA coast from the Exmouth Gulf to Broome as fisheries bycatch (Kangas et al., 2007); however, none from waters of the Dampier Archipelago.

The preferred habitat of the Short-nosed Seasnake has been identified as reef flats or shallow waters along the outer reef edge, which may be present around some of the coastal islands of the Dampier Archipelago. There is potential for Short-Nosed Seasnakes to occur within the Dampier Archipelago, but given the lack of its preferred habitat within the study area and immediate surrounds it is considered unlikely that this species would be present within the disturbance footprint.

Loggerhead Turtle – Caretta caretta

Loggerhead Turtles (*Caretta caretta*) are listed as Endangered and Migratory under the EPBC Act and BC Act. Loggerhead Turtles are a nearshore species which prefer warm, shallow continental shelves and coastal bays and estuaries, feeding on benthic invertebrates including molluscs and crustaceans (Shigenaka, 2003). While data on foraging movements of this species in WA are lacking, satellite tracking of four Loggerhead Turtles nesting on the Muiron Islands shows one individual traversed through the Dampier Archipelago but did not occur in waters adjacent to the development envelope (Seaturtle.org, 2021). Although Loggerhead Turtle nesting activity within the Dampier Archipelago (Cohen Island) has been reported (CALM, 1990), Pendoley et al. (2016) did not find any evidence of Loggerhead Turtle nesting activity in over 20 years of tracking data.

It is likely foraging or migrating adult Loggerhead Turtles will occur within the waters of the Dampier Archipelago (Murujuga). However, significant numbers within waters adjacent to the development envelope are unlikely, given the sparsity of optimal foraging habitat. Internesting females and hatchlings are expected to be absent.

Leatherback Turtle – Dermochelys coriacea

Leatherback Turtles (*Dermochelys coriacea*) are listed as Endangered and Migratory under the EPBC Act and Vulnerable under the BC Act. No major Leatherback Turtle rookeries are known to occur in Australia, with scattered nesting reported in Queensland (Limpus & MacLachlan, 1979, 1994; Limpus et al., 1984b) and the Northern Territory (Hamann et al., 2006; Limpus & MacLachlan, 1994) only. Leatherback Turtle diet is dominated by gelatinous organisms such as jellyfish, salps, squid and siphonophores (Bjorndal, 1997), which influences their distribution (Leary, 1957; Lazell, 1980), both in the open ocean (Lazell, 1980) and close to shore (Hoffman & Fritts, 1982; Suarez, 2000).

It is possible foraging or transient Leatherback Turtles may pass through waters of the Dampier Archipelago (Murujuga), but due to lack of significant food sources, individuals are not expected within the development envelope.

Green Turtle – Chelonia mydas

Green Turtles (*Chelonia mydas*) are listed as Vulnerable and Migratory under the EPBC Act and BC Act. Green Turtles have been recorded nesting on a number of islands within the Dampier Archipelago (Figure 10-4). Green Turtles nesting here are part of the North West Shelf genetic stock, which is described as stable (Commonwealth of Australia, 2017a). The *Recovery plan for marine turtles in Australia* identifies nesting beaches of the Dampier Archipelago, including a 20 km internesting buffer, as habitat critical – an area which is also a designated BIA (Figure 10-4). In particular, Rosemary, Legendre and Delambre islands are identified as minor important nesting areas for this species (Commonwealth of Australia, 2017a). Interannual fluctuations in nester abundance is well documented in Green Turtles (e.g., Limpus et al., 2005), which have been linked to the Southern Oscillation Index (Limpus & Nicholls, 1994; Limpus & Nicholls, 1988) and sea surface temperatures (Solow et al., 2002) in northern and eastern Australia. As shown in Table 10-6, nesting occurs between November and March, with a peak between December and February. Following a ~60-day incubation period, hatchlings begin to emerge from nests between January and May, with a peak in February and March (Commonwealth of Australia, 2017a).

Although the body of literature describing marine turtle movement patterns during the breeding season is increasing, information specific to the Dampier Archipelago is more limited. Pendoley (2005) provides details of satellite tracking data for Green and Hawksbill Turtles nesting on Rosemary Island. Female Green Turtles travelled up to 5 km but typically remained within shallow, nearshore waters less than 10 m deep (Pendoley, 2005).

During non-breeding, Green Turtles typically occupy nearshore, coastal bays, feeding on seagrasses and macroalgae (Bjorndal, 1997; Bolten, 2003). They are herbivorous for the majority of their life history; however, post-hatching, Green Turtles are omnivorous in their pelagic stage, and recent findings point to an oceanic diet including sea jellies for some populations (Arthur et al., 2008; Bolten, 2003). Although foraging grounds for Green Turtles within the Dampier Archipelago have not been identified with the available tracking data (Pendoley, 2005), it is possible foraging individuals occur within seagrass habitat of the Dampier Archipelago (Murujuga). Satellite tracking data has revealed the Dampier Archipelago is important for Green Turtles on migration, though individuals appeared to traverse waters of the outer-most islands of the Archipelago, and the eastern side of the Burrup Peninsula, rather than waters close to the development envelope (Pendoley, 2005).

Green Turtles have been recorded nesting on EII, 2 km west of the development envelope, and West Intercourse Island, 9 km from the development envelope (Table 10-6). However, a review of track count survey data collected over 20 years indicated mean track density was less than one per night at these beaches (Pendoley et al., 2000) and therefore, the contribution of nesting habitat for this genetic stock is consider negligible and these nesting areas are not considered further. The nearest nesting beach with mean track density of more than one per night is Enderby Island, 17 km west of the development envelope (Table 10-6).

Although the development envelope is overlapped by a BIA and habitat critical for internesting behaviours, at these distances, the density of internesting females and dispersing Green Turtle hatchlings within the waters adjacent to the development envelope is expected to be low. Foraging and migrating Green Turtles may occur in the waters adjacent to the development envelope; however, large numbers are not expected given the lack of significant foraging habitat and based on understanding of known migration routes.

Table 10-6: Records of nesting behaviour of Environment Protection and Biodiversity Conservation-listed marine turtles on islands of the Dampier Archipelago within 20 km of the development envelope (Pendoley et al., 2016)

	Mean tracks per day^{-1} (Pendoley et al., 2016)						
	Angel	Dolphin	East Intercourse	Enderby	Gidley	Rosemary	West Intercourse
Approx. distance to development envelope (km)	15	17	2	17	20	20	9
Green Turtle		<1*	<1*	11-100		11-100	<1*
Hawksbill Turtle	1-10			1-10		101-500	
Flatback Turtle		<1*	<1*	11-100	<1*	11-100	<1*
*Nesting beaches with <1 track per day are considered to be of negligible importance to nesting marine turtles							

Table 10-7: Peak activity of nest females and emerging hatchlings of Green, Flatback and Hawksbill Turtles of relevant genetic stocks (Commonwealth of Australia, 2017a)

Species	Activity	Jul		Aug		Sep		Oct		Nov		Dec		Jan		Feb		Mar		Apr		May		Jun	
Green Turtle	Nesting																								
	Emergence																								
Hawksbill Turtle	Nesting																								
	Emergence																								
Flatback Turtle	Nesting																								
	Emergence																								

Hawksbill Turtle – Eretmochelys imbricata

Hawksbill Turtles (*Eretmochelys imbricata*) are listed as Vulnerable and Migratory under the EPBC Act and BC Act. The Dampier Archipelago is considered a major important nesting area under the *Recovery plan for marine turtles in Australia*, with nesting beaches and a 20 km internesting buffer identified as habitat critical (Commonwealth of Australia, 2017a) and a designated BIA (Figure 10-4). In particular, Rosemary Island is recognised as an internationally significant nesting site for Hawksbill Turtles. Evidence of Hawksbill Turtle nesting has also been found on a number of other islands (Table 10-6), with nesting activity being highest on Enderby, Eaglehawk, Angel and Delambre islands (Pendoley et al., 2016), in addition to very low numbers at Holden Beach and No Name Bay on the Burrup Peninsula ((Woodside, 2018). These nesting females are part of the WA genetic stock (H-WA) which is of unknown status. While nesting and hatching can occur year-round, notable peaks occur between October and January for nesting, and December and February for hatchling (Commonwealth of Australia, 2017a).

Satellite tracking data collected from a small number of internesting Hawksbill Turtles in the Dampier Archipelago suggest nesting female Hawksbill Turtles remained within 1 km of nesting beaches on Rosemary Island (Pendoley, 2005).

Hawksbill Turtles are the most tropical of all marine turtle species and are found within rock and reef habitats, coastal areas and ponds. They are known to forage amongst vertical underwater cliffs, on coral reefs and on gorgonian (soft coral) flats, as well as seagrass or algae meadows (Bjorndal, 1996). Hawksbills feed primarily on sponges, but will also consume shrimp, squid, anemones, algae, seagrass, sea cucumber and soft corals (Bjorndal, 1996). Although foraging grounds for Hawksbill Turtles within the Dampier Archipelago have not been identified with the available tracking data (Pendoley, 2005), considering the diet of the species, and the habitats within its waters, it remains plausible that foraging individuals occur within the waters of the Dampier Archipelago (Murujuga).

As with Green Turtles, the Dampier Archipelago appears important for migrating Hawksbill Turtles, though individuals appeared to traverse waters of the outer-most islands of the Dampier Archipelago (Murujuga), rather than waters close to the development envelope (Pendoley, 2005).

While significant Hawksbill Turtle rookeries exist within the Dampier Archipelago (e.g., Rosemary Island), the nearest beaches to the development envelope with recorded nesting occur on Angel Island, 15 km to the north (Table 10-6). Although the development envelope is overlapped by a BIA and habitat critical for internesting behaviours, given the distance to known nesting beaches and studies on internesting movements, it is unlikely internesting females and dispersing hatchlings will be present within the waters adjacent to the development envelope. Foraging and migrating Hawksbill Turtles may occur in the waters adjacent to the development envelope; however, large numbers are not expected, given the lack of significant foraging habitat and our understanding of known migration routes.

Flatback Turtle – Natator depressus

Flatback Turtles (*Natator depressus*) are listed as Vulnerable and Migratory under the EPBC Act and BC Act. Within the Dampier Archipelago, Flatback Turtle nesting has been recorded across a number of islands (Table 10-6), with the Dampier Archipelago listed as a minor important nesting area under the *Recovery plan for marine turtles in Australia* (Commonwealth of Australia, 2017a). These nesting beaches, and a 60 km internesting buffer, are identified as habitat critical. The area is also a designated BIA, though the internesting buffer is larger at 80 km (Figure 10-4). A high frequency of nesting tracks has been recorded at Rosemary, Enderby and Delambre islands (Pendoley et al., 2016). Delambre Island has been recognised as the largest Flatback Turtle rookery in Australia, with an estimated 3,500 nesting females per year (Chaloupka, 2018), and is considered a major important nesting area (Commonwealth of Australia, 2017a). Other islands of notable nesting activity include Legendre and Eaglehawk islands (Pendoley et al., 2016). Individuals nesting here belong to the Pilbara genetic stock (F-Pil), the status of which is unknown (Commonwealth of Australia, 2017a). Nesting typically occurs between October and March, peaking between November and January with hatchling emergence peaking in February and March (Commonwealth of Australia, 2017a).

Knowledge of the internesting movements of Flatback Turtles within the Dampier Archipelago is provided by satellite tracking of 30 individuals nesting at Bells Beach and five at Delambre Island (Thums et al., 2018). During internesting, these Flatback Turtles remained within an average distance of 14.2 ± 8.8 km of their nesting site and in water depths of 8.1 ± 2.7 m (Thums et al., 2018). These distances are less than those reported for internesting Flatback Turtles at Thevenard Island (78.4 ± 31.6 km; Whittock, Pendoley & Hamann, 2014), Barrow Island (68.7 ± 48.5 km; Whittock, Pendoley & Hamann, 2014) and Lacepede Islands (39.1 ± 8.3; Waayers et al., 2011), and also at mainland rookeries Mundabullangana (38.7 ± 8.6 km; Whittock, Pendoley & Hamann, 2014) and Cemetery Beach (57.6 ± 37.2 km; Whittock, Pendoley & Hamann, 2014) near Port Hedland. Even applying shorter distances reported by Thums et al. (2018), it is possible internesting females and dispersing hatchlings may occur within the development envelope, or waters in proximity, albeit in low densities.

The importance of the Dampier Archipelago for non-breeding Flatback Turtles is unknown. Flatback Turtle foraging areas have been found to occur in waters shallower than 130 m and within 315 km of the shore, with many areas located in 50 m water depth and 66 km from shore (Whittock et al., 2016). Since their main diet comprises algae, squid, invertebrates and molluscs, foraging individuals may occur within the waters of the Dampier Archipelago (Murujuga).

Flatback Turtles have been recorded nesting on EII, 2 km north-west of the development envelope, and West Intercourse Island, 9 km west. As described above for Green Turtles, the abundance of nesting females on these beaches is expected to be negligible, considering the proximity to existing industry and the low mean track density reported in Pendoley et al. (2006), and are not considered further. The nearest nesting beaches with a mean track density of more than one per night are at Enderby Island. The nesting beaches at Enderby Island are 17 km west of the development envelope, which is overlapped by a BIA and habitat critical for internesting behaviours. Recent findings also indicate Rosemary Island, 20 km north of the development envelope, is an important rookery for Flatback Turtles (Fossette et al., 2021), with the number of fresh tracks recorded per night comparable to Barrow Island (Fossette et al., 2021).

Flatback Turtles appear to move greater distances from nesting beaches during the internesting period compared with other marine turtle species. Although the water depths adjacent to the development envelope are favourable for internesting Flatback Turtles, the proximity to existing industry may reduce their likely presence. It is possible internesting Flatback Turtles may occur, but they are unlikely to be at similar densities to the waters adjacent to significant nesting beaches. Considering the distance to the nearest notable nesting beach (17 km), the density of dispersing Flatback Turtles is expected to be low.

Foraging Flatback Turtles may occur in the waters within and adjacent to the development envelope; however, large numbers are not expected, given the lack of significant foraging habitat and water depths (<10 m) being shallower than the apparent optimal depth of 50 m (Whittock et al., 2016).

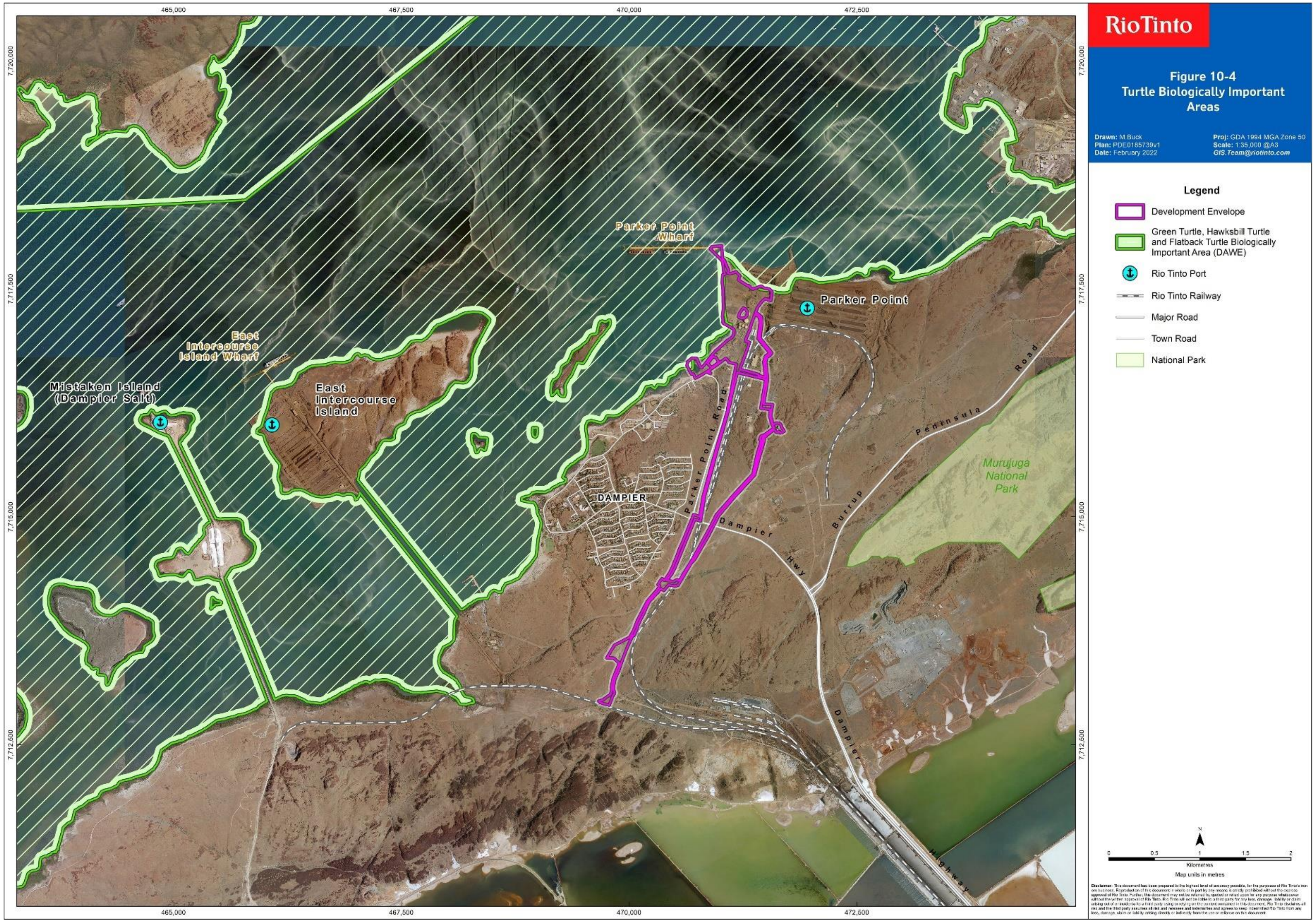


Figure 10-4: Marine turtle biologically important areas

10.1.8 Protected Fish Species

Due to the lack of complex benthic habitats in waters within and adjacent to the development envelope, neither high abundance nor diversity of fish species are expected. Due to the proximity to Port of Dampier, commercial fishing activities are absent.

The key species of concern are the sawfish species: Narrow Sawfish *Anoxypristis cuspidate*, Dwarf Sawfish *Pristis clavate* and Green Sawfish *Pristis zijsron*. Sawfish generally inhabit inshore coastal, estuarine and riverine environments (Commonwealth of Australia, 2015). Distribution of adult and juvenile Sawfish in Australia include the northern coastlines of WA, Northern Territory and Queensland. In WA, Sawfish may occur along the Pilbara coast, with pupping of Green Sawfish 'likely to occur' between Port Hedland and the North West Cape (Commonwealth of Australia, 2015).

The known distribution of sawfish species in north-western Australia has been based on targeted sampling or discovery/donation of sawfish rostrum (Morgan et al. 2011). The closest targeted sawfish surveys to the Project area have occurred at Onslow (Morgan et al. 2015; Morgan et al. 2017). Nursery sites for newborn sawfish pups are generally found in shallow, nearshore habitats often in close proximity to river mouths (Morgan et al. 2011). The Project area is not located close to a river mouth. Of the three species of sawfish identified as having the potential of occurring in the Project area only the green sawfish has been confirmed through sightings or evidence of rostra in the Karratha area (Morgan et al. 2019; Morgan et al. 2011). Green Sawfish generally have a very small home range, occupy very shallow waters and are likely to avoid areas of high vessel traffic, such as Parker Point (Morgan et al. 2017).

Though the presence of Sawfish species within inshore environments of the Dampier Archipelago has not been studied, research and commentary provided by Dr David Morgan (Harry Butler Institute) to support other projects in the Pilbara (i.e. Port Hedland Spoilbank Marina Project) have stated that sawfish have a home range of approximately 400 km. A collation of recent records occurring after 2010 of sawfish recorded or caught between 80 Mile Beach and south to Karratha, totalled 66 sightings (Morgan et al, 2020). Considering the home range of sawfish and the availability of similar suitable habitats along the Pilbara coast, it is considered that if present, the density of sawfish in waters within the development area will be low.

10.2 Potential environmental impacts

A number of potential impacts have been avoided and mitigated through the Proposal development and engineering design process (section 2.4). Direct and indirect impacts during construction, commissioning and operation are described below.

10.2.1 Direct impacts

Potential direct impacts of the Proposal to marine fauna have been identified in Table 10-8.

Table 10-8: Potential direct environmental impacts

Potential impacts	Proposal phase	Activities with potential to have impact
Injury or fatality as a result of interaction with vessels	Construction of the piles and intake infrastructure	• Vessel presence during construction may disturb marine fauna and result in collision with individuals, leading to injury or mortality.
Behavioural responses to underwater noise	Construction of piles and intake infrastructure	• Underwater noise emissions during construction include continuous noise sources associated with vessel use and rotary drilling in the existing intake pond.

Potential impacts	Proposal phase	Activities with potential to have impact
Behavioural changes due to artificial light	Construction Commissioning Operation	• Potential for increase in artificial lighting associated with construction, commissioning and operation, such as facility lighting and vehicle lights • Impacts on marine fauna from artificial light may include changes in physiology, altering behaviours, change in the availability of habitat or food resources, and/or increase in predation rates. • The Recovery Plan for Marine Turtles in Australia lists artificial light as a key threat as it may disrupt critical behaviours such as inhibiting nesting and disrupting hatchling orientation (Commonwealth of Australia, 2017).
Impingement and entrainment of marine fauna	Intake pond	• There is potential for impingement (marine fauna trapped against intake screens by force of the flowing water) and entrainment (fauna actively drawn into plant intake) of marine fauna associated with seawater that is drawn to the intake. Seawater will be drawn from the artificial seawater intake pond which connects to the open ocean through an existing culvert. The culverts are covered by screens with a minimum aperture of 150 mm. The estimated velocity of intake water through the culverts is expected to be 0.1 to 0.15 m/s.
Displacement from habitat due to habitat disturbance	Construction of the plant, pipelines and intake infrastructure	• Likely disturbance during construction of approximately 5 ha of suitable or marginal terrestrial shorebird habitat (shoreline and disturbed – artificial wetland habitat; Table 10-5) occurring in the development envelope.

10.2.2 Indirect impacts

Potential indirect impacts of the Proposal to marine fauna during construction have been identified in Table 10-9. No indirect impacts to marine fauna during commissioning or operation were identified. Note that potential impacts from brine discharge and increased total suspended solids are discussed in Chapter 7 (Marine Environmental Quality).

Table 10-9: Potential indirect environmental impacts

Potential impacts	Proposal phase	Activities with potential to have impact
Introduction of invasive marine species	Construction of the pipelines and intake infrastructure	• The use of vessels brings the potential for introduction of non-native invasive marine species (NIMS) transported via ballast water and as biofouling on vessel hulls.

10.3 Mitigation

This section describes the mitigation measures that have been applied to the potential impacts to mitigate the risks of significant residual impacts. To develop these mitigation measures, the mitigation hierarchy of 'avoid, minimise and rehabilitate' has been applied, with a focus on avoiding impacts where possible.

For this Proposal, the implementation of mitigation measures significantly reduces impacts to the environment and enables the Proposal to meet EPA’s objective for marine fauna.

Table 10-10 sets out the technically feasible mitigation measures that have been applied to each potential impact and arranges those mitigation measures by where they sit within the mitigation hierarchy.

Table 10-10: Marine fauna mitigation measures

Potential impact	Applicable proposal phases	Mitigation method
EPA objective: To protect marine fauna so biological diversity and ecological integrity are maintained		
Direct impacts from injury or fatality as a result of interaction with vessels	Construction	**Avoid** Vessels will only be used for the construction of the outfall pipeline and intake refurbishment where land-based methods are not fit for purpose. **Minimise** If deemed necessary, one or two small barge vessels will be used. Vessels will travel at less than 8 knots when within 45 m of the wharf, as per the Port of Dampier Handbook. Vessels will adhere to requirements under the Australian National Guidelines for Whale and Dolphin Watching 2017 A Marine Fauna Observer will be on board whenever a vessel is in use **Rehabilitate** In the unlikely event that marine fauna are injured, injured fauna shall be managed by appropriately qualified personnel in accordance with the Iron Ore (WA) Wildlife Interaction Guidelines.
Direct and indirect impacts – behavioural changes due to artificial light	Construction Commissioning Operations	**Minimise** During construction, lights that do not require to be continually lit will be switched off. During operations, lights that do not require to be continually lit will be switched off or activated by motion sensors. The lighting design for the desalination plant will follow the principles of Best Practice Lighting Design outlined in the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia, 2020), including: • use lighting only where/when needed • direct light downwards and away from sensitive habitats (ocean) • shield lamps to prevent light spill (vertical and horizontal). All permanent desalination plant outdoor lighting will consist of either low-pressure sodium-vapour and/or amber LED (595 nm) luminaries. In the unlikely event that fauna is attracted to lights in the area, it shall be immediately reported to the onsite Environmental Advisor. Uninjured trapped fauna shall be relocated/released by an appropriately qualified person to a nearby area of suitable habitat. **Rehabilitate** Sick and/or injured fauna shall be managed by appropriately qualified personnel in accordance with the Iron Ore (WA) Wildlife Interaction Guidelines.
Direct impacts – behavioural	Construction	**Avoid**

Potential impact	Applicable proposal phases	Mitigation method
responses to underwater noise		Piles to secure the seawater intake pumps will be installed into the bedrock using drilling methods instead of driving methods to eliminate sources of impulsive noise. Piling will only be undertaken during daylight hours to ensure visibility of the exclusion zone for the Marine Fauna Observer. It should also be noted that sawfish species are nocturnal, and restricting piling activities to daylight hours avoids key times that sawfish may be transiting adjacent to the project area, removing this impact pathway. **Minimise** Culverts will be blocked during construction activities within the existing intake pond, reducing noise propagation out of the pond. Marine Fauna Observes will be deployed when pile driving activities occur to observe for marine fauna within a 100 m exclusion zone around the seawater intake pond, and shutdown operations if protected marine fauna species occur within this exclusion zone. Operations should implement a soft-start style approach, where the drilling increases in speed gradually over the period of a few minutes, to allow nearby fauna to move away. **Rehabilitate** No rehabilitation mitigation measures were identified.
Direct impacts from impingement and entrainment of marine fauna	Commissioning Operations	**Avoid** Screened culverts will prevent marine fauna larger than 150 mm from entering the existing intake pond. The culverts at the entrance of the intake pond are covered by screens with a minimum aperture of 150 mm. Intake velocity at culverts, located 100 m from intake pipes, will be managed to maintain 0.1 – 0.15 m/s. **Minimise** Culverts are submerged, reducing the likelihood of turtle hatchlings swimming into the existing intake pond. In the unlikely events that marine fauna do become trapped and injured, it shall be immediately reported to the onsite Environmental Advisor. Uninjured trapped fauna shall be relocated/released by an appropriately qualified person to a nearby area of suitable habitat. A fauna handling licence shall be obtained where required as directed by the onsite Environmental Advisor. **Rehabilitate** Sick and injured fauna shall be managed by appropriately qualified personnel in accordance with the Iron Ore (WA) Wildlife Interaction Guidelines.
Direct impact – displacement from habitat due to habitat disturbance	Construction Operations	**Avoid** To avoid impacts, the development envelope has been located on highly disturbed, reclaimed land within an established industrial area. The design of the development envelope has specifically avoided areas of higher ecological value. The intake pond has been located within an existing intake pond and the discharge outlet is located on an existing wharf in an industrial port. **Minimise**

Potential impact	Applicable proposal phases	Mitigation method
		Clearing of vegetation has been minimised through the design process. Five hectares of suitable shorebird habitat (0.5 ha of shoreline and 4.5 ha of disturbed – artificial wetland) habitat will be cleared during construction. **Rehabilitate** All areas that have been cleared for construction and commissioning purposes and which are not required for operations, will be rehabilitated as soon as practicable after construction.
Indirect impacts from introduction of invasive marine species	Construction	**Avoid** No ballast water exchange will occur during vessel operations, reducing the risk of introduction of non-native invasive marine species (NIMS) **Minimise** An NIMS risk assessment will be completed for all construction vessels. Appropriate management controls will be utilised, dependent on the risk associated with the vessel. **Rehabilitate** None identified.

10.4 Assessment and significance of residual impacts

This section provides a full assessment of the level and significance of expected impacts on marine fauna resulting from construction, commissioning and operational phases of the Proposal. The following impact assessment assumes the mitigation measures listed in Section 10.3 are implemented, and therefore, only the residual impacts are discussed.

10.4.1 Direct impacts

10.4.1.1 Injury or fatality as a result of interaction with vessels

Vessel movements can result in collisions between the vessel and marine fauna, potentially resulting in superficial injury, serious injury that may affect life functions and mortality. The factors that contribute to the frequency and severity of impacts due to collisions vary greatly due to vessel type, vessel operation (specific activity, speed), physical environment (water depth) and the type of animal potentially present and their behaviours.

It is anticipated that construction work for the Proposal will be conducted from the shore and/or off the jetty where feasible. However, there may be times when a construction barge and dive support vessel (two additional vessels) will be required to support the construction activities (specifically for refurbishment of the intake pond and construction of the outfall diffuser). Vessels will be small and slow-moving in the development envelope.

Impacts to fauna from collision with vessels is highly unlikely to be significant for the following reasons:

- Any vessel used will be small and will travel at slow speeds (8 knots/hr) close to shore
- The Proposal's CEMP has incorporated Marine Fauna Observers to be engaged during construction to monitor for any marine activity in the development envelope and report any impacts to the Department of Biodiversity, Conservation and Attractions and DoEE.
- Given the proximity of the development envelope to shore, it is highly unlikely that large mammals such as Humpback Whales or Dugongs will be present. Inshore dolphins may occur, but given the slow speeds of vessels and the presence of a fauna spotter, no collisions are likely.
- The density of turtles, seasnakes and sawfish in the development area is expected to be low. The development envelope is within a working port and in proximity to wharf berths, and these marine animals are likely to avoid the area in response to vessel noise. Combined with the low speed of vessels during construction, the likelihood of collision with individuals is reduced.

10.4.1.2 Impacts from artificial light

In accordance with the National Light Pollution Guidelines for Wildlife, potential impacts to marine threatened species were considered out to 20 km from the development envelope. The viewshed analysis that was undertaken to understand the direct visibility of artificial light from the Proposal, found that the visual impacts in terms of artificial light are expected to be limited due to the design of the Proposal and the presence of existing infrastructure in the area (RTIO, 2021). The desalination plant has been designed so that it minimises disruption in the landscape and has a reduced impact to visual amenity. In addition, the mitigation measures outlined in section 10.3 include adopting the principles of Best Practice Lighting Design outlined in the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia, 2020). Using these methods, land-based lighting will be shielded and directed away from the ocean, therefore light spill onto the sea surface is only credible from vessel lighting. The use of vessels (if deemed necessary) will be temporary during construction and will not be used at night, therefore behavioural responses to artificial light to underwater species (fish, marine mammals) are not expected to occur.

The residual impact of any artificial lighting to seabirds, shorebirds and marine turtles is discussed below.

Seabirds

Artificial light can have a variety of effects on seabirds, depending upon the species and the life stage or behaviours being undertaken at the time. Negative responses of birds to artificial light may include collision, entrapment, stranding, grounding and disorientation from the usual migration route, potentially resulting in reduced fitness, injury or death (Commonwealth of Australia, 2020).

Species that are nocturnal, such as procellariforms (albatrosses, petrels, shearwaters) are at greater risk of negative impacts, with the bulk of the literature relating to the synchronised mass exodus of fledgling seabirds from their nesting sites as a result of artificial light (Deppe et al., 2017; Raine et al., 2007; Rodriguez et al., 2015a; Rodriguez et al., 2015b; Le Corre et al., 2002; Reed et al., 1985). Of the seabirds potentially occurring within the development envelope, the Wedge-Tailed Shearwater is most at risk from artificial light impacts. The nearest breeding colony is located 13 km north at Conzinc Island (section 10.1.4), which is less than the distance from which fledgling shearwaters have been impacted by artificial light (Commonwealth of Australia, 2020). Results of the viewshed analysis predict light may be directly visible from Conzinc Island. Operational outdoor light will be amber, which is less attractive to birds than a very bright light (Raine et al., 2007) and upward light spill will be reduced, minimising the risk of shearwater groundings. Given the implementation of mitigation measures and distance of the Proposal from Conzinc Island, the risk to individuals is considered low and significant impacts to Wedge-Tailed Shearwaters are not expected.

In the unlikely event a bird of any species is grounded within the development envelope, the individual will be released or cared for as appropriate prior to release, reducing impacts at the individual level and preventing significant impacts at the population level from occurring.

Migratory shorebirds

Although suitable and marginal habitat within the development envelope exists, low numbers of shorebirds were recorded (AECOM, 2021). These shorebirds may be foraging and/or roosting, but do not nest in Australia (section 10.1.5). Light associated with the Proposal may have the potentially beneficial effect of increased foraging efficiency, or negative impacts associated with displacement from roosting sites (Santos et al., 2010; Rogers et al., 2006). Should the latter occur, impacts are not expected to be significant, considering the small number of shorebirds recorded, the small spatial area of the development envelope and the availability of similar and more optimal habitat in the Dampier Archipelago.

Artificial light may also attract migratory shorebirds in flight (Longcore et al., 2013), influencing stop-over selection and impacting successful migration and decreasing fitness (McLaren et al., 2018). Mitigation measures reducing upward light spill during operations will reduce the intensity of light as seen by a migrating shorebird. The Dampier Saltworks is an important bird area hosting significant aggregations of shorebirds (section 10.1.5). Given the proximity of the Dampier Saltworks to existing industry, and the lack of reports indicating disorientation of shorebirds at these facilities, significant disorientation is not expected.

Marine turtles

The Commonwealth's *Recovery plan for marine turtles* (Commonwealth of Australia, 2017) outlines habitat critical to the survival of a species ('habitat critical') for marine turtle genetic stocks. Biologically Important Areas (BIAs) are areas where listed threatened and migratory species display biologically important behaviour such as breeding, foraging, resting and migration. BIAs of highest relevance for the consideration of light impacts are nesting and internesting BIAs for each species.

Noting this, the location, extent, condition and importance of nesting and internesting habitats for Flatback, Hawksbill and Green turtles (for which BIAs exist in the development area) are considered in this section.

The potential impacts of artificial light on marine turtles have been well documented, although the vulnerability of individuals to negative impacts is influenced by life history stage and behaviour. Although the behavioural responses of marine turtles are relatively well understood, there are currently no quantitative impact thresholds for artificial light due to the expansive suite of factors that influence individual vulnerability. In addition to the intensity of the light source, the spectral power distribution (wavelength and colour), atmospheric scattering, cloud reflectance, spatial extent of skyglow, duration of exposure, horizon elevation and lunar phase can all influence behavioural responses to varying degrees.

Table 10-11 summarises the mean number of turtle nesting tracks per day for Enderby, Rosemary and Angel Islands, the three islands that support significant numbers of nesting females within 20 km of the development envelope (Table 10-6), and whether directly visible light at these locations was predicted by the viewshed analysis. Of these three islands, light was not predicted to be directly visible at nesting beaches on Enderby and Rosemary islands (Table 10-11). On Angel Island, the southern-facing sandy beaches have direct line of sight to light sources associated with the Proposal, however these beaches are 15km away from the proposal.

While the viewshed analysis can provide an indication of nesting beaches with directly visible light, it cannot inform assessment of light intensity, or the extent of skyglow visible above the horizon. However, considering the size of the development envelope, proximity to existing industrial development, and implementation of mitigation measures (such as use of amber wavelengths), skyglow associated with the Proposal is unlikely to be detectable above existing skyglow on the Burrup Peninsula. As a result, significant impacts to marine turtles of any life stage are not expected, as discussed in more detail below.

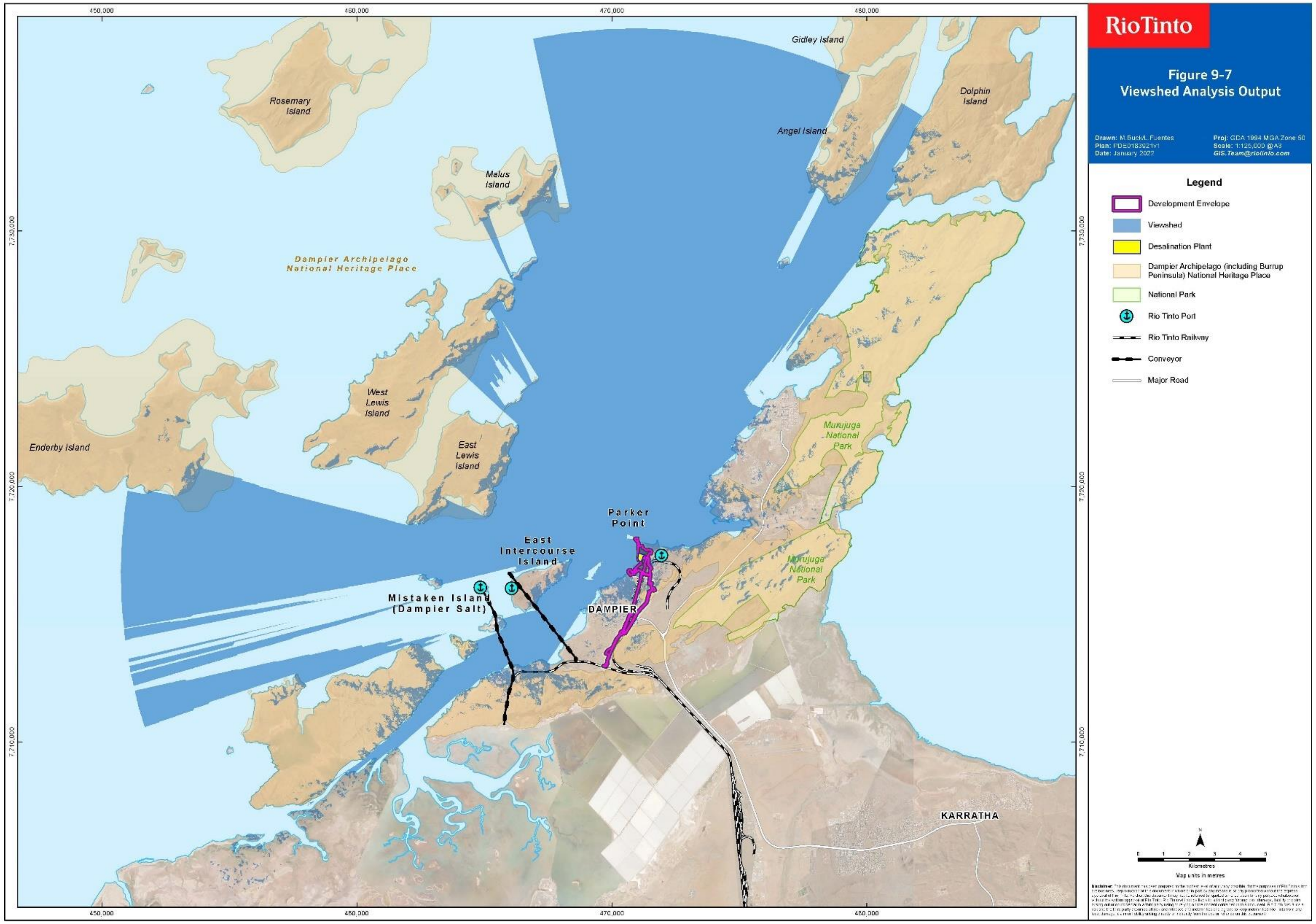


Figure 10-5: Viewshed analysis outputs

Table 10-11: Summary of viewshed analysis and nesting information

Island	Species present	Distance from development envelope (km)	Mean tracks.day^{-1} (Pendoley et al., 2016)	Conclusions
Angel	HK	15	1 to 10	Small number of southern-facing sandy beaches exposed to direct line of sight. Low number of individuals potentially exposed to directly visible light.
Enderby	GR	17	11 to 100	South-eastern-facing coastline exposed to direct line of sight, but no sandy beaches have direct line of sight. Individuals not expected to be exposed to directly visible light.
	HK		1 to 10	
	FB		11 to 100	
Rosemary	GR	20	11 to 100	No direct line of sight visible. Individuals not expected to be exposed to directly visible light.
	HK		101 to 500	
	FB		11 to 100	

Legend: *HK = Hawksbill Turtle, GR = Green Turtle, FB = Flatback Turtle*

Internesting / Nesting adults

Adult female marine turtles return to land, predominantly at night, to nest on sandy beaches, relying on visual cues to select, and orientate on, nesting beaches and return to the ocean post-nesting. That artificial lighting on or near beaches has been shown to disrupt nesting behaviour is relatively well documented (Witherington & Martin, 2003). Beaches with light spill, such as those located adjacent to urban developments, roadways and piers, often have lower densities of nesting females compared with beaches with less development (Salmon, 2003; Hu et al., 2018). In addition to potential impacts on nesting females before or during nesting, artificial light also has the potential to impact post-nesting behaviour. On completion of laying, nesting females are thought to use light cues to return to the open ocean, orientating towards the brightest light (Witherington & Martin, 2003). While some evidence suggests post-nesting sea-finding behaviour can be disrupted by artificial light, adults appear much less vulnerable compared to hatchling turtles (Witherington & Martin, 2003).

The closest nesting beach that may be exposed to directly visible light and supports notable nesting abundance is Angel Island, 15 km to the north of the development envelope. At this distance, direct light spill onto nesting beaches is negligible. As described above, the characteristics of the Proposal lighting is unlikely to result in skyglow that can be detected above the existing skyglow in the region. Therefore, impacts from lighting to nesting marine turtles are not expected to occur.

Hatchlings

Hatchling turtles emerge from the nest, typically at night (Mrosovsky & Shettleworth, 1968), and must rapidly reach the ocean to avoid predation (Salmon, 2003). Hatchlings locate the ocean using a combination of topographic and brightness cues, orienting towards the lower, brighter oceanic horizon, and away from elevated darkened silhouettes of dunes and/or vegetation behind the beach (Pendoley & Kamrowski, 2015; Lohmann et al., 1997; Limpus & Kamrowski, 2013). Artificial lights interfere with natural light levels and silhouettes, which disrupts hatchling sea-finding behaviour (Withington & Martin, 2003; Pendoley & Kamrowski, 2015; Kamrowski et al., 2014). Hatchlings may become disorientated – where hatchlings crawl on circuitous paths – or become misorientated – where they move in the wrong direction – possibly attracted to artificial lights (Withington & Martin, 2003; Lohmann et al., 1997; Salmon, 2003). Hatchlings disoriented or misoriented by artificial lighting may take longer, or fail, to reach the sea. This may result in increased mortality through dehydration, predation or exhaustion (Salmon & Witherington, 1995).

Once in nearshore waters, artificial lights on land can also interfere with the dispersal of hatchlings. An internal compass set while crawling down the beach, together with wave cues, are used to reliably guide hatchlings offshore (Lohmann & Lohmann, 1992, Stapput & Wiltschko, 2005; Wilson et al., 2021). However, in the absence of wave cues, swimming hatchlings have been shown to orientate towards light cues (Lorne & Salmon, 2007; Harewood & Horrocks, 2008) and in some cases, wave cues were overridden by light cues (Thums et al., 2013, 2016; Wilson et al., 2018). This effect of artificial light can slow down their in-water dispersal (Witherington & Bjorndal, 1991b; Wilson et al., 2018) or increase their dispersion path, potentially depleting yolk reserves, or even attract hatchlings back to shore (Truscott et al., 2017). In addition to interfering with swimming, artificial light can influence predation rates, with increased predation of hatchlings in areas with significant skyglow (Gyuris, 1994; Pilcher et al., 2000). Since the nearshore area tends to be predator-rich, hatchling survival may depend on them exiting this area rapidly (Gyuris, 1994). Should this be the case, aggregation of predatory fish occurring in artificially lit areas and under artificial structures (Wilson et al., 2019) may further increase predation of hatchlings.

The closest nesting beach that may be exposed to directly visible light and supports notable nesting abundance is Angel Island, 15 km to the north of the development envelope (Table 10-11). Although impacts to hatchling orientation have been recorded at beaches 15 km from LNG facilities (Kamrowski et al., 2014), this scenario included three LNG plants, each with significantly greater sources of light intensity, such as flares, compared to the Proposal. Following implementation of mitigation measures, directly visible light will be minimised and skyglow resulting from the Proposal is not expected to be detectable above existing levels. Therefore, impacts to marine turtle hatchlings from Proposal lighting are not expected.

In summary, the Proposal is not expected to increase the risk of potential significant impacts to marine turtles from artificial light.

10.4.1.3 Behavioural responses to underwater noise

Underwater noise emissions will be generated from pile installation and vessel use. These noise sources will only be present during the construction phase, presenting only a temporary source of potential impact.

Up to six piles will be installed into the bedrock to secure the seawater intake pumps in the pond. The estimated maximum diameter of the piles is 1,050 mm and estimated maximum wall thickness is 20 mm. Drilling methods are proposed over driven/hammering methods due to the requirement to install the piles into bedrock. Drilled piles will minimise noise and vibration associated with the works to both the marine environment and to the community of Dampier.

Furthermore, during piling activities the intake pond's culverts will be plugged disconnecting the pond from the surrounding marine environment, reducing noise propagation beyond the pond. Expert technical advice (Jasco, 2022) has concluded that it is unlikely that noise levels from pile installation within the plugged pond 120 m from the coastline edge will results in significant acoustic energy emitted into shallow water environment around the intake pond. A sound level threshold of 120 dB SPL (sound pressure level) appropriate for marine fauna may, under conservative assumptions, be reached within 11 m of the seawater intake pond wall. It is far more likely that this level may not be exceeded at all from the drilling operations (Jasco, 2022; Appendix K).

- The following mitigation measures will assist in ensuring there are no impacts to marine fauna from drilling noise: Marine Fauna Observers will be deployed when pile driving activities occur to observe for marine fauna within a 100 m exclusion zone around the seawater intake pond, and shutdown operations if marine fauna occur within this exclusion zone.
- Piling will only be undertaken during daylight hours to ensure visibility of the exclusion zone for the Marine Fauna Observer.

- Operations will implement a soft-start style approach, where the drilling increases in speed gradually over the period of a few minutes, to allow nearby fauna to move away.

Given that drilling noise is temporary and it is unlikely that underwater noise will be heard outside of the intake wall, in addition to the mitigation measures above, it is highly unlikely that residual underwater noise impacts will significantly impact marine species.

10.4.1.4 Impacts from impingement and entrainment of marine fauna

Direct loss of marine fauna through impingement (fauna trapped against intake screens by the force of the flowing water) and entrainment (fauna actively drawn into the seawater intake pond) are expected to be minimised via the engineering design of the seawater intake pond. Design of the culverts (which link the ocean to the intake pond), and the intake structure will minimise any potential impacts of impingement and entrainment. An aperture of 150 mm will be used in the screens covering the culverts and the estimated velocity of feedwater through the culverts is low (0.1 – 0.15 m/s). Based on this, impingement of marine fauna larger than 150 mm and adult marine organisms is considered unlikely as they can swim against the passive water intake. Furthermore, it is considered unlikely that hatchlings will congregate in large numbers at the entrance of the culverts based on the distant location of the culverts in relation to known turtle nesting beaches in the Dampier Archipelago (Fossette et al. 2021) and satellite tracking of hawksbill and green turtles (AIMS 2020; DPaW 2021) indicating that Parker Point is not actively used for inter-nesting or foraging activities.

In the unlikely event hatchling turtles are near the culverts, the continuously submerged location of the culvert beneath the sea surface will prevent hatchlings, as passive surface swimmers, from actively swimming into the culverts.

10.4.1.5 Displacement from habitat due to habitat disturbance

Although suitable and marginal habitat within the development envelope for some shorebird species was recorded, records indicate numbers of individuals are low (AECOM, 2021). As described in Section 10.1.5, the species identified in AECOM (2021) are migratory and do not breed in Australia. As a result, shorebirds occurring within the development envelope may forage and/or roost, but no nesting occurs. During construction, disturbance or removal of these suitable or marginal habitats may result in temporary or permanent displacement of a low number of shorebirds.

Impacts are not expected to be significant, considering the small spatial area of the development envelope and the availability of similar, and better quality, habitat on the Burrup Peninsula and Dampier Archipelago.

10.4.2 Indirect impacts

10.4.2.1 Impacts from introduction of non-native invasive marine species

Once introduced, NIMS may prey on local species lacking evolved defences, outcompete indigenous species for food, space or light, and hybridise with local species such that the endemic species is lost. Common NIMS are marine invertebrates which are translocated as larval stages through ballast water or via biofouling. Accordingly, native marine invertebrates are at risk of impacts of competition or predation. These impacts have the potential to escalate to higher trophic levels and result in changes to the natural ecosystem.

However, mitigation measures include that the exchange of ballast water will not occur during vessel operations, which will prevent NIMS from being introduced via ballast water.

10.4.3 Cumulative impacts

There is potential for cumulative impacts to marine fauna from other industrial activity within the vicinity of the Proposal, such as existing Port of Dampier activities.

The Proposal will result in an additive, albeit very small, increase in the spatial extent of the artificial light footprint across the Burrup Peninsula more widely. However, the intensity of artificial light emissions is expected to be insignificant when compared to existing light sources on the Burrup Peninsula. As such, cumulative impacts to marine fauna from multiple light sources are not expected.

Approximately 5 ha of suitable habitat for one or more shorebird species was identified within the development envelope (Table 10-5). Disturbance, both temporary and permanent, to this habitat is not expected to result in significant impacts to shorebirds, considering the small spatial area of the development envelope and the availability of similar, and in many cases better quality, habitat on the Burrup Peninsula and Dampier Archipelago. Therefore, when considered cumulatively with disturbance to similar habitat from other developments, no increase in impact significance of the Proposal to marine fauna is expected.

In summary, when considering impacts cumulatively, the level of impact to marine fauna from the Proposal is not expected to increase and remains insignificant.

10.5 Summary of the significance of residual impacts

This section summarises the significance of residual impacts for marine fauna in accordance with the Statement of Environmental Principles, Factors and Objectives (EPA, 2021b). The connections and interactions between other environmental factors are considered in the holistic impact assessment (Section 14). The remaining matters as outlined in Section 6 of the Statement of Environmental Principles, Factors and Objectives (EPA, 2021b) are considered in Table 10-12.

In summary, Table 10-12 demonstrates that by implementing the mitigation measures outlined in Table 10-10, the Proposal can meet EPA’s objective for marine fauna.

Table 10-12: Assessment of significance for marine fauna

Residual impact	Consideration of key EPA (2021) matters	Significance of residual impact	Recommended conditions and DMA regulation for significant residual impacts
Impacts from vessel strike	**Values, sensitivity and quality of the environment** If land-based options are not viable, one or two marine vessels will be used during refurbishment of the intake pond and installation of the outlet diffuser. If used, the vessels will be small barges that will operate in the shallow waters of the development envelope. These waters do not represent important habitat for protected marine species vulnerable to vessel strike. **Extent** If necessary, one or two small marine vessels will be used and will be confined to the development envelope. A marine fauna observer will be onboard to reduce the likelihood of fauna strike. **Resilience of the environment** The small size of the vessels and low speed decreases the likelihood of vessel strike with marine fauna. Due to the very low numbers of individuals potentially using the area and therefore impacted by vessel strike, marine fauna populations will be highly resilient to any impacts. **Consequence of mitigation hierarchy** The mitigation hierarchy will minimise the potential impact by reducing the likelihood and consequence of a vessel strike. In the unlikely event that fauna is struck, where practicable to do so, injured fauna will be rehabilitated, reducing impact to individuals. **Cumulative effects** Cumulative impacts are not expected given vessel use will be temporary. **Level of confidence in the prediction of residual impacts** The consequence of vessel strikes to marine fauna is well documented in the literature. Further, the relationship between vessel speed and the likelihood of a strike occurring has been demonstrated in several publications. Given the low number of vessels and their slow speeds, the shallow habitats and lack of marine fauna likely in the area, there is a high level of confidence in the prediction of residual impacts.	Due to the low number and speed of vessels within the development envelope, the expected low abundance and presence of fauna and the behavioural responses expected (i.e., localised avoidance), significant impacts from vessel strike are not expected.	No conditions proposed.
Impacts from light emissions	**Values, sensitivity and quality of the environment**	Not considered significant, based on the extent of residual light spill and skyglow compared	No conditions proposed. Management actions proposed in the CEMP and OEMP are

Residual impact	Consideration of key EPA (2021) matters	Significance of residual impact	Recommended conditions and DMA regulation for significant residual impacts
	The Dampier Archipelago provides important habitat for a number of marine fauna species, including marine mammals, marine reptiles fish, seabirds and shorebirds. **Extent** In accordance with the National Light Pollution Guidelines, potential impacts were considered out to 20 km from the development envelope. However, the mitigation measures in place are expected to reduce the extent of light spill and skyglow to the extent that light emissions from the Proposal are not expected to be detectable above existing light levels. **Resilience of the environment** Since the Proposal is not expected to result in light levels above the existing levels on the Burrup Peninsula, the environment will be resilient to potential impacts. Although a low number of individuals may interact with Proposal lighting, marine fauna populations will be highly resilient to any impacts. **Consequence of mitigation hierarchy** The mitigation hierarchy will minimise the potential impact by reducing the extent of light spill and skyglow from the Proposal. Where practicable to do so, injured fauna will be rehabilitated, reducing impact to individuals. **Cumulative effects** The Proposal will result in an additive, albeit negligible, increase in the spatial extent of the artificial light footprint on the Burrup Peninsula. However, the intensity of artificial light emissions is expected to be insignificant when compared to existing light sources on the Burrup Peninsula, and cumulative impacts to marine fauna are not expected. **Level of confidence in the prediction of residual impacts** The potential impacts of light emissions on marine turtles, and habitat use of marine turtles in the Dampier Archipelago (Murujuga), are well reported in the literature, providing high confidence in the prediction of residual impacts. Data regarding the presence of breeding seabirds across the Dampier Archipelago is scarcer. However, Rio Tinto's long-term operations on the Burrup Peninsula include reporting obligations for fauna. Rio Tinto's operational experience provides confidence in the prediction of impacts.	to existing levels, and the distance to significant marine fauna habitat.	considered sufficient to manage this potential impact.

Impacts from underwater noise	**Values, sensitivity and quality of the environment** The Dampier Archipelago provides important habitat for a number of marine fauna species, including marine mammals, marine reptiles fish, seabirds and shorebirds. **Extent** During piling activities, the intake pond's culverts will be plugged disconnecting the pond from the surrounding marine environment, reducing noise propagation beyond the pond. Expert technical advice (Jasco, 2022) has concluded that it is unlikely that noise levels from pile installed on land 120 m from the coastline edge will results in significant acoustic energy emitted into shallow water environment around the intake pond. A sound level threshold of 120 dB SPL appropriate for marine fauna may, under conservative assumptions, be reached within 11 m of the seawater intake pond wall. It is far more likely that this level may not be exceeded at all from the drilling operations. **Resilience of the environment** Potential impacts are restricted to temporary behavioural responses of individuals, such as avoidance. Avoidance is not expected to displace individuals from important habitat. Therefore, marine fauna will be resilient to underwater noise. **Consequence of mitigation hierarchy** The mitigation hierarchy avoids high-intensity impulsive noise from driven piling and minimises underwater noise emissions from propagation beyond the pond, which disconnects the pond from the surrounding marine environment. To further minimise potential impacts, Marine Fauna Observers will be deployed when pile driving activities occur to observe for marine fauna within a 100 m exclusion zone around the seawater intake pond, and shutdown operations if marine fauna occur within this exclusion zone. Operations should implement a soft-start style approach, where the drilling increases in speed gradually over the period of a few minutes, to allow nearby fauna to move away. Piling will only be undertaken during daylight hours to ensure visibility of the exclusion zone for the Marine Fauna Observer. **Cumulative effects** No cumulative impacts were identified. **Level of confidence in the prediction of residual impacts**	Not considered significant, based on impacts being limited to the construction phase, daylight hours, localised and temporary behavioural responses and the lack of important habitat in close proximity for marine fauna.	No conditions proposed. Management actions proposed in the CEMP are considered sufficient to manage this potential impact.

Residual impact	Consideration of key EPA (2021) matters	Significance of residual impact	Recommended conditions and DMA regulation for significant residual impacts
	Recorded noise levels for representative noise sources were used in the prediction of impacts and provides a high level of confidence.		
Impacts from impingement or entrainment of marine fauna	**Values, sensitivity and quality of the environment** The shallow waters around the culverts for the intake pond do not represent important habitat for marine fauna. **Extent** The area in which impingement and entrainment of fauna may occur is limited to the culverts and the seawater intake pond respectively. **Resilience of the environment** No significant impacts are expected and therefore the environment is considered resilient. **Consequence of mitigation hierarchy** The installation of culvert screens will prevent marine fauna larger than 150 mm entering the intake pond. The intake velocity at culverts will be 0.1 - 0.15 m/s, meaning the majority of species will be able to swim against this velocity and will not be vulnerable to impingement. The culverts will be beneath the surface of the water, reducing the likelihood that hatchlings (if present) will swim into the culverts and become entrained in the intake pond. **Cumulative effects** No cumulative impacts were identified and therefore impacts remain insignificant. **Level of confidence in the prediction of residual impacts** The prediction is based on intake velocities determined through engineering design, size of the culverts and the lack of suitable habitat for marine fauna surrounding the culverts.	Hatchling turtles and fish are not expected to be drawn into the intake lagoon due to mitigation measures in place. Therefore, significant impacts are not expected.	No conditions proposed. Management actions proposed in the OEMP are considered sufficient to manage this potential impact.

Residual impact	Consideration of key EPA (2021) matters	Significance of residual impact	Recommended conditions and DMA regulation for significant residual impacts
Impacts from non-native invasive marine species	**Values, sensitivity and quality of the environment** The shallow waters of the development envelope, where non-native invasive species could be introduced, are not considered to provide important habitat for sensitive marine fauna species. **Extent** The area in which non-native invasive species could be introduced is limited to the development envelope. **Resilience of the environment** Significant impacts were not predicted, due to the preventative measure in place, and therefore the environment is considered resilient. **Consequence of mitigation hierarchy** The mitigation hierarchy will avoid introduction of non-native invasive species due to lack of ballast water exchange during vessel operations, and will minimise the likelihood of introduction through implementation of vessel risk assessments. **Cumulative effects** No cumulative impacts were predicted, and the level of significance is unchanged. **Level of confidence in the prediction of residual impacts** The prediction of residual impacts is based on industry experience in the success of measures to prevent introduction of non-native invasive species.	Following implementation of mitigation measures, the risk of non-native invasive species being introduced and establishing in the development envelope is very low and therefore impacts to marine fauna are not considered significant.	No conditions proposed.

Residual impact	Consideration of key EPA (2021) matters	Significance of residual impact	Recommended conditions and DMA regulation for significant residual impacts
Impacts from habitat disturbance	**Values, sensitivity and quality of the environment** While the development envelope provides suitable habitat for marine fauna, habitat for critical behaviours, such as foraging or breeding, are lacking. **Extent** Five hectares of suitable shorebird habitat may be disturbed or lost due to the Proposal. **Resilience of the environment** The disturbed habitat contains communities that are locally common and occur outside the development envelope in larger volumes and better quality. Therefore, the environment is considered resilient. **Consequence of mitigation hierarchy** The mitigation hierarchy avoids disturbance to important or optimal habitat and minimises the area of habitat disturbance. Rehabilitation of shorebird habitat may occur following construction. **Cumulative effects** No cumulative impacts were predicted and therefore the level of significance is unchanged. **Level of confidence in the prediction of residual impacts** A detailed habitat mapping survey was completed and there is therefore a high level of confidence regarding the prediction of impacts.	Impacts are not expected to be significant, considering the small spatial area of the development envelope and the availability of similar, and in many cases better quality, habitat on the Burrup Peninsula and Dampier Archipelago.	No conditions proposed. Management actions proposed in the OEMP are considered sufficient to manage this potential impact.

10.6 Environmental outcomes

Based on the implementation of the mitigation hierarchy and management measures proposed, the Proposal will not have significant residual impacts to marine fauna.

10.6.1 Proposed controls and monitoring

Control measures are outlined in Table 10-10.

10.6.2 Conclusion

Noting the limited area of impact to marine fauna habitat (approximately 5 ha), temporary period for construction (~ 18 months) and current levels of disturbance in the Port waters, as well as the proposed management measures and commitments, the Proponent is of the view that the potential impacts can be managed to acceptable levels. The Proposal is considered unlikely to result in permanent or irreversible impacts to conservation significant marine fauna at a species or population level, and is unlikely to cause a population decline, impact critical ecological functions and breeding cycles, or remove habitat critical to the survival of marine fauna. The Proponent is of the view that the EPA's environmental objectives can be met for this Factor.

11 OTHER ENVIRONMENTAL FACTOR – FLORA AND VEGETATION

EPA's objective for flora and vegetation is *to protect flora and vegetation so that biological diversity and ecological integrity are maintained*

The relevant policy and guidance for flora and vegetation is described in Appendix E.

11.1 Receiving environment

11.1.1 Studies and information sources

Table 11-1 lists the relevant studies and publications for flora and vegetation. These have helped inform the description of the existing environment and assessment of impacts for the Proposal.

Table 11-1: Relevant studies used to inform the assessment of flora and vegetation

Author	Study (Date)	Technical Guidance requirements (EPA, 2016e)
AECOM	Flora and fauna assessment: Dampier Seawater Desalination Plant (AECOM, 2021; Appendix L) Dampier Salt Native Vegetation Clearing Permit Report (Biota, 2011) Dampier Resilience Native Vegetation Clearing Permit Support Report (Biota, 2018) Botanical Survey of the Dampier Power Station and Sub-station and 33kV Network Connection at 7 Mile (Rio Tinto, 2011)	A detailed flora and vegetation assessment was undertaken using methods outlined in the Flora Survey Technical Guide (EPA, 2016e). Vegetation condition was determined using the scale adapted from Trudgen (1988) as recommended in the Flora Survey Technical Guide (EPA, 2016e). The Phase I survey coincided with the flowering period of numerous annual and perennial species. The Phase II survey coincided with the typical 'ideal survey season' in accordance with EPA (2016e) Flora Survey Technical Guide.

Flora and fauna assessment: Dampier Seawater Desalination Plant (AECOM, 2021; Appendix L)

The flora and fauna assessment undertaken by AECOM meets the requirements of *Technical guidance – Flora and vegetation surveys for EIA* (EPA, 2016a). The study consisted of both desktop and field surveys and was led by a botanist with 14 years' experience. The methodology for this study is detailed below.

During desktop surveys, a search was undertaken of a number of publicly accessible government databases using an area of up to 20 km around the development envelope. These searches specifically included NatureMap, DBCA Threatened Species and Communities database including Threatened and Priority Flora and communities, WA Herbarium records, Atlas of Living Australia and the EPBC Act PMST report. Previous survey reports were also consulted to provide regional context. Based on the information from previous survey reports and database search results, a table was compiled of all flora species that are 'likely to occur', 'may occur' or 'unlikely to occur' in the development envelope.

Field surveys comprised a two-phase reconnaissance flora and vegetation assessment, with targeted surveys using methods outlined in *Technical guidance – Flora and vegetation surveys for EIA* (EPA, 2016a). This survey took place in two phases:

- Phase I: between 6 and 11 August 2020
- Phase II: between 12 and 15 April 2021.

This survey methodology meets the Technical Guidance (EPA, 2016a) based on the small scale of the Proposal and the highly disturbed nature of the development envelope (existing 75% cleared/highly disturbed). The type of survey is also appropriate for the nature of the potential impacts (a large proportion is linear infrastructure/water pipelines).

Field surveys focused on 31 relevè points selected from satellite imagery of areas determined to be most representative of the vegetation communities. Data on the presence of plant species, their cover and abundance, structural composition of vegetation, physical environment and presence/absence of disturbance was collected from the relevès. Vegetation communities were described based on species composition and landform based on the Association Level V in accordance with the National Vegetation Information System Framework. Vegetation condition was determined using the scale adapted from Trudgen (1988) as recommended by *Technical guidance – Flora and vegetation surveys for EIA* (EPA, 2016a).

Targeted flora searches were also undertaken for the conservation-significant flora species that were identified during desktop studies as being likely to occur within the development envelope. Linear transects were walked approximately 20 m apart and if conservation-significant flora were observed, data was collected in accordance with the DBCA Threatened and Priority flora collection forms.

11.1.2 Regional context

The largest regional vegetation classification scheme recognised by EPA is the Interim Biogeographical Region of Australia (IBRA), which is relevant to the development envelope as it provides regional context to the receiving environment. The development envelope is located on the coastal edge of the IBRA Pilbara bioregion and Roebourne sub-region (Figure 11-1), which is categorised by vast coastal plains and inland mountain ranges with cliffs and deep gorges (DoEE, 2012). Regionally, the area consists of coastal and sub-coastal plains with grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia stellaticeps* or *A. pyrifolia* and *A. inaequilatera* (DoEE, 2012). The uplands of the region are dominated by *Triodia* grasslands, and the ephemeral drainage lines are fringed with *Eucalyptus victrix* or *Corymbia hamersleyana* woodlands (DoEE, 2012). Marine alluvial flats and river deltas consist of Samphire and mangal communities. Regionally, rare features of the IBRA Pilbara bioregion include the numerous offshore islands, the Burrup Peninsula and the Cane River swamp community (DoEE, 2012).

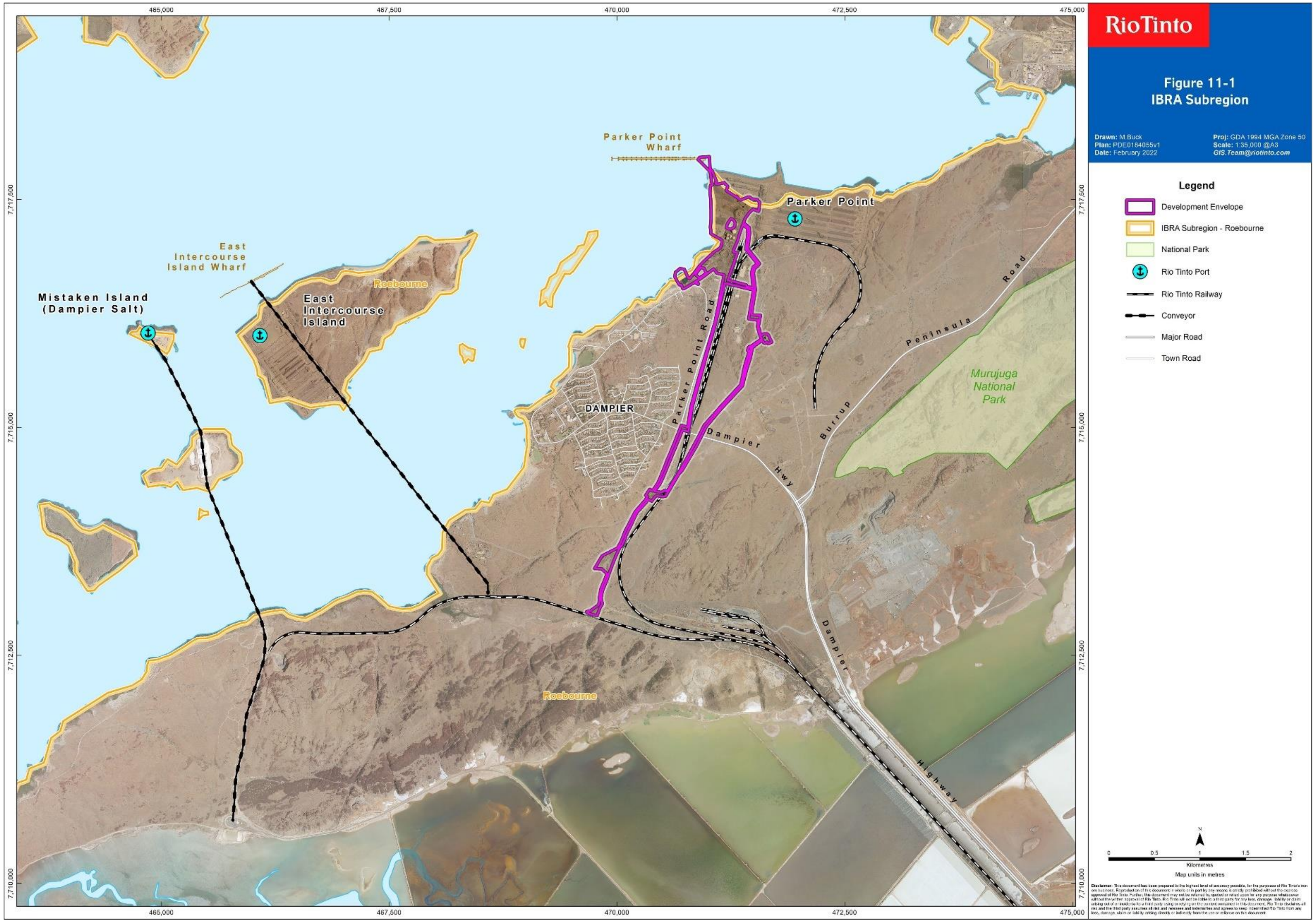


Figure 11-1: Interim biogeographical region of Australia

To understand the vegetation expected at a regional level, Beard (1975) mapping was used, which details the current extent of remnant vegetation remaining in WA when compared with pre-European extents. According to Beard (1975), the development envelope is located in vegetation association ‘117’, which is the Abydos Plain – Roebourne. Vegetation association 117 is characterised by hummock grassland *Triodia* spp., of which there is currently 94.43% of this vegetation association in WA and 99.3% remaining in the Pilbara IBRA region (Govt. of WA 2018).

Other regionally significant features near the development envelope include the Murujuga National Park (approximately 1.5 km from the development envelope, at the closest point) and the Dampier Archipelago (including the Burrup Peninsula) National Heritage Place (intercepted by the development envelope – 0.9 ha). These areas have additional protection status over the flora and vegetation. Furthermore, a portion of the Murujuga National Park is also identified as an environmentally sensitive area as declared under section 51B of the EP Act (Figure 11-2). The environmentally sensitive area is approximately 15 km from the development envelope at its closest point.

From a geological perspective, the development envelope is located within the Fortescue Province, which is described at a regional level as hills and ranges (with stony plains and some alluvial plains and sandplains) on the volcanic granitic and sedimentary rocks of the Pilbara Craton. Soils in this area are stony with red loamy earths and red shallow loams (and some red/brown non-cracking clays, red deep sandy duplexes and red deep sands) (Tille, 2006, within AECOM, 2020). Regional land system and soil mapping also identifies the development envelope as being within the Granitic System (286Gr) (Figure 11-3), which is characterised by rugged granitic hills and hill tracts of granitic rocks, with pockets of shallow, gritty surfaced acidic soils (van Vreeswyk et al., 2004). Flora and fauna surveys confirmed the topography of the development envelope is typical of the Granitic System, with elevations up to 100 m.

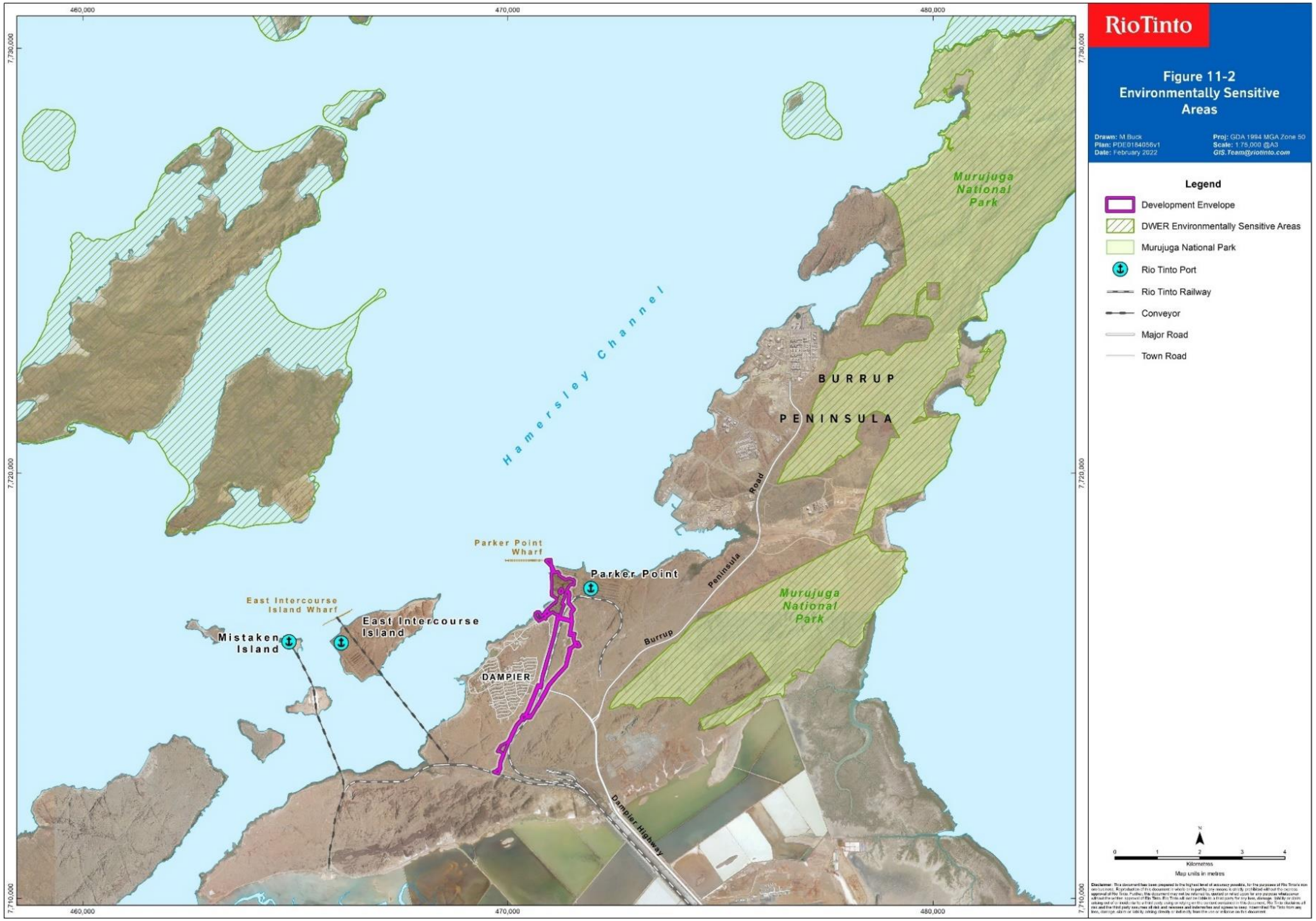


Figure 11-2: Environmentally sensitive areas

Figure 11-3: Land systems and soils mapping

11.1.3 Flora

During desktop assessments, publicly available databases were searched to determine whether listed flora species were likely to occur in, or near, the development envelope.

In addition to the database searches listed in section 11.1.1, the Proponent's existing information on Threatened and Priority flora in and near the development envelope was provided and previous survey reports were reviewed for regional context. All flora that was identified in the database and existing information searches were then assessed in terms of how likely they were to be found within the development envelope. The likelihood criteria that were applied is shown in Table 11-2.

Table 11-2: Categories of likelihood of occurrence for flora species

Likelihood category	Definition
Likely to occur	Habitat is present in the survey area and the species has been recorded in proximity to the survey area
May occur	Habitat may be present and/or the species has been recorded in proximity to the survey area
Unlikely to occur	No suitable habitat is present and the species has not been recorded in proximity to the survey area

Based on the results of the desktop assessment, no Threatened flora were identified as occurring and 22 Priority flora were identified as potentially occurring. Of these 22 Priority flora species, three species were identified as 'likely to occur' and one species was identified as 'may occur'. These are presented in Table 11-3. The remaining 18 species were assessed as being 'unlikely to occur' and are not presented in Table 11-3.

Table 11-3: Conservation-significant flora identified from database searches and their likelihood of occurrence

Species	WA	Habitat[1]	Count date	Likelihood of occurrence
Rhynchosia bungarensis	P4	Associated with rocky slopes, rockpiles, rock pools and gullies.	2010	Likely to occur, numerous records nearby, suitable habitat.
Rostellularia adscendens* var. *latifolia	P3	Ironstone soils. Near creeks, rocky hills.	2007	May occur, suitable habitat, one record nearby from previous survey.
Terminalia supranitifolia	P3	Rocky outcrops, slopes, piles. Among basalt rocks and on sand.	2003	Likely to occur, numerous records nearby associated with rocky outcrops.
Vigna triodiophila	P3	Scree and rockpiles.	2009	Likely to occur, records nearby, suitable habitat.
1. Habitat derived from Pilbara Flora (Rio Tinto and DPAW 2015) and WAH (1998) Florabase. **2. Location provided by Rio Tinto.**				

Field surveys included targeted searches for the three conservation-significant flora species likely to occur within the development envelope. No flora listed under the under the EPBC Act, or gazetted as Threatened (formerly Declared Rare Flora (DRF)) under the Western *Australian Biodiversity Conservation Act 2016* (BC Act) were recorded or are expected to occur within the Proposal area.

One listed Priority 3 species (*Eragrostis surreyana*) was recorded during the AECOM 2021 survey within the development envelopment and surrounding environment associated with the Disturbed – Artificial Ephemeral Wetland vegetation unit (Table 11-4), (Figure 11-4). The population of *E. surreyana* found during the survey comprised approximately 885 individuals, of which 751 were recorded to occur within the development envelope, within the area delineated for the borrow pits (Figure 11-4). The local and regional distribution of this species is discussed in the following section.

Results of the targeted field surveys specific to the four targeted species and one recorded species are detailed in Table 11-4.

Table 11-4: Targeted flora survey results

Targeted species	Conservation status	Likelihood based on desktop assessment	Field survey findings	Likelihood based on field survey results
Rostellularia adscendens* var. *latifolia	P3	Likely, records nearby. Suitable habitat.	Species not recorded during targeted flora survey.	Unlikely to occur.
Terminalia supranitifolia	P3	Likely, numerous records nearby associated with rocky outcrops.	Species not recorded during targeted flora survey.	Unlikely to occur.
***Themeda* sp. Hamersley Station (M.E. Trudgen 11431)**	P3	Likely, records nearby. Suitable habitat.	Habitat for this species was not identified during targeted flora survey.	Unlikely to occur.
Vigna triodiophila	P3	Likely, records nearby. Suitable habitat.	Species not recorded during targeted flora survey. However, species would not have been in flower at the time of the survey.	May occur around rockpiles.
Eragrostis surreyana	P3	Unlikely, no suitable habitat.	Species recorded within the Disturbed – Artificial Ephemeral Wetland vegetation association.	Does occur.

During flora surveys, AECOM also identified a total of 124 native species from 88 genera and 39 families recorded within the development envelope (AECOM, 2021). The best-represented family was Fabaceae (30 native species), followed by Poaceae (12 native species) and Malvaceae (11 native species). The diversity reflects the various landforms encountered during the survey, including wetland/creek systems, shoreline, grasslands and rocky slopes. No vegetation communities listed as Threatened Ecological Communities under the EPBC Act or BC Act were recorded during the field survey.

11.1.3.1 Local and Regional distribution of *Eragrostis surreyana*

Eragrostis surreyana is listed as a P3 (Priority 3 – Poorly Known Taxa) species on the Declared Rare and Priority Flora List. P3 species are taxa that are known from several populations, some of which are not thought to be under immediate threat. They are candidates for declaration as rare flora but are in need of further survey work to further characterise their regional distribution.

E.surreyana is usually found in seasonally wet, shallow, grey alluvial soils over rock, although some records have been from deeper soils in a seasonally wet creek line. Most collections have been made from streams, with one collection from a seasonal seepage area on a gentle slope near the base of the Chichester escarpment.

The Rio Tinto database has 247 records representing 14,207 individuals across the entire Pilbara bioregion. *E. surreyana* is restricted to seasonal wetland areas in the Pilbara Bioregion of Western Australia. It has likely suffered loss of populations through habitat degradation caused by sheep and cattle grazing (Shepherd & Trudgen, 2011).

In 2011, Shepherd & Trudgen reported that although the species was quite widespread, at the time in was only known from five locations in the Pilbara; four populations being from the Chichester Range including Mt Montagu, south of Pannawonica; and one population on the Burrup Peninsula located within the Murujuga National Park (copied from Shepherd & Trudgen 2011).

Survey work undertaken by AECOM in 2021 of the Proposal's study area found an additional population representing 885 individuals, increasing the known Burrup Peninsula's local population to a total of 988. Within the development envelope, 14 records were found representing 751 individuals, which represents approximately 5% of Pilbara bioregion records or 76% of records in the immediate area (within 100 km). This population was found to be associated with the Disturbed – Artificial Ephemeral Wetland vegetation association (Table 11-4), the condition of which was classified as degraded (Table 11-7). Given the species was found in abundance throughout these disturbed areas, it is highly likely that it will be found in suitable ephemeral wetland habitats known to occur in the surrounding environment.

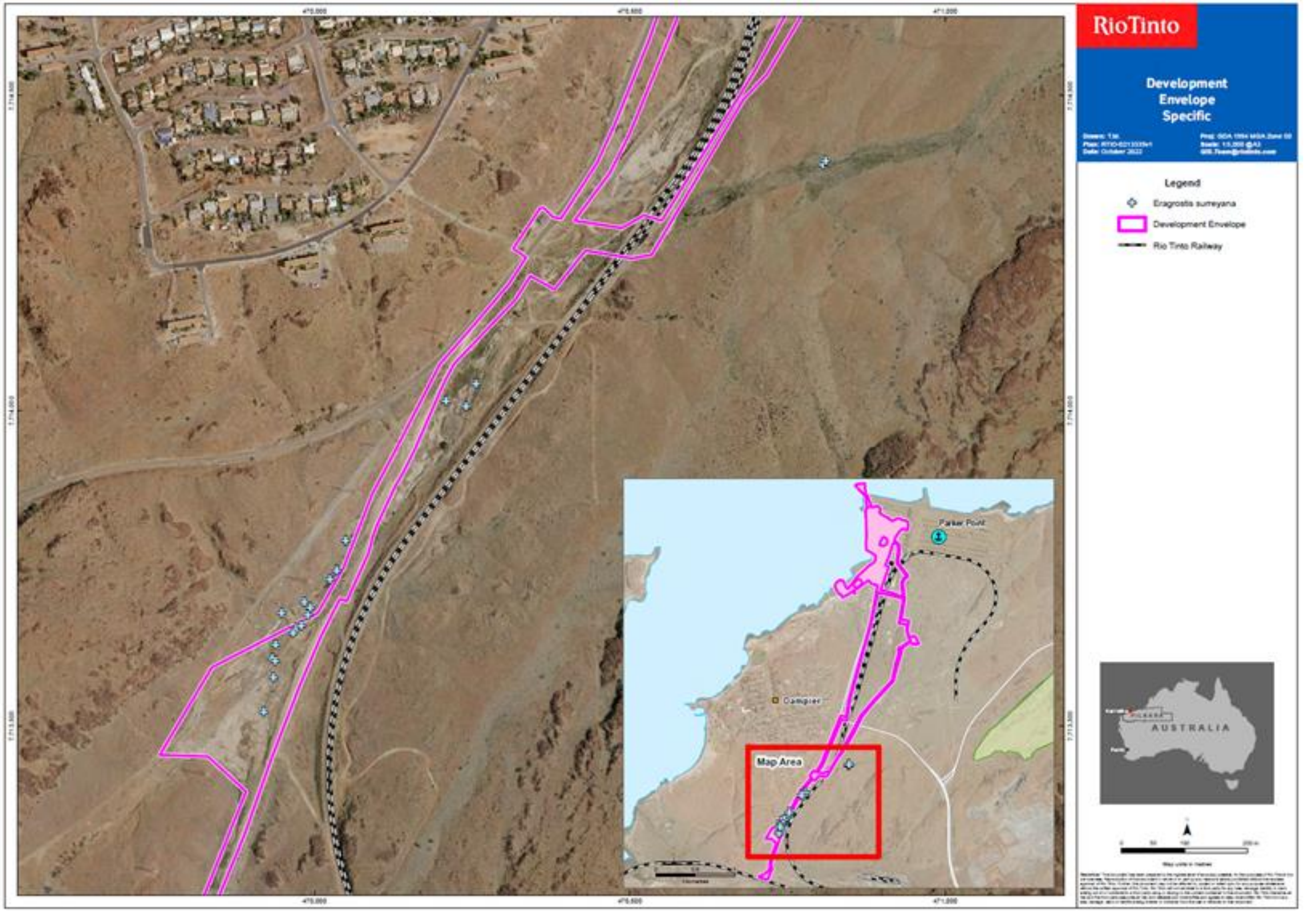


Figure 11-4: Locations of *E. Surreyana* in the study area

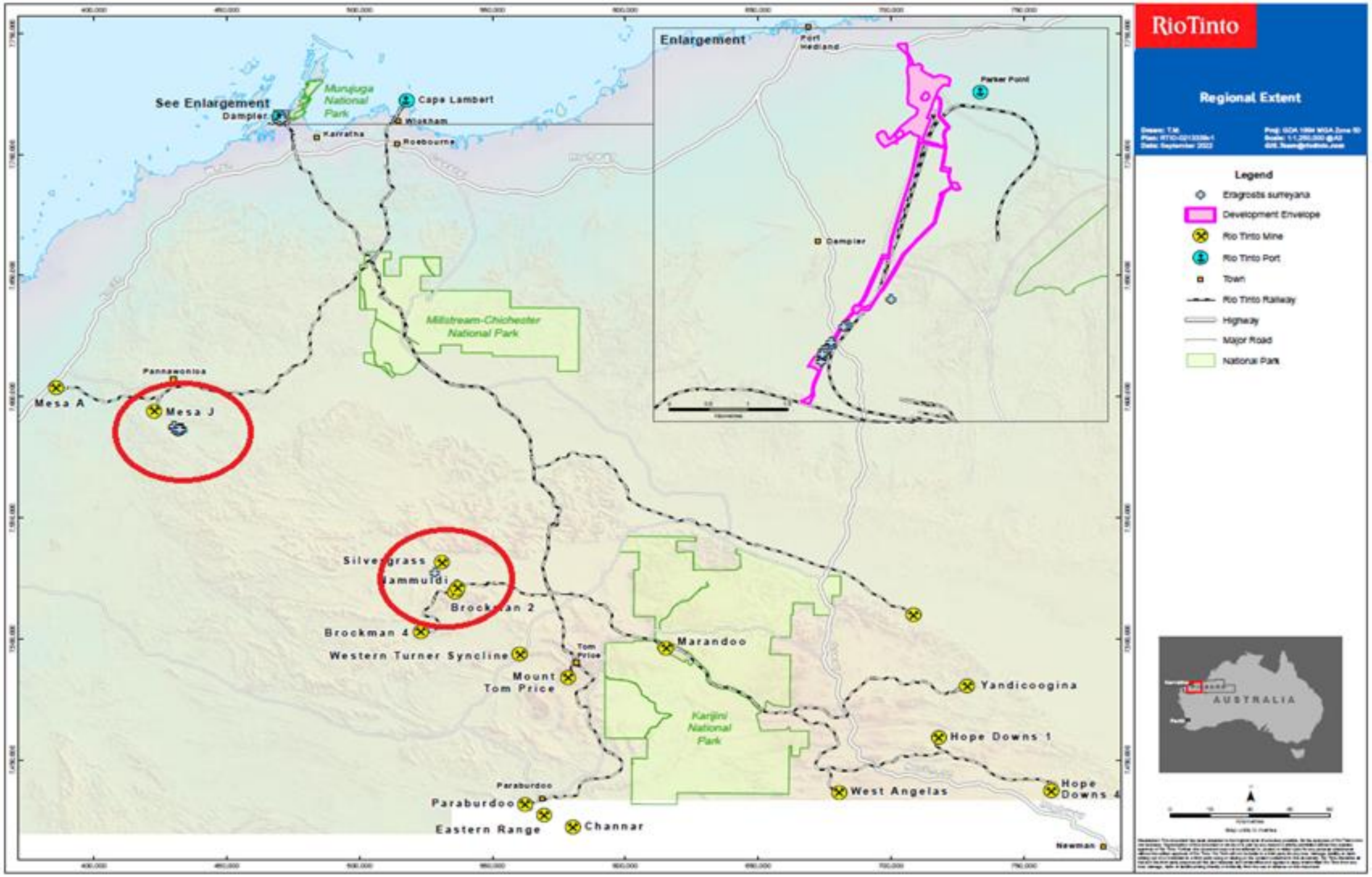


Figure 11-5: Regional locations of *E. Surreyana*

11.1.4 Vegetation

During desktop assessments, publicly available databases (listed in section 11.1.1) were searched to determine whether listed vegetation communities (Threatened Ecological Communities [TECs] and Priority Ecological Communities [PECs]) were likely to occur within 20km of the development envelope.

Previous survey reports were also reviewed for regional context. All TECs and PECs that were identified in these database and existing information searches were then assessed in terms of how likely they were to be found within the development envelope. The likelihood criteria applied are shown in Table 11-5.

Table 11-5: Categories of likelihood of occurrence for ecological communities (AECOM, 2021)

Likelihood category	Definition
Likely to occur	Known occurrences of the community in proximity to the survey area. Vegetation looks the same within the known occurrence and survey area based on aerial imagery. Geographic location is similar to the survey area.
May occur	Known occurrence of the community in the local area, and/or vegetation looks the same within known occurrence and survey area is based on aerial imagery. Geographic location is similar to the survey area.
Unlikely to occur	Known occurrence of the community in proximity to the survey area; however, geographic location does not occur in survey area.

No TECs and five PECs were identified as occurring within 20km of the development envelope based on database searches. Table 11-6 lists the PECs and their likelihood of occurring in the development envelope.

Table 11-6: Priority ecological communities identified in the desktop assessment

Community name and description	Conservation status		Distance of recorded community from development envelope	Likelihood of occurrence in development envelope
	EPBC Act	WA		
Roebourne Plains coastal grasslands with gilgai micro-relief on deep cracking clays	–	P1	7.3 km	Unlikely
Horseflat Land System	–	P3	8.8 km	Unlikely
Burrup Peninsula rock pile communities	–	P1	3.5 km	May occur
Coastal dune native tussock grassland dominated by *Whiteochloa airoides*	–	P3	17.5 km	Unlikely
Burrup Peninsula rock pool communities	–	P1	6.8 km	Unlikely

Field surveys were conducted to identify vegetation communities within the development envelope and to confirm whether the listed PECs that were identified during desktop surveys were present. Vegetation communities have been described and mapped based on changes in dominant species composition and landform, and descriptions have also been based on the Association Level V in accordance with the Vegetation Information System Framework (DAWE, 2020). Delineation of vegetation communities was supported by analysing floristic data collected within relevès.

Plant communities were classified based on a species-by-site matrix of crown cover values. From the options available in the multivariate analysis package PC-ORD (MJM Software Design, 2011 as referenced in AECOM, 2021), Ward's method of hierarchical grouping was chosen using the relative Euclidian distance measure (AECOM, 2021, and references therein). This is one of two methods recommended by McCune and Grade (2002) as a way to avoid space distortion and changing among samples (AECOM, 2021). Analysis considered all floristic data, with the Braun-Blanquet scale applied to foliage cover (AECOM, 2021).

No PECs or TECs were recorded during field surveys. The development envelope was found to 'skirt the edge' of several rockpiles that have similar characteristics to the Burrup Peninsula rock pile PEC. This PEC is described as pockets of vegetation in rock piles, rock pockets and outcrops and represents fire and evolutionary refugia with high habitat diversity for plants (AECOM, 2021, and references therein). The development envelope follows existing tracks and pipelines that avoid all significant rock piles. The rockpiles in the development envelope do not represent this PEC and it has not been recorded previously in the survey area (Biota, 2018; Rio Tinto, 2011). Known occurrence of this PEC is 3.5 km from the development envelope. Because this PEC is not considered to be within the development envelope, there is no direct impact from the Proposal.

Eight vegetation communities were identified within the development envelope during field surveys and are described in Table 11-7 and mapped in Figure 11-6. The total area of native vegetation within the development envelope is 13.5 ha. The majority of the development envelope (43.2 ha or 75%) is already cleared or completely degraded land. The remainder of the development envelope is open water (0.8 ha).

Table 11-7: Vegetation communities identified during field assessments

Vegetation description	Extent within development envelope	Species richness	Vegetation condition
Flowlines/tidal			
EcScCc **Minor flowline** ***Eucalyptus camaldulensis* and *Melaleuca lasiandra* low woodland over *Sesbania cannabina, Solanum horridum* and *Adriana tomentosa* var. *tomentosa* mid open shrubland over **Cenchrus ciliaris* low open tussock grassland.**	0.7 ha	44 native species 1 weed species	Good
GpTzTa **Minor flowline** ***Grevillea pyramidalis* and *Terminalia canescens* low isolated trees over *Trichodesma zeylanicum* var. *zeylanicum, Pluchea rubelliflora* and *Streptoglossa decurrens* tall herbland over *Triodia angusta* and **Cenchrus ciliaris* tall mixed hummock and tussock grassland.**	0 ha Does not occur within development envelope	22 native species 1 weed species	Good
FvTdlc **Tidal/shoreline** ***Flueggea virosa* subsp. *melanthesoides, Rhyizophora stylosa* and *Avicennia marina* scattered mangrove patches with *Typha domingensis, Cyperus vaginatus* and *Spinifex longifolius* low scattered sedges with *Ipomoea costata* and **Passiflora foetida* scattered climbers.** **Recorded along the mid to upper levels of shoreline where plants occurred sporadically. Low levels of the shoreline were devoid of vegetation.**	0.5 ha	23 native species 3 weed species	Good

Vegetation description	Extent within development envelope	Species richness	Vegetation condition
PaTiEo **Tidal flats** ***Pittosporum phillyreoides* and *Acacia coriacea* scattered tall trees over *Tecticornia indica, Enchylaena tomentosa* and *Acacia ampliceps* low open shrubland over *Eriachne obtusa* and **Cenchrus ciliaris* low open tussock grassland.** **Associated with tidal flats on clay soils.**	0 ha Does not occur within development envelope	9 native species 1 weed species	Good
Hummock grasslands			
AbEtTa **Hummock grassland** ***Acacia bivenosa, Salsola australis* and *Corchorus walcottii* mid to low open shrubland over *Euphorbia tannensis* subsp. *eremophila, Euphorbia australis* and *Tribulus hirsutus* low open herbland over *Triodia angusta* and *Triodia epactia* tall hummock grassland.** **Recorded on flat clay with some rocks on surface.**	0 ha Does not occur within development envelope	50 native species 1 weed species	Good
SdSfTe **Hummock grassland** ***Solanum diversifolium, Indigofera monophyla* and *Acacia synchronicia* mid to low open shrubland with *Swainsona formosa, Boerhavia coccinea* and *Euphorbia australis* mid to low open herbland over *Triodia epactia* hummock grassland.** **Recorded on skeletal soils often downslope from scree slopes.**	2.8 ha	32 native species 2 weed species	Good to very good
ToAlTe **Hummock grassland** ***Trachymene oleracea* subsp. *oleracea, Trichodesma zeylanicum* var. *zeylanicum* and *Swainsona formosa* mid to tall herbland with *Abutilon lepidum, Crotalaria novae-hollandiae* and *Senna notabilis* low shrubland over *Triodia epactia* tall hummock grassland.** **Recorded on scree slopes with occasional *Terminalia canescens* growing from rockpiles.**	5.0 ha	73 native species 3 weed species	Very good
Disturbed – significantly altered			
Rocky shore **Shoreline comprised of partially human-made, partially natural rocks, boulders and sand.**	0.01 ha	NA	NA
AaEgPr **Disturbed – artificial ephemeral wetland** **These artificial wetlands are formed from old borrow pits associated with the construction of nearby rail/road infrastructure.** ***Acacia ampliceps* and *Sesbania cannabina* medium open shrubland over *Eleocharis geniculate, Schoneus falcatus* and *Cyperus vaginatus* low open sedgeland over *Pluchea rubelliflora, Samolus repens* and *Stemodia grossa* low open herbland.** **Represents artificial ephemeral wetlands. Wetter areas include *Typha domingensis.***	4.5 ha	37 native species 6 weed species	Degraded
Total extent within development envelope	13.5		

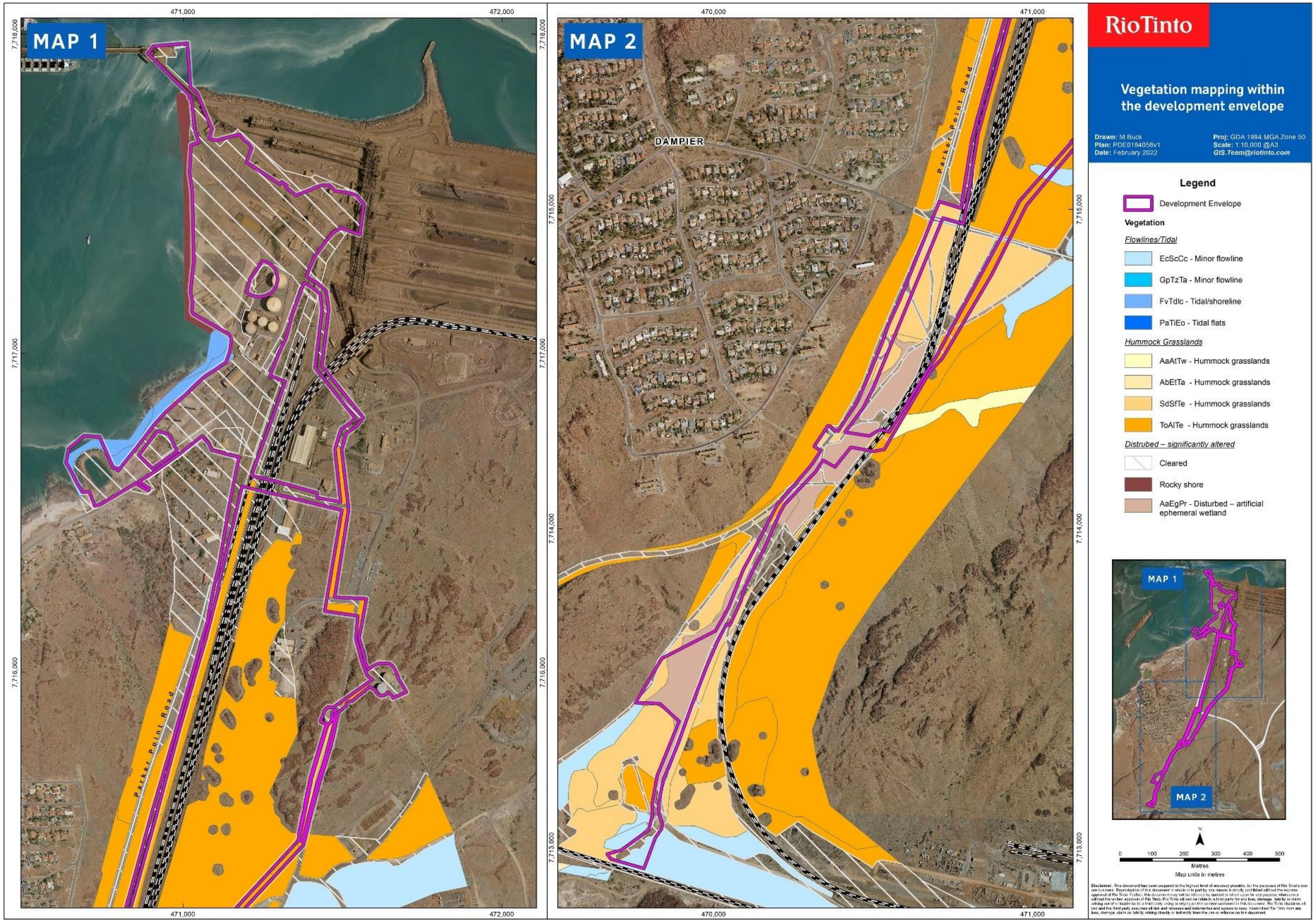


Figure 11-6: Vegetation mapping within the development envelope

During field surveys the condition of vegetation was identified and defined using the scale adapted from Trudgen (1988) as recommended in the *Technical guidance – Terrestrial flora and vegetation surveys for environmental impact assessment* (EPA, 2016e) (Table 11-8). The condition of vegetation within the development envelope is outlined in

Table 11-9 and mapped in Figure 11-7. The majority of the 13.5 ha of native vegetation within the development envelope is in Poor to Degraded condition (10.9 ha or 81%).

Table 11-8: Bushland condition ratings used to assess vegetation condition (Trudgen, 1988)

Descriptor	Eremaean and Northern Botanical Provinces
Excellent	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Very good	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good	Most obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
Degraded	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
Completely degraded	Areas that are completely or almost completely without native species in the structure of their vegetation, i.e., areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

Table 11-9: Overall vegetation condition within the development envelope

Condition rating	Extent	Portion of total development envelope
Very good	0.06 ha	0.1%
Good	2.48 ha	4.3%
Poor	6.44 ha	11.2%
Degraded	4.53 ha	7.9%
Completely degraded (cleared)[10]	43.2 ha	75.2%
Open water	*0.74 ha*	*1.3%*

[10] This category includes the area of reclaimed land

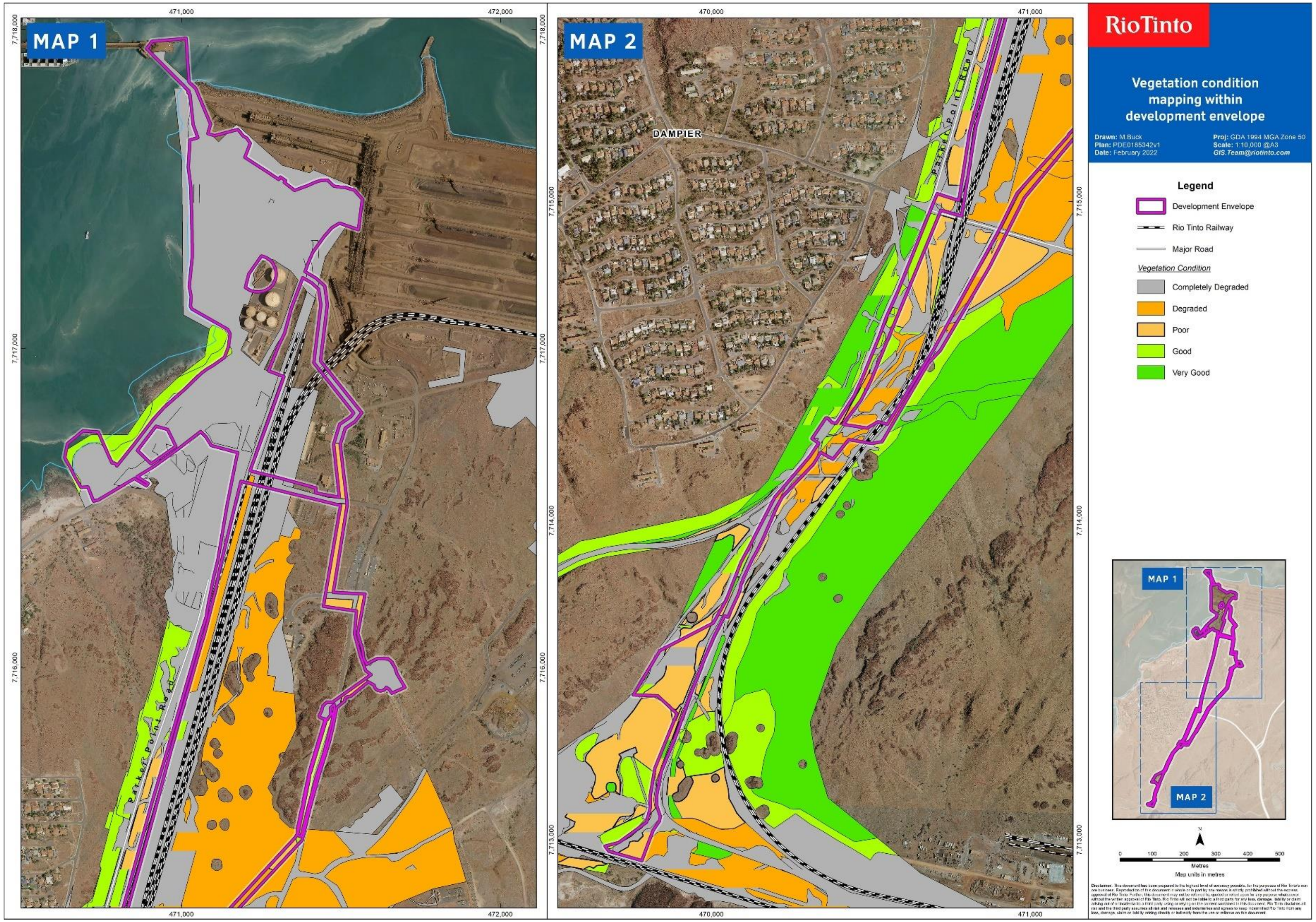


Figure 11-7: Vegetation condition mapping within development envelope

11.1.5 Introduced flora and weeds

During targeted flora surveys, six weed species were recorded, all of which are considered common in the Pilbara region. The most common weed was **Cenchrus ciliaris* (buffel grass) (AECOM, 2021) and two weed species were recorded only in Phase II surveys including **Stylosanthes hamata*, which was recorded along roadsides, and **Flaveria trinervia*, which was recorded in the Disturbed – Artificial Ephemeral Wetland community.

None of the weeds that were recorded are listed as Declared Pests under the *Biosecurity and Agriculture Management Act 2007*, or are of National Significance (AECOM, 2021).

11.1.6 Acid sulfate soils

The development envelope has been assessed to understand the likely presence of acid sulfate soils. A desktop assessment for acid sulfate soils was completed using the Acid Sulfate Soils Risk Maps published by DWER. Two areas of the development envelope are in areas where there is a low to moderate risk of acid sulfate soils occurring (Figure 11-8). The largest area sits below the rockwall of the existing intake pond and is not expected to be disturbed.

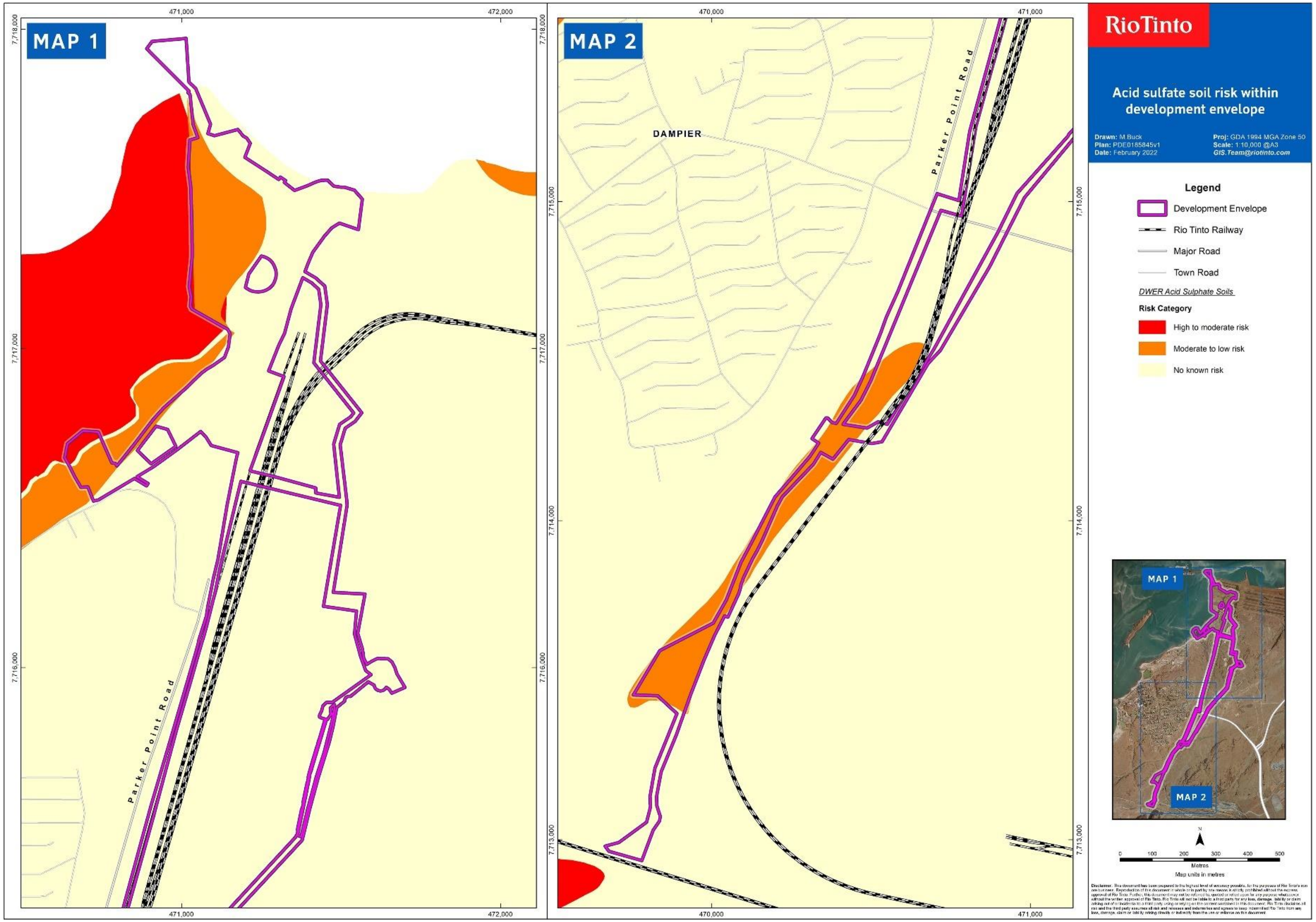


Figure 11-8: Acid sulfate soil risk within development envelope

11.2 Potential environmental impacts

Direct and indirect impacts to flora and vegetation from construction, commissioning and operation of the Proposal are outlined in this section. A number of potential impacts have been mitigated through the Proposal development and engineering design process (Section 2.4).

11.2.1 Direct impacts

Potential impacts of the Proposal to flora and vegetation during construction have been identified in Table 11-10. There are no potential direct impacts to flora and vegetation during commissioning or operation.

Table 11-10: Potential direct environmental impacts

Potential impacts	Proposal Phase	Activities with potential to have impact
Direct reduction and degradation of vegetation from clearing within the development envelope during construction	Clearing and earthworks during construction	• Clearing of 13.5 ha of native vegetation within a total development envelope of 57.5 ha. Of the native vegetation 10.97 ha is in poor to degraded condition (81%) and 2.54 ha is vegetation in good to very good condition (19%).
Direct loss of significant flora species as a result of clearing (*E. surreyana*)	Clearing and earthworks during construction	• Clearing and ground disturbance for the excavation of borrow material.

11.2.2 Indirect impacts

Potential indirect impacts of the Proposal to flora and vegetation during construction, commissioning and operations have been identified in Table 11-11.

Table 11-11: Potential indirect environmental impacts

Potential impacts	Construction element	Activities with potential to have impact
Reduction and degradation of vegetation	Movement of plant and equipment during construction	• Movement of plant and equipment into the development envelope from other locations could transfer weed material, increase weed abundance and indirectly impact local flora. • During construction dust may be generated above natural, background levels and this could deposit on vegetation.
	Altered fire regimes during construction and operation	• Activities associated with construction and operation could create a spark and have the potential to increase loss of native vegetation and/ or flora due to fire impacts (e.g., welding, static ignition from vehicle).

11.2.3 Cumulative impacts

There are not expected to be significant cumulative impacts from the Proposal on the basis the development envelope has been located within an area that has been largely previously disturbed, with 47.7 ha (83%) in cleared or degraded condition. Only 13.5ha (23%) of the development envelope is covered by native vegetation with 2.5 ha (4%) of the development envelope classed as in very good or good condition. The vegetation within the development does not provide significant ecological linkages to the surrounding areas.

No vegetation clearing will occur outside the development envelope, and any indirect impacts that may occur outside the development envelope will be limited due to the highly disturbed and industrial nature of the surrounding area.

11.3 Mitigation

This section describes the measures that have been applied to the potential impacts to mitigate the risks of significant residual impacts. To develop these mitigation measures, the mitigation hierarchy of ‘avoid, minimise and rehabilitate’ has been applied, with a focus on avoiding impacts where possible.

For this Proposal, the implementation of mitigation measures significantly reduces impacts to the environment and enables the Proposal to meet EPA’s objective for flora and vegetation.

Table 11-12 sets out the technically feasible mitigation measures that have been applied to each potential impact and arranges those mitigation measures by where they sit within the mitigation hierarchy.

Table 11-12: Flora and vegetation mitigation measures

Potential impact	Applicable proposal phases	Mitigation method
EPA objective: To protect flora and vegetation so biological diversity and ecological integrity is maintained		
Direct reduction and degradation of vegetation from clearing within the development envelope during construction	Construction	**Avoid** To avoid impacts, the development envelope has been located on highly disturbed, reclaimed land within an established industrial area. The design of the development envelope has specifically avoided areas of higher environmental value within the development envelope, such as higher quality vegetation, and areas that are already cleared have been prioritised for use. **Minimise** Clearing of vegetation has been minimised through the design process (up to 13.5 ha). Ground disturbance and clearing will be undertaken in accordance with the Rio Tinto Projects – Iron Ore: Land Clearing and Disturbance Procedure. Land clearing will be undertaken through a permitted process that requires verification from the Disturbance Permit Coordinator before granting authorisation to clear. Once clearing is completed, cleared areas will be inspected and verified, with all cleared areas tracked on the Land Clearing Register. **Rehabilitate** All areas that have been cleared for construction and commissioning purposes and which are not required for operations will be rehabilitated as soon as practicable after construction. Topsoil will be managed through the Soil Resource Work Practice so as to preserve the biotic and physical characteristics of topsoil resources and aid the success of rehabilitation. Rehabilitation criteria will be established to include targets that ensure landforms are stable, and that biodiversity is consistent with agreed end land uses.
Direct loss of significant flora species as a result of clearing (*E. surreyana*)	Construction	**Avoid** The Proponent proposes to design the borrow pit footprint to avoid and minimise, where possible, records of *E. surreyana* found within the development envelope. The proponent has avoided 24% of the known local population of *E. surreyana*. Given the degraded condition of the artificial wetland habitat that the species was found it, it is highly probable that there are more individuals in the surrounding areas that are not subject to disturbance. The proponent is committed to doing further targeted surveys in suitable seasonally wet habitats to ascertain the range of this species in the surrounds. For optimal results, surveys may need to be conducted in post-wet conditions. **Minimise** Clearing of vegetation has been minimised through the design process. Up to 4.5 ha of disturbed – artificial wetland habitat will be disturbed during construction. Ground disturbance and clearing will be undertaken in accordance with the Rio Tinto Projects – Iron Ore: Land Clearing and Disturbance Procedure. Land clearing will be undertaken through a permitted process that requires verification from the Disturbance Permit Coordinator before granting authorisation to clear. Once clearing is completed, cleared areas will be inspected and verified, with all cleared areas tracked on the Land Clearing Register.

Potential impact	Applicable proposal phases	Mitigation method
		All construction activities will be managed through the Construction EMP which has been prepared for the project. **Rehabilitate** All areas that have been cleared for construction and commissioning purposes and which are not required for operations will be rehabilitated as soon as practicable after construction. Topsoil will be managed through the Soil Resource Work Practice so as to preserve the biotic and physical characteristics of topsoil resources and aid the success of rehabilitation. Rehabilitation criteria will be established to include targets that ensure landforms are stable, and that biodiversity is consistent with agreed end land uses.
Indirect impact resulting in the reduction and degradation of vegetation	Construction Commissioning Operations	**Avoid** Interaction with potential acid sulfate soils will be avoided. There will be no excavations in excess of 100 m^3 of soil or dewatering and/or drainage works within areas that have been identified by DWER as having a risk of potential acid sulfate soils. If excavation of more than 100 m^3 is required, appropriate consultation with DWER will be undertaken and the risk will be assessed and managed. **Minimise** All spark-generating activities will be managed through a hot works permitting system which manages designated hot works areas and assesses risk to minimise the risk of a fire occurring. Vehicles on construction roads will keep to authorised tracks/roads and restricted to 40 km/h. Only potable water will be in water transfer pipelines when non-routine discharge events occur. Any discharges of water to land will be directed to natural drainage lines to reduce impacts. Natural drainage lines will be retained as far as practicable. Dust mitigation measures will be used in areas that have the potential to generate dust. Visual dust assessments will be included in the HSE Checklist. Assessment of dust controls at construction sites will be included in the Engineer's Audit and Inspection Program. The Rio Tinto Projects – Iron Ore: Weed Control Procedure and Equipment Hygiene Inspection Certificate will be used for all vehicles associated with construction of the Proposal, with records retained on a Vehicle Hygiene Register. Weekly weed inspections will be undertaken, with results recorded. In instances where commissioning and operations wastewater cannot be discharged to land, it will be discharged to an existing drain outside the development envelope which is licenced. **Rehabilitate** All areas that have been cleared for construction and commissioning purposes and which are not required for operations will be rehabilitated as soon as practicable after construction. Topsoil will be managed through the Soil Resource Work Practice to preserve the biotic and physical characteristics of topsoil resources and aid the success of rehabilitation.

Potential impact	Applicable proposal phases	Mitigation method
		Rehabilitation criteria will be established to include targets that ensure landforms are stable, and that biodiversity is consistent with agreed end land uses. A weed control program will be implemented if required.

11.4 Assessment and significance of residual impacts

11.4.1 Direct impacts

11.4.1.1 Direct reduction and degradation of vegetation from clearing within the development envelope during construction

Clearing and ground disturbance during construction is proposed within the development envelope, including up to 13.5 ha of vegetation. Of the 13.5 ha of native vegetation, 10.97 ha (81%) is in poor to degraded condition and 2.54 ha (19%) is in good to very good condition (AECOM, 2021).

Within the development envelope, AECOM (2021) identified a total of 124 native species from 88 genera, and 39 families recorded within the development envelope. Although flora was considered diverse, it was noted that all vegetation communities were considered locally common and were in better condition outside the footprint. Notable disturbance was evident from the existing railway, access tracks, weed invasion (particularly buffel grass), and the creation of disturbed artificial wetlands from material extraction.

Due to the mostly disturbed and cleared nature of the site, the overall value and sensitivity of the site is considered poor. The majority of the development envelope is located on reclaimed land that has been subject to considerable historical and ongoing disturbance from the construction and operation of infrastructure associated with the port.

Ground disturbance and clearing for the Proposal will be undertaken in accordance with the Rio Tinto Projects – Iron Ore: Land Clearing and Disturbance Procedure. Land clearing will be undertaken through a permitted process that requires an area to be surveyed and pegged before obtaining verification from the Disturbance Permit Coordinator that the area can be cleared. Once clearing is completed, cleared areas will be inspected and verified, with all cleared areas tracked on the Land Clearing Register. All land clearing will be minimised as far as practicable and all temporarily cleared areas for construction and commissioning activities will be rehabilitated as soon as possible (eg. Borrow pit areas).

Topsoil will be managed through a topsoil register (Soil Resource Work Practice) so as to preserve the biotic and physical characteristics of topsoil resources and aid the success of rehabilitation.

Although land disturbance within the development envelope is expected to cause direct impact to flora and vegetation, this is not expected to be a significant impact due to the location of the Proposal in a highly disturbed area with poor quality native vegetation and significant existing cleared, previously disturbed or reclaimed land areas. Although some good-excellent vegetation (2.5 ha) is proposed to be cleared, this will be minimised as far as practicable and rehabilitated where possible. AECOM (2021) did not identify any vegetation that forms significant connections with the surrounding environment and concluded that the vegetation proposed for clearing is well represented within the region.

11.4.1.2 Direct loss of one Priority flora species (E. surreyana) as a result of clearing

The Proponent's consultants undertook targeted survey work for Threatened and Priority flora species within the study area and recorded approximately 885 individuals of *E. surreyana* (AECOM, 2021). Prior to the study work conducted in 2021, the known population of *E. surreyana* recorded within the Burrup Peninsula was approximately 103 individuals, found in one population 15 km north-east of the study area. This brings the total number of known local records within the Burrup Region (within 100km of the study area) for this species to 988 individuals. In a regional context, the Rio Tinto database has 247 records representing 14,207 individuals across the entire Pilbara bioregion. The presence of *E. surreyana* within the locality is considered a range extension from their southern Pilbara population, likely to have been transported to Dampier via road.

The records were found to be restricted to the Disturbed – Artificial Ephemeral Wetland (AaEgPr) vegetation association where standing water collects in areas previously cleared by historical excavation activity (for borrow material) and is likely to vary with water availability (AECOM, 2021). Noting this, it is reasonable to concluded that the species is a disturbance specialist and likely to be found widely in the surrounding environment as 9.27 ha this disturbed habitat type was mapped to occur in the study area. Of the mapped vegetation type in the study area, a total of 4.5 ha (up to 48.5 %) could be impacted by the proposed excavation for borrow material. The Proponent's consultants concluded that this vegetation community is considered common and widespread on the Burrup Peninsula. Noting this it is likely that additional records of this species will be found across this vegetation type, thereby further reducing the significance of any impacts.

Considering a conservative assessment of potential impacts to *E. surreyana* from excavation for borrow material without any controls or mitigation measures, the implementation of the Proposal has the potential to impact up to 751 individuals located within the development envelope. This unmitigated impact will result in the clearing of approximately 5% of Pilbara bioregion records and 76% of known records in the immediate area (within 100 km) (Tables 11- and 11-6). The regional impact on this species is considered to be minor, as 95% of known records are located outside of development envelope and will not be impacted by the Proposal. Although 76% of the local population is found within the development envelope, it is considered likely that further surveys will locate additional individuals and populations, thereby reducing the significance of impacts resulting from the Proposal. The Proponent intends to undertake additional surveys in 2023 to further characterise the extent of the local population.

To avoid and minimise the impacts to the local population of the species, the Proponent proposes to implement a number of mitigation measures once the extent of the local population has been further characterised through additional surveys in 2023, including:

- Designing the borrow pit infrastructure footprint in a manner that minimises the clearing of high clusters of the species, where practicable.
- Applying adequate exclusion zones surrounding records of the species, where practicable, to ensure individuals located outside of the infrastructure footprint are protected.

Table 11- 5: Known extent of *E. surreyana* recorded in Pilbara Region

Priority Flora Species	Known Extent (Pilbara Bioregion)	Burrup Region (Within 100km)		Study Area		Development Envelope	
		No.	%	No.	%	No.	%
E. surreyana	14,207	988	6.9	885	6.2	751	5.2

Table 11- 6: Local extent of *E. surreyana* recorded in Burrup Peninsula (within 100km)

Priority Flora Species	Local Population (Within 100km)	Study Area		Development Envelope	
		No.	%	No.	%
E. surreyana	988	885	89.6	751	76.01

11.4.2 Indirect reduction and degradation of vegetation

Indirect impact to flora and vegetation from altered fire regimes during construction and operations

As described in Sections 11.1.3 and 11.1.4, the receiving environment within the development envelope does not contain any conservation-significant flora, TECs or PECs. Furthermore, the surrounding area generally contains low quality, highly disturbed vegetation. However, there are small areas of good quality vegetation that contain higher ecological value along the contingency pipeline corridor and at the booster pump station.

Welding activities will be frequent within the development envelope during construction. These activities will ultimately only extend for the duration of the construction period and will therefore not be long term. Occasional, non-routine operational activities, such as maintenance, could cause sparks and start fires, leading to the indirect loss of flora and vegetation. It is expected that these activities would only occur during intermittent, but routine, maintenance activities. There are no regular, ongoing operational activities that could result in sparks being generated or which require work to be undertaken on or close to uncleared vegetation.

During all Proposal phases, spark-generating activities will be managed through a hot works permitting system, which will manage designated hot work areas and assess hot-work-related risks to ensure fires cannot occur. This includes hot works taking place under the supervision of a Fire Warden, where combustible materials cannot be removed from within a 15-metre radius of the work area.

Implementation of mitigation measures will ensure rapid identification of, and response to, fires. This will reduce the spatial extent of potential fire damage to vegetation and flora. Given most flora and vegetation in and around the development envelope is low quality, the potential indirect impact to flora and vegetation is not significant.

Indirect impacts to flora and vegetation from dust deposition during construction

During construction, land disturbance has potential to generate dust, which may indirectly impact flora and vegetation within the development envelope and areas adjacent to it.

Dust deposition on vegetation can indirectly impact essential plant processes, such as transpiration and photosynthesis, by causing blockages to leaf stomata, thereby preventing adequate uptake of sunlight, carbon dioxide and oxygen, leading to an overall decline in vegetation health.

Dust deposition is considered a threat to the Burrup Peninsula rock pile communities; however, the development envelope follows existing tracks and pipelines that avoid all significant rock piles. The rockpiles in the development envelope do not represent this PEC and it has not been recorded previously in the survey area (Biota, 2018; Rio Tinto, 2011), therefore no impacts are expected.

The assessment of dust controls at construction sites shall be included in the Engineer’s Audit and Inspection Program and dust mitigation measures will be used in areas that have potential to generate dust during all phases of the Proposal. This includes the use of water carts on unsealed access roads and haul roads. Restricted vehicle speed limits of 40 km/h will be implemented on all roads within the development envelope in order to minimise dust.

Impacts to vegetation from dust deposition as a result of the Proposal are unlikely to extend past the construction phase and will therefore be short in duration. Furthermore, the potential consequences from dust deposition will be limited by the nature of the receiving environment, which is highly disturbed with large areas of existing cleared and degraded vegetation. For these reasons the impact to flora and vegetation from dust is not expected to be significant.

Indirect impacts to flora and vegetation from the introduction of weeds and disease during construction

During construction, land disturbance and the use of earthwork machinery has the potential to move existing weeds around the development envelope or introduce new weeds to it.

Weeds identified as Weeds of National Significance, invasive grasses, and weeds listed as Declared Pests under the *Biosecurity and Agriculture Management Act 2007*, are all considered significant weeds. No weed species that fall within these definitions were identified within the development envelope. However, four weed species were recorded, all of which are considered common in the Pilbara region. The most common weed was buffel grass, which is considered an aggressive weed and was present across the development envelope.

The Vehicle Hygiene and Weed Inspection form will be completed for all vehicles accessing the development envelope, with records maintained in a Vehicle Hygiene Register. Weed hygiene measures will be observed when moving equipment from weed-contaminated to non-weed-contaminated areas within the development envelope. Weekly weed inspections will be completed and a weed control plan implemented, should it be required. Additionally, all personnel will be required to report any new weed infestation locations, should they be observed.

The impacts to flora and vegetation from the potential introduction of weeds and disease is unlikely to be significant as there are no known significant weed species within the development envelope and the weeds that have been identified are common to the region. Furthermore, controls will be in place to minimise the spread of existing weeds and to prevent the introduction of new weeds and disease from machinery.

11.5 Summary of the significance of residual impacts

This section summarises the significance of residual impacts for flora and vegetation in accordance with the Statement of Environmental Principles, Factors and Objectives (EPA, 2021b). The connections and interactions between other environmental factors are considered in the holistic impact assessment (Section 14). The remaining matters as outlined in Section 6 of the Statement of Environmental Principles, Factors and Objectives (EPA, 2021b) are considered in Table 11-14.

Table 11-14: Assessment of significance for flora and vegetation

Residual impact	Consideration of key EPA (2021) matters	Significance of residual impacts	Recommended conditions and DMA regulation for significant residual impacts
Direct reduction and degradation of vegetation from clearing within the development envelope **Indirect reduction and degradation of vegetation**	**Values, sensitivity and quality of the environment** Intact native vegetation was homogenous in the area, with vegetation communities observed in better condition outside the survey area. None of the communities represent a Threatened, Priority or geographically restricted ecological community. Notable disturbance was evident from the existing railway, access tracks, weed invasion (particularly buffel grass), and the artificial wetlands (old borrow pits associated with the construction of nearby rail/road infrastructure). Due to the mostly disturbed and cleared nature of the site, the overall value and sensitivity of the site is considered poor. **Extent** A total of 57.5 ha of land will be disturbed within the development envelope during construction (Section 2.1.2.2), with the rest of the development envelope (0.8 ha) in ocean. The majority of this land is already cleared/disturbed (43.2 ha or 75%), and 13.5 ha (23 %) comprises native vegetation (Section 11.1.4). Of the native vegetation, 10.9 ha (81%) is in poor and degraded vegetation condition (10.9 ha), and the remaining 2.5 ha (19%) is vegetation in good to very good condition (Section 11.1.4) (AECOM, 2021). **Resilience of the environment** Vegetation communities within the development envelope are considered locally common and are in better condition outside the footprint; therefore, the environment is considered resilient to the clearing proposed as part of this Proposal. **Consequence of mitigation hierarchy** Due to the mostly disturbed and cleared nature of the site, the overall value and sensitivity of the site is considered poor and the clearing required as part of this project is not expected to have a significant impact. **Cumulative effects** No cumulative impacts are expected. **Level of confidence in the prediction of residual impacts** A detailed survey was completed and there is therefore a high level of confidence regarding the prediction of impacts.	13.5 ha of native vegetation will be cleared through construction of the Proposal, of which 81% is in poor and degraded condition. All vegetation communities were considered locally common and were in better condition outside the development envelope. Notable disturbance was evident from the existing railway, access tracks, weed invasion (particularly buffel grass), and the creation of artificial wetlands from material extraction. Due to the mostly disturbed and cleared nature of the site, the overall value and sensitivity of the site is considered poor. Residual impacts to flora and vegetation from the proposed clearing will not be significant.	No conditions are recommended.
Direct loss of significant flora species as a result	**Values, sensitivity and quality of the environment** *E. surreyana* was recorded in the study area associated with the Disturbed - artificial wetland vegetation community. This vegetation type comprised old borrow pits	Due to the mostly disturbed and cleared nature of the habitats in	To determine the extent of *E. surreyana* in the immediate surrounds, the proponent is

of clearing (*E. surreyana*)	associated with the construction of nearby rail/road infrastructure and was in degraded condition. Due to the mostly disturbed and cleared nature of the site, the overall value and sensitivity of this habitat is considered poor. **Extent** The records were found to be restricted to the Disturbed – Artificial Ephemeral Wetland (AaEgPr) vegetation association where standing water collects in areas previously cleared by historical excavation activity. Conservatively, 4.5 ha of 'Disturbed – Artificial Wetland Habitat', which supports 751 *E. surreyana*, may be cleared during construction, without the implementation of mitigation measures. Given our current knowledge of the *E. surreyana*, the population found in the DE represents 76% of the local population (within 100km), and 5% of individuals in the Pilbara bioregion. Given the extent of this species is poorly known and it was found in a previously cleared area that is in degraded condition, it is highly likely that this species exists in suitable habitat outside of the study area. **Resilience of the environment** Given the degraded nature of the artificial wetland habitats that *E. surreyana* was found it, the P3 species is considered to be a disturbance species that is adept to growing in previously cleared and degraded habitats. It is highly likely that with further surveys the species could be found in other more suitable habitats outside the development envelope. Given the degraded nature of the habitat that *E.surreyana* was found in, the species is considered to be resilient to the clearing proposed as part of this Proposal. **Consequence of mitigation hierarchy** Due to the mostly disturbed and cleared nature of the site, the overall value and sensitivity of the site is considered poor and the clearing required as part of this project is not expected to have a significant impact on regional populations of *E. surreyana*. **Cumulative effects** No cumulative impacts are expected. **Level of confidence in the prediction of residual impacts** Little is known about the distribution, range and numbers of *E. surreyana* in the Pilbara region. However, given the species was found in the development area in previously cleared and currently degraded habitat, it is likely that the species is present in surrounding areas in similar or better quality habitats.	which *E. surreyana* was found, the overall value and sensitivity of artificial wetland habitat is considered poor and widely represented across the Burrup region. Given the possibility that *E. surreyana* will be found in similar, better quality habitats in the Pilbara, the removal of individuals from the development area is unlikely to have a significant impact on the species.	committed to doing further surveys in suitable habitats outside of the current study area. The recommended condition is "the proponent shall carry out further targeted surveys for E. surreyana in suitable habitats within five kilometres of the population within the study area".

11.6 Environmental outcomes

Based on the implementation of the mitigation hierarchy and management measures proposed, the residual impact of the Proposal to flora and vegetation is the clearing of 13.5 ha of native vegetation within the development envelope. Of the native vegetation, the majority is in Poor to Degraded condition (10.9 ha or 81%) and the remaining 2.5 ha is in Good to Very Good condition (19%).

None of the existing native vegetation comprises conservation-listed ecological communities and there are no Threatened flora present. Given the flora and vegetation communities are well represented regionally, this impact is not considered to be significant.

One population of *E. surreyana* was recorded, comprising approximately 885 individuals, of which 751 are likely to be impacted by the proposal. *E. surreyana* is listed as Priority 3 by DBCA and occurs within the Disturbed – Artificial Ephemeral Wetland vegetation association which is in degraded condition. The Proponent is committed to carrying out further surveys for this species in suitable habitats outside of the development area. Surveys will be carried out in suitable conditions (post rain).

11.6.1 Proposed controls and monitoring

As described in the Proposal description, the Proposal will involve clearing and disturbance of the 57.5 ha development envelope, with cleared areas to include up to 13.5 ha of native vegetation and up to 751 individuals of E. surreyana, a P3 species (Figure 11-6). Monitoring of cleared areas will be completed to ensure no more than 13.5 ha are cleared.

11.6.2 Conclusion

The EPA objective for flora and vegetation is "*to protect flora and vegetation so that biological diversity and ecological integrity are maintained*" (EPA, 2016a). This objective has been met for the Proposal for the following reasons:

- The majority of the development envelope is in a highly disturbed area and clearing of native vegetation has been minimised to 13.5 ha, of which 10.9 ha (81%) is in poor to degraded condition.
- One P3 species, *E. surreyana*, was recorded in the development area and up to 751 individuals may be impacted during clearing for burrow material, which represents 5% of records of this species in the Pilbara bioregion. The species was recorded in the 'Disturbed – Artificial Ephemeral Wetland' that was in degraded condition. Given the presence of this species in recently cleared and degraded habitats, it is likely that it will exist in similar habitats elsewhere outside of the study area. The Proponent is committed to carrying out further surveys in similar, suitable habitats, to further understand the distribution of this poorly known species.
- No species listed as Threatened under the BC Act or EPBC Act were identified within the development envelope.
- No TECs or PECs were identified within the development envelope.

12 OTHER ENVIRONMENTAL FACTOR – TERRESTRIAL FAUNA

EPA's objective for terrestrial fauna is *to protect terrestrial fauna so that biological diversity and ecological integrity are maintained*

The relevant policy and guidance for terrestrial fauna is described in Appendix B.

12.1 Receiving environment

12.1.1 Studies and information sources

Table 12-1 lists the relevant studies and publications for terrestrial fauna. These have helped inform the description of the existing environment and assessment of impacts for the Proposal.

Table 12-1: Relevant studies used to inform the assessment of flora and vegetation

Author	Study (Date)	Technical Guidance requirements (EPA, 2020a)
AECOM	Flora and fauna assessment: Dampier Seawater Desalination Plant (AECOM, 2021; Appendix L) Dampier Salt Native Vegetation Clearing Permit Report (Biota, 2011) Dampier Resilience Native Vegetation Clearing Permit Support Report (Biota, 2018) Botanical Survey of the Dampier Power Station and Sub-station and 33 kV Network Connection at 7 Mile (Rio Tinto, 2011)	Fauna surveys included a basic terrestrial fauna assessment in accordance with Terrestrial Vertebrate Fauna Survey Technical Guide (EPA, 2020) and a targeted survey for Trapdoor Spiders and Northern Quoll. This level of survey is appropriate, given the high level of existing disturbance within the development envelope. The survey included habitat assessment, photography and mapping as per the Technical Guidance. Opportunistic fauna observations and low-intensity sampling was also completed as per the Technical Guidance.

Flora and Fauna Assessment: Dampier Desalination Plant, AECOM, 2021

The flora and fauna assessment undertaken by AECOM meets the requirements of *Technical guidance – Terrestrial vertebrate fauna surveys for EIA* (EPA, 2020) and *Technical guidance – Sampling of short-range endemic invertebrate fauna* (EPA, 2009). The study consisted of both desktop and field surveys and was led by a zoologist from AECOM. The methodology for this study in relation to the fauna survey is detailed below.

Desktop surveys assessed a number of publicly accessible government databases, assessing an area of up to 20 km around the development envelope. These searches specifically included NatureMap, DBCA Threatened Species and Communities, Atlas of Living Australia and the EPBC Act PMST report. Previous survey reports were also consulted to provide regional context and, based on the information from previous survey reports and database search results, a table was compiled of all threatened fauna species that were 'likely to occur', 'may occur' or 'unlikely to occur' in the development envelope.

General field surveys were undertaken in conjunction with the flora and vegetation field surveys described in Section 11.1.1, in two phases:

- Phase I: between 6 and 11 August 2020
- Phase II: between 12 and 15 April 2021.

The primary focus of the field survey was to verify findings of the desktop assessment and to identify and map significant fauna habitat. Signs of Threatened fauna species with the potential to use habitats within the survey area were also searched for. Specifically, the general field survey focused on the following:

- Assess the range of habitat types present and their condition. This was intended to determine the presence of suitable habitat for conservation-significant fauna species that were considered ‘likely’ to occur in the area following desktop surveys.
- Collect opportunistic recordings of fauna present within the survey area using calls, scats, tracks and diggings.

Targeted surveys were also undertaken for short-range endemic (SRE) Trapdoor Spiders and Northern Quoll (*Dasyurus hallucatus*).

Targeted Trapdoor Spider surveys were undertaken by traversing the entire survey area on foot and selecting sample point locations to conduct a detailed habitat assessment. A representative range of micro-habitats or niches were searched for evidence of Trapdoor Spiders.

Targeted Northern Quoll surveys were undertaken in accordance with state and commonwealth technical guidance by deploying motion sensor cameras at five locations within the survey area. Sites were chosen based on:

- Sun trajectory
- Wind conditions and the potential for movement of nearby vegetation to trigger the motion sensor cameras
- Nearby undisturbed rockpiles that could provide suitable habitat for the Northern Quoll
- Areas where fauna may move when transiting around or through rail infrastructure; i.e., culverts
- Areas where Northern Quoll habitat exists in close proximity to other habitats where cameras could pick up other fauna sightings; i.e., near one of the artificial wetland areas.

Parameters for assessing fauna habitats included the structure, complexity and continuity of the habitat present and the presence and abundance of habitat features (AECOM, 2021).

Taxonomy and nomenclature of vertebrate species for mammals, reptiles and amphibians used in AECOM (2021) is consistent with the WA Museum’s Checklist of Vertebrates of WA (2020) and the Australian Faunal Directory for avian species.

12.1.2 Regional context

The Burrup Peninsula supports a diverse terrestrial vertebrate fauna assemblage, with representatives of both the Eyrean and Torresian zoogeographic regions. It is populated with species that have typically adapted to high temperatures and intermittent rainfall (AECOM, 2021). The species diversity of the Burrup Peninsula is comparatively high when considering its small area in relation to the Pilbara overall. This is partly due to a range of different macrohabitats found on the Burrup Peninsula, but also the diversity of micro-habitats providing food and shelter within each habitat type. As many as 47 species of mammals, 173 species of birds and 98 species of reptiles may inhabit or visit the development envelope and surrounding coastal fringes (AECOM, 2021). Few of these species are restricted to the Burrup Peninsula alone; however, some key species are endemic to the Pilbara, with several species on the Burrup Peninsula representing isolated populations.

Vegetation creating fauna habitats on the Burrup Peninsula can be broadly described as being dominated by hummock grassland, grass steppe and soft spinifex. Section 11.1.2 contains further information about the regional context of vegetation within the development envelope.

12.1.3 Fauna habitat

AECOM (2021) mapped and described five fauna habitats within the development envelope. Four of these are summarised in Table 12-2 and are shown in Figure 12-1. The fifth habitat is ‘shoreline’ which supports marine fauna, including shorebirds, and is discussed and assessed in Section 10.

None of the terrestrial habitats represent ‘core habitat’ for conservation-significant fauna species that have the potential to occur in the development envelope (Table 12-4). However, they do comprise habitat considered ‘suitable’ and ‘marginal’ for five conservation-significant species that have been assessed during desktop surveys with potential to occur within the development envelope (AECOM, 2021) (Table 12-4).

No suitable habitat for SREs was identified during desktop or field surveys. However, the possibility of SREs occurring in the development envelope is discussed further in the sections below.

Table 12-2: Fauna habitats within the development envelope

Habitat	Habitat description	Relevant species	Area in development envelope
Disturbed – artificial wetlands	Standing water (seasonal), occasional mature trees, sedges, herbs and low shrubs provide moderate ground cover. It appears these relatively flat areas were created by earthworks (e.g., excavation of fill material associated with the construction of nearby rail/road infrastructure). Moderate complexity when water is present. This habitat is a result of historical earthworks (likely for sourcing fill). Due to significant rainfall in July 2020, these relatively flat areas contained ponded water. It would be expected that surface water would be temporary, and these areas would be dry for much of the year.	Suitable habitat for shorebirds discussed in Section 10. Vagrant visitors may include: • Peregrine Falcon • Ghost Bat.	4.5 ha
***Triodia* grasslands on rocky slopes and flats**	Grasslands with moderate to high ground cover on rocky slopes and flat areas. Includes some tall shrubs over diverse low herbs, shrubs and grasses. Occurs on skeletal rocky slopes and around rock piles. Varies in complexity from high to low in the absence of rock piles to provide shelter. Recorded on skeletal slopes.	Considered suitable foraging habitat for the Northern Quoll and Lined Soil-Crevice Skink. Rock piles provide suitable denning habitat for the Northern Quoll. Marginal habitat for the Western Pebble-Mound Mouse and Pilbara Olive Python. Vagrant visitors may include: • Peregrine Falcon • Barn Swallow • Ghost Bat.	7.8 ha
Minor creeks	Ephemeral creeks that intersect existing railway. Includes mature trees in varying densities (no hollows observed), low log litter and moderate-density groundcover of tussock grasses, herbs and shrubs. Recorded on skeletal rocky soils. Complexity is moderate to high with the presence of under-mid and upper-storey vegetation.	Marginal foraging habitat for the North-Western Free-Tailed Bat. Vagrant visitors may include: • Peregrine Falcon • Barn Swallow • Ghost Bat.	0.7 ha

Habitat	Habitat description	Relevant species	Area in development envelope
Shoreline[11]	Rocky/boulder shoreline sloping from existing infrastructure (port) into subtidal areas. Intertidal areas were dominated by oyster-encrusted rocks and there were no low tidal sand or mudflats exposed seaward of the rocky shoreline (i.e., no mudflat habitat suitable as foraging areas for shorebirds). Isolated patches of mangroves (predominantly *Avicennia marina*) on mid-upper levels of the rocky shoreline. Complexity is low with minimal ground cover.	Suitable foraging and resting habitat for: • Common Sandpiper • Ruddy Turnstone • Caspian Tern • Large Sand Plover • Lesser Sand Plover • Pacific Golden Plover • Broad-Billed Sandpiper. Marginal roosting habitat for migratory species, including: • Common Tern • Grey-Tailed Tattler. Marginal foraging habitat for vagrant species, including: • Peregrine Falcon • Barn Swallow • North-Western Free-Tailed Bat • Bar-Tailed Godwit.	0.5 ha
Cleared	Rail, road and port infrastructure providing minimal habitat. Includes some escarpments of rocks along the rail corridor.	Marginal habitat from human-made rock walls and rock piles for: • Northern Quoll • Pilbara Olive Python. Vagrant visitors may include: • Barn Swallow • Peregrine Falcon • Ghost Bat.	43.2 ha

[11] This habitat type is assessed under the Marine Fauna environmental factor in Section 10

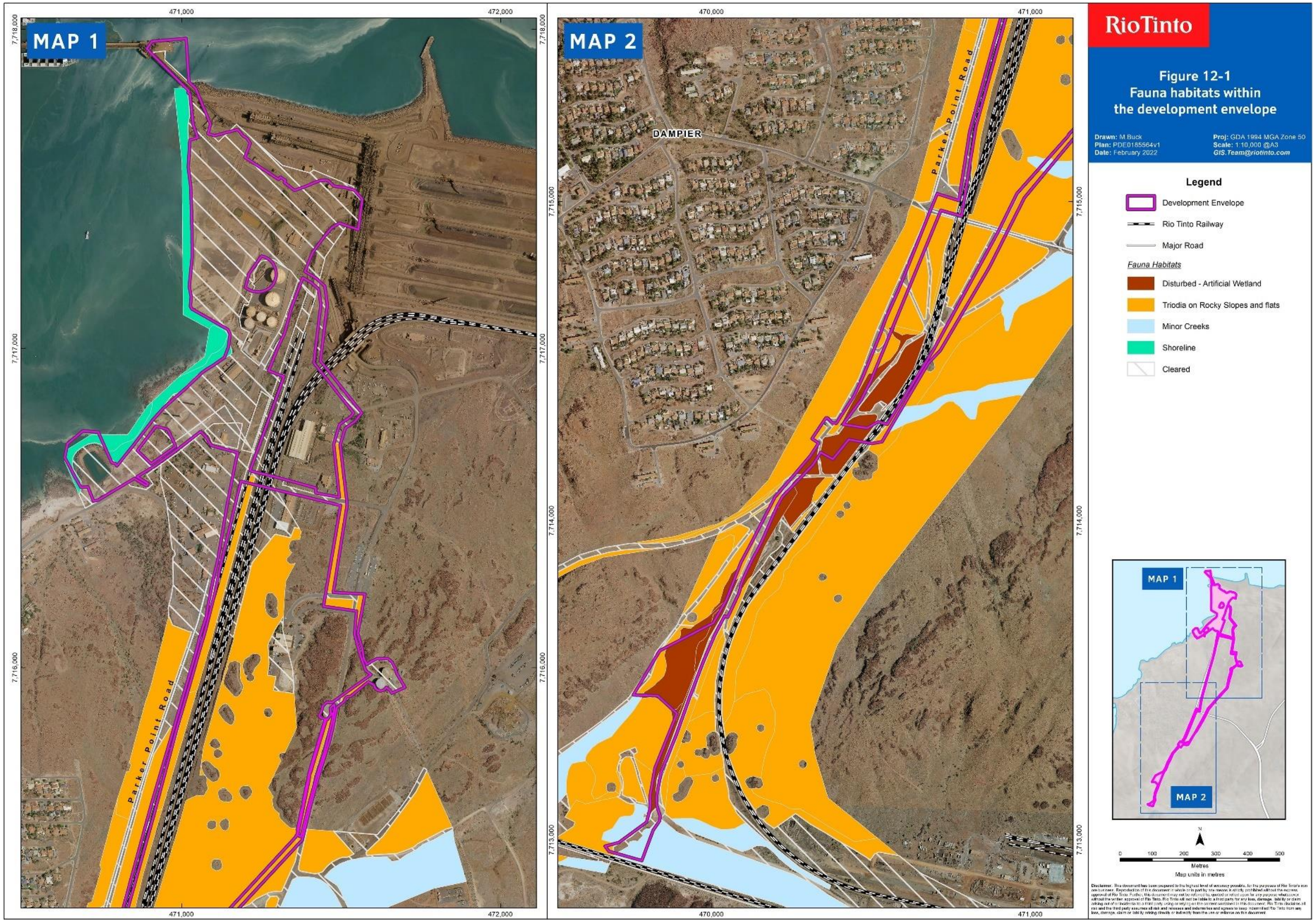


Figure 12-1: Fauna habitats within the development envelope

12.1.4 Conservation-significant fauna

Conservation-significant fauna was identified through desktop assessments and field studies and targeted surveys for Northern Quoll (*Dasyurus hallucatus*) and Trapdoor Spiders (Section 12.1.1). All threatened fauna identified in database searches were assessed in terms of how likely they were to be found within the development envelope. The likelihood criteria that were applied are shown in Table 12-3.

Table 12-3: Categories of likelihood of occurrence for fauna species

Likelihood category	Definition
Likely to occur	Survey area is within the known distribution of the species, habitat is present in the survey area and the species has been recorded in proximity to the survey area.
May occur	Survey area is within the known distribution of the species, marginal habitat may be present and/or the species has been recorded in proximity to the survey area.
Unlikely to occur	Survey area is outside the known distribution for the species, or no suitable habitat is present, and the species has not been recorded in proximity to the survey area.

The desktop surveys found 55 conservation-significant fauna species that could occur within the development envelope. Of these, 43 are birds which rely on the marine environment for all or part of their lifecycle: these are assessed in Section 10 and not discussed further here.

The likely presence of the remaining 12 species, based on desktop assessments and field surveys, are described in Table 12-4. Those considered likely to occur, or may occur, are described in more detail in Sections 12.1.5 to 12.1.7.

Table 12-4: Likely presence of fauna within the development envelope

Species name	Common name	EPBC Act	BC Act	Expected presence	Justification
Birds					
Falco peregrinus	Peregrine Falcon	–	Other specially protected species	Likely to occur	Suitable habitat present, several records in vicinity.
Hirundo rustica	Barn Swallow	Migratory	Migratory	May occur	Potentially suitable habitat present, some recent records in vicinity.
Cuculus optatus	Oriental Cuckoo	Migratory	Migratory	Unlikely to occur	No suitable habitat, one record inland 9 km.
Apus pacificus	Fork-Tailed Swift	Migratory	Migratory	Unlikely to occur	No known records in vicinity. Suitable habitat present.
Mammals					
Dasyurus hallucatus	Northern Quoll	Endangered	Endangered	Likely to occur	Limited suitable habitat (i.e., rocky outcrops) occur in the survey area. Anecdotal evidence of this species sighted along rocky wall near shoreline outside of the development area. More extensive and undisturbed rocky outcrops occur to the east and south of the survey area.

Species name	Common name	EPBC Act	BC Act	Expected presence	Justification
Macroderma gigas	Ghost Bat	Vulnerable	Vulnerable	May occur	Roosting habitat is not likely to occur in the survey area but may be present in the nearby ridges and hills. Species likely to be resident and forage opportunistically in the survey area.
Mormopterus cobourgianus	North-Western Free-Tailed Bat	–	P1	May occur	Opportunistic forager in the survey area. No suitable roosting habitat. While only very limited mangrove habitat (i.e., a few scattered trees on a rocky shoreline) occurs within the survey area, this species may be an incidental visitor due to the proximity of more suitable mangrove habitat to the south of the EII causeway.
Pseudomys chapmani	Western Pebble-Mound Mouse	–	P4	May occur	Limited suitable habitat present, one record in vicinity.
Hydromys chrysogaster	Water-Rat	–	P4	Unlikely to occur	No permanent bodies of water, one record more than 20 years ago.
Leggadina lakedownensis	Northern Short-Tailed Mouse	–	P4	Unlikely to occur	No suitable habitat. Not recorded or determined as having potential to occur in other recent surveys.
Reptiles					
Notoscincus butleri	Lined Soil-Crevice Skink (Dampier)	–	P4	Likely to occur	Suitable habitat present, numerous records in vicinity.
Liasis olivaceus barroni	Pilbara Olive Python	Vulnerable	Vulnerable	Likely to occur	Suitable habitat present, numerous records in vicinity.

12.1.5 Mammals

AECOM (2021) reported observation of two species of mammals during field surveys, the Euro (Common Wallaroo) and Feral Cat. Motion sensor cameras captured the Euro 39 times and the Feral Cat twice. Several bat images were also captured but it was not possible to ascertain their identification. Four conservation-significant species (Northern Quoll, Ghost Bat, North-Western Free-Tailed Bat and Western Pebble-Mound Mouse) may, or are likely to, occur within the development envelope.

Northern Quoll – *Dasyurus hallucatus*

The Northern Quoll occupies a wide range of habitats, including rocky areas, deserts, eucalypt forests and woodlands, hammock grass (*Plechtrachne* sp.) basalt hills, mesas, high and low plateaux, lower slopes, occasional tor fields and stony plains supporting either hard to soft spinifex grasslands (Braithwaite & Griffiths, 1994; van Vreeswyk et al., 2004). They are opportunistic foragers that feed on a broad range of items, switching dietary resources according to season and availability (Pollock, 1999; Oakwood, 2000, 2008a). They exhibit semelparous life history traits, rendering isolated populations susceptible to local extinction (Hill & Ward, 2010).

Habitat critical to the survival of the Northern Quoll ('habitat critical') includes rocky areas and offshore islands, though mapping of these habitats on a national scale is not currently feasible (Hill & Ward, 2010).

Northern Quolls on the Burrup Peninsula are likely to inhabit complex landforms of rocky outcrops, which can afford greater cover from predators than more open areas (Cardno, 2019). They will usually den in hollow trees or small caves and crevices in rocky outcrops (AECOM, 2021). According to the DBCA database, the nearest record is from 2015 within rock piles approximately 3 km from the development envelope.

Within the development envelope, 7.8 ha of the '*Triodia* grasslands on rocky slopes and flats' has been identified as suitable foraging and denning habitat for the Northern Quoll. Marginal habitat was identified in cleared areas, including human-made rock walls. The majority of the rocky outcrops are in proximity to existing infrastructure. It is recognised there are human-made rocky habitats such as rockwalls/seawalls and road/rail embankments that may be used by Quolls. However, these areas are likely to be less important than rocky outcrop areas to the south and east of the development envelope that are less disturbed and provide greater connectivity between areas of relatively secure habitat.

Targeted surveys for the Northern Quoll were undertaken using motion sensor cameras at five locations during the Phase I survey and five different suitable habitat locations during the Phase II survey. The cameras were deployed for a total of 37 nights. No observations were recorded, nor was any evidence of Northern Quolls, such as dens or scats, identified. While the survey design was appropriate and according to technical guidance, the Northern Quoll is cryptic and often inhabits complex landscapes where detection is difficult. Although the lack of detections during field surveys does not provide evidence of absence of this species, the density in the area surrounding the development envelope is expected to be low. This is due to the highly disturbed landscape within the development envelope, lack of connectivity with other suitable habitat, and the low density of mainland populations of the species. Thus, the identified habitats are not considered habitat critical.

Ghost Bat – *Macroderma gigas*

The Ghost Bat (*Macroderma gigas*) has been recorded in recent fauna surveys in the King Bay-Hearson Cove area of the Burrup Peninsula (approximately 10 km north of the development envelope) (AECOM, 2021) and is known to have a wide distribution along the Pilbara coast and up to 400 km inland. During the daytime the species typically roost in caves and rock fissures where temperatures are relatively stable. No roosting habitat, observations or evidence of Ghost Bats were recorded during the field surveys. All of the fauna habitats within the development envelope (listed in Table 12-2) may provide foraging habitat.

The Ghost Bat may present as a vagrant visitor in any of the fauna habitats within the development envelope.

North-Western Free-Tailed Bat – *Mormopterus cobourgianus*

The North-Western Free-Tailed Bat (*Mormopterus cobourgianus*) is commonly associated with mangrove habitat, which provides foraging habitat and roosting habitat in tree hollows. The species has been recorded in recent fauna surveys in the King Bay-Hearson Cove area of the Burrup Peninsula (approximately 10 km from the development envelope) (AECOM, 2021).

Within the development envelope, minor creeks were identified as marginal foraging habitat for the North-Western Free-Tailed Bat. Although larger trees were observed in the minor creek habitats, none were observed with hollows suitable for use. No suitable roosting habitat was identified. The species may be an incidental visitor due to the proximity of more suitable mangrove habitat to the south of the EII causeway and may occur within the development envelope.

Western Pebble-Mound Mouse – *Pseudomys chapmani*

The Western Pebble-Mound Mouse (*Pseudomys chapmani*) prefers hummock grasslands, *Triodia basedowii*, *Acacia* spp. and *Ptilotus* spp. where it creates its own microhabitat by scattering a mound of pebbles around its burrows (Kitchener, 1983; Burbidge, 2016). Several disused mounds have been recorded on the Burrup Peninsula recently (GHD, 2020), though none in field surveys of the development envelope (AECOM, 2021). Further, only one observation of this species has been recorded, approximately 6 km from the development envelope in 1993. The *Trodia* grassland of rocky slopes and flats within the development envelope was identified as marginal habitat for the Western Pebble-Mound Mouse, and therefore the species may occur.

12.1.6 Birds

AECOM reported 39 bird species observed during the survey. Thirty of these species are predominantly terrestrial based and were observed within or over grasslands and minor creek lines. Two conservation-significant species (Peregrine Falcon and Barn Swallow) may, or are likely to, occur within the development envelope.

Peregrine Falcon – *Falco peregrinus*

The Peregrine Falcon (*Falco peregrinus*) is widespread through the Pilbara region and inhabits a variety of environments. There are seven records near the development envelope and marginal foraging habitat was recorded (AECOM, 2021).

The Peregrine Falcon may be a vagrant visitor to the development envelope; however, it is unlikely to be reliant on the habitats present.

Barn swallow – *Hirundo rustica*

The Barn Swallow (*Hirundo rustica*) is widespread in northern Australia during the summer months (Pizzey & Knight, 2007). Habitat includes open country and agricultural land, especially near water, railyards and towns (Pizzey & Knight, 2007). Individuals have been recorded in the area (AECOM, 2021). Although none were directly observed during field surveys, suitable habitat was identified and therefore this species may occur in the development envelope.

12.1.7 Reptiles

Six reptile species were recorded, including the Ring-Tailed Dragon (*Ctenophorus caudicinctus*), Bynoe's Gecko (*Heteronotia bynoei*), Eastern Pilbara Lined Ctenotus (*Ctenotus duricola*), Barred Wedgesnout Ctenotus (*Ctenotus schomburgkii*) and the Lined Firetail Skink (*Morethia ruficauda*).

Tracks of a medium sized Monitor (*Varanus* spp.) were noted at one location, with an unidentified dragon species captured on camera in the rocky shoreline habitat. Two conservation-significant species (Pilbara Olive Python and Lined Soil-Crevice Skink) may, or are likely to, occur within the development envelope.

Pilbara Olive Python – *Liasis olivaceus barroni*

The Olive Python (Pilbara subspecies) is known to occur at 17 locations in the Pilbara, mostly in the Hamersley Range and Dampier Archipelago (Wilson & Swan, 2010). It is often associated with rockpiles around permanent water pools and seasonal creeks. On the Burrup Peninsula, the species prefers granophyre rock piles and is occasionally found in neighbouring spinifex grasslands (Cardno, 2019; AECOM, 2021). The nearest record to the development envelope is from 2005 and located near the Dampier townsite (approximately 1 km). There is additional anecdotal evidence of this species occurring along constructed rock walls (Rio Tinto *pers comm.* noted in AECOM, 2021). The majority of DBCA records of this species are from the rock formations north-east of the development envelope.

No observations or evidence of the Pilbara Olive Python were recorded during the field surveys. The *Triodia* grasslands on rocky slopes and flats (7.8 ha), human-made rock walls and rock piles provide marginal habitat for the species, and therefore it is considered likely to occur in the development envelope.

Lined Soil-Crevice Skink (Dampier) – *Notoscincus butleri*

The Lined Soil-Crevice Skink (*Notoscincus butleri*) is usually found in hummock grasslands on stony or sandy ground. It is a relatively poorly known species that has been recorded at the Hearson Cove–King Bay area of the Burrup Peninsula, including West Intercourse Island approximately 5 km from the development envelope (AECOM, 2021).

Although no direct observations were recorded during field surveys within the development envelope, the '*Triodia* grasslands on rocky slopes and flats' fauna habitat was identified as suitable foraging habitat for the Lined Soil-Crevice Skink and it is therefore considered likely to occur.

12.1.8 Short-range endemic species

Two Trapdoor Spider species, *Idiosoma* sp. and *Kwonkan* sp., were considered to potentially occur in the development envelope based on the desktop assessment (ALA online database). Both genera are known to support SRE species. Trapdoor Spider species typically inhabit relatively mesic, sheltered environments that were isolated during the aridification of Australia (AECOM, 2021). During the field survey, almost all areas searched comprised of rocky hard surface unsuitable for burrowing spiders.

No evidence of Trapdoor Spiders (e.g., burrows/lids) or suitable habitat for supporting trapdoor species was recorded within the development envelope during the survey (AECOM, 2021).

12.2 Potential environmental impacts

A number of potential impacts have been mitigated through the Proposal development and engineering design process (Section 2.4).

12.2.1 Direct impacts

Potential direct impacts of the Proposal to terrestrial fauna during construction, commissioning and operation have been identified in Table 12-5. Table 12-6 outlines the direct disturbance to fauna habitat that is proposed.

Table 12-5: Potential direct environmental impacts to terrestrial fauna

Potential impacts	Proposal phase	Activities with potential to have impact
Reduction and degradation of fauna habitat from clearing	Construction	• Up to 13.5 ha of fauna habitat will be cleared within the 57.5 ha development envelope (Table 12-6). • Pipelines will intersect the Triodia on rocky slopes habitat.
Loss or injury of fauna from excavation and trenching	Construction	• Trenching and excavation is associated with the construction of pipelines.
		• Excavations and trenches have the potential to entrap terrestrial fauna during construction.
Loss or injury of fauna from artificial light, noise and fauna-human interactions	Construction Commissioning Operations	• During construction, commissioning and operation, noise will be generated by operating equipment such as pumps. Lighting will be required to maintain safety and security and site personnel will be present.

Table 12-6: Direct impacts to fauna habitat

Habitat type	Area within development envelope
Disturbed – artificial wetlands	4.5 ha
***Triodia* grasslands on rocky slopes and flats**	7.8 ha
Minor creeks	0.7 ha
Shoreline	0.5 ha
Total	**13.5 ha**
Cleared	43.2 ha
Open water	*0.8 ha*
Total	**57.5 ha**

12.2.2 Indirect impacts

There are no potential indirect impacts to terrestrial fauna during construction, commissioning or operations.

12.2.3 Cumulative impacts

The cumulative impact of the Proposal on terrestrial fauna requires the Proposal to be considered in context with other existing or reasonably foreseeable activities, developments and land uses when considering the significance of impacts.

None of the terrestrial habitats represent 'core habitat' for conservation-significant fauna species that have the potential to occur in the development envelope. The Proposal will result in clearing of up to 13.5 ha of terrestrial fauna habitat. However, none of the recorded fauna habitats are restricted to the development envelope; they are widespread and common throughout the Dampier Archipelago and surrounds.

Given there are no impacts to conservation-significant fauna habitat, cumulative impacts with existing or future proposals from this Proposal are not expected.

12.3 Mitigation

This section describes the measures that have been applied to the potential impacts to mitigate the risks of significant residual impacts. To develop these mitigation measures, the mitigation hierarchy of 'avoid, minimise and rehabilitate' has been applied, with a focus on avoiding impacts where possible.

For this Proposal, the implementation of mitigation measures significantly reduces impacts to the environment and enables the Proposal to meet EPA's objective for terrestrial fauna.

Table 12-7 sets out the technically feasible mitigation measures that have been applied to each potential impact and arranges those mitigation measures by where they sit within the mitigation hierarchy.

Table 12-7: Terrestrial fauna mitigation measures

Potential impact	Applicable proposal phases	Mitigation method
EPA objective: To protect terrestrial fauna so that biological diversity and ecological integrity are maintained		
Direct impact to fauna from reduction and degradation of fauna habitat	Construction	**Avoid** The desalination plant has been located on highly disturbed, reclaimed land within an established industrial area. The design of the development envelope has specifically avoided areas of higher ecological value, such as higher quality vegetation and fauna habitat. **Minimise** Clearing of vegetation and fauna habitat has been minimised through the design process and will not exceed 13.5 ha (Table 12-6). Ground disturbance and clearing will be undertaken in accordance with the Rio Tinto Projects – Iron Ore: Land Clearing and Disturbance Procedure. Land clearing will be undertaken through a permitted process that requires verification from the Disturbance Permit Coordinator before granting authorisation to clear. Once clearing is completed, cleared areas will be inspected and verified, with all cleared areas tracked on the Land Clearing Register. An appropriately trained Fauna Spotter will be present during the clearing of any native vegetation. **Rehabilitate** All areas that have been cleared for construction and commissioning purposes and which are not required for operations will be rehabilitated following construction completion and prior to demobilisation. Excavations will be backfilled as soon as possible. Uninjured trapped/grounded fauna will be relocated/released by an appropriately qualified person to a nearby area of suitable habitat. Injured fauna will be managed by appropriately qualified personnel in accordance with the Iron Ore (WA) Wildlife Interaction Guidelines.
Direct impacts resulting in loss or injury of fauna from excavation or trenching activities	Construction	**Avoid** Excavation and trenching activities are not feasible to avoid. **Minimise** Daily inspections of all open trenches and removal of trapped and/or injured fauna will be performed by an appropriately trained Fauna Spotter. Fauna egress ramps will be installed in all excavations and open trenches at an incline of no greater than 45 degrees. All interactions with fauna will be reported and maintained in a Fauna Register during construction, commissioning and operations. Information relevant to impacts to fauna from excavation/trenching activities will be included in the project induction (as required). **Rehabilitate** Excavations will be backfilled as soon as possible.

Potential impact	Applicable proposal phases	Mitigation method
Direct impact to fauna from artificial light, noise and fauna-human interactions	Construction Commissioning Operations	**Avoid** Lighting, noise and fauna-human interactions are not feasible to avoid. **Minimise** The lighting design for the desalination plant will follow the principles of Best Practice Lighting Design outlined in the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia, 2020), including: • Use of lighting only where/when needed • Direction of light away from sensitive habitats • Shielding of lamps to prevent light spill (vertical and horizontal). During construction, lights that do not require to be continually lit will be switched off. During operations, lights that do not require to be continually lit will be switched off or activated by motion sensors. Barbed wire fencing shall only be utilised when required for security of infrastructure, and all installed barbed wire shall have bat deflectors installed as per the Rio Tinto guidelines. Construction work will be performed in accordance with Section 6 of the Australian Standard 2436-2021 Guide to noise control on construction, maintenance and demolition sites. Any plant and/or equipment with faulty or insufficient mufflers/noise dampeners will be taken out of service. Putrescible waste will be stored in fauna-proof waste receptacles at all times before disposal. Vehicle speeds will be limited on all construction roads within the development envelope. Relevant controls will be included in the site induction (as required). **Rehabilitate** Uninjured trapped/grounded fauna shall be relocated/released by an appropriately qualified person to a nearby area of suitable habitat. Injured fauna will be managed by appropriately qualified personnel in accordance with the Iron Ore (WA) Wildlife Interaction Guidelines.

12.4 Assessment and significance of residual impacts

This section provides an assessment of the level of impact expected to terrestrial fauna during each phase of the Proposal (construction, commissioning and operation). This section assumes all controls listed in Section 12.3 are implemented and therefore only the residual impacts are discussed.

12.4.1 Direct impacts

12.4.1.1 Direct impacts from the reduction and degradation of fauna habitat

Fauna habitat

The Proposal will result in clearing of up to 13.5 ha of terrestrial fauna habitat, including 4.5 ha of disturbed – artificial wetlands, 7.8 ha of Triodia grasslands on rocky slopes and flats, 0.7 ha of minor creeks and 0.5 ha of shoreline habitat (note that impacts to shoreline habitat is discussed in detail in Chapter 10). None of the recorded fauna habitats are restricted to the development envelope and they are widespread and common throughout the Dampier Archipelago and surrounds.

The Proposal is likely to have limited habitat fragmentation impacts, with the majority of the water transfer pipelines being installed either replacing existing pipelines or being constructed directly adjacent to existing pipelines. In addition, the pipeline profile is low, which allows ground-dwelling fauna the ability to move over the pipeline, further reducing the potential impact of habitat fragmentation. A Fauna Spotter will also be present during the clearing of native vegetation, further mitigating the risk of impacts beyond the approved areas for clearing.

Conservation-significant fauna

Four conservation fauna species are likely to occur within the development envelope given the presence of suitable habitat listed below:

- Northern Quoll: potential foraging and denning habitat
- Pilbara Olive Python: marginal habitat
- Peregrine Falcon: foraging habitat
- Lined Soil-Crevice Skink (Dampier): foraging habitat.

No core habitats for these species were identified within the development envelope and no observations or evidence of these species were identified during field surveys. However, there are historical records of all four species near the development envelope, albeit anecdotally for the Northern Quoll (AECOM, 2021).

Northern Quoll

No observations or evidence (such as dens or scats) of Northern Quolls were recorded in or adjacent to the development envelope during the biological field surveys (AECOM, 2021). The results of the surveys concluded it would be rare for the Northern Quoll to be found within the development envelope, and the density of the species in the surrounding area is expected to be low (AECOM, 2021). No critical habitat for the Northern Quoll occurs within the development envelope.

Habitat removal and fragmentation are key threats to the Northern Quoll. Mainland populations of Northern Quoll are low-density, distributed populations. The habitats most likely to be used by Northern Quoll within the development envelope include human-made structures (rock walls and rock piles) within areas that are already cleared, and *Triodia* grasslands on rocky slopes and flats. The Proposal will avoid disturbance to human-made rock walls and rock piles associated with other activities within and surrounding the development envelope (i.e., existing rail embankments). The *Triodia* grasslands on rocky slopes and flats habitat type were predominantly identified along the edge of the existing corridors for the onshore water transfer pipeline routes. A total of 7.8 ha of *Triodia* grasslands on rocky slopes and flats within the development envelope will be cleared for the Proposal.

As the Proposal avoids impacts to habitat critical to the survival of the species and does not result in fragmentation of key movement corridors, impacts of habitat removal to the Northern Quoll will not be significant.

Pilbara Olive Python, Lined Soil-Crevice Skink and Peregrine Falcon

Although some habitat is considered ‘suitable’ or ‘marginal’ for conservation-significant fauna that may occur in the development envelope, AECOM (2021) concluded these habitats are widespread on the Burrup Peninsula and no fauna species are likely to be restricted to or reliant on the habitats present. Furthermore, the disturbed nature of the development envelope and the large portion already cleared (43.2 ha, 75%) indicates it is unlikely to provide important habitat linkages. The pipeline profile is also low, allowing ground-dwelling fauna the ability to move over the pipeline, reducing the impact of habitat fragmentation associated with the proposed works. Given these factors, impacts of the Proposal on Pilbara Olive Python, Lined Soil-Crevice Skink and Peregrine Falcon will not be significant.

12.4.1.2 Injury or death to fauna associated with excavation/trenching activities

During construction, land disturbance will include earthworks for activities such as foundation preparation, borrow pits and pipeline installation. It is possible that, from time to time, these earthworks will result in trenches being excavated and left open for various periods of time during construction. Trenching activities for the Proposal are mostly limited to installation of the pipelines between the seawater intake, outfall and the desalination plant, and services (e.g., power and fibre optics). Following construction activities, the pipelines and services will be buried within the desalination plant, and pipelines will be low profile in pipeline corridors.

Open excavations, especially trenches, have the potential to trap fauna. If entrapment occurs for prolonged periods of time, fauna may be at risk of dehydration, starvation and increased predation. Due to the low abundance of terrestrial fauna species within the development envelope, the frequency and number of individuals becoming trapped will be lower. This likelihood will be further reduced by the use of fauna egress ramps to facilitate their escape.

In addition, daily inspections of trenches will be undertaken by trained Fauna Spotters who will remove and manage trapped individuals.

Following implementation of these mitigation measures, impacts to terrestrial fauna from trenching will not be significant.

12.4.1.3 Injury or death to fauna associated with artificial light, noise or human interactions

Artificial light

During construction and commissioning, temporary construction lighting will be provided to ensure construction activities can be performed safely. Lighting towers may be used if natural lighting is not sufficient for safe construction during working hours.

During operations, permanent lighting will be established around the buildings at the Desalination Plant site and will consist of amber LEDs to the extent required to provide safe working conditions. Maintenance activities are not planned to be through the night, but occasional night activities may be required for unplanned maintenance. No additional lighting is expected to be installed along the water transfer pipeline routes.

In all instances, lighting will align with the best-practice lighting design recommended in the National Light Pollution Guidelines (DoEE, 2020), whereby lighting will only be provided to the minimum needed for specific purposes during construction, commissioning and operations; only the areas required to be lit will be; and the lowest-intensity lighting appropriate for the task will be used.

Lighting has potential to disrupt critical behaviour and cause physiological changes to wildlife (DoEE, 2020). Details of species-specific responses to artificial light for those species that may occur in the development envelope are lacking. However, impacts may include extended foraging in species that are visual predators, such as the Peregrine Falcon and Pilbara Olive Python, which may increase predation risk to other species, including the Lined Soil-Crevice Skink. Additionally, the Northern Quoll may be at more risk of predation from feral cats.

Implementation of mitigation measures will reduce light emissions during the construction, commissioning and operation phases, lessening the potential for the impacts described above to occur. Given the proximity of the Proposal to existing industry, any fauna present will likely have acclimatised to a level of anthropogenic light.

As a result, the potential impacts to terrestrial fauna from artificial light emissions at the individual or population level will not be significant.

Noise

During construction and commissioning, noise will be generated throughout the development envelope from the operation of construction machinery, ground preparation and installation of piles. During operations, noise is expected to be generated within the desalination plant site from the operation of plant equipment, particularly pumps.

A noise assessment was conducted for expected construction and operational noise levels (Wood, 2021; Appendix D). The study concluded that the Proposal can be constructed and operated without any discernible increase in received noise levels (Section 8.1.6). While it is still possible that fauna in close proximity to the activities may show a behavioural response to noise, given the existing surrounding industries, any fauna present will likely have acclimatised to a level of anthropogenic noise. Further, since no core habitats or those considered critical to the survival of a species are present within the development envelope, potential impacts from noise at the individual or population level will not be significant.

Fauna-human interactions

During all Proposal phases, personnel will be present onsite. This introduces the potential for interactions between fauna and personnel, including vehicle strikes.

No construction or operation activities require personnel to enter areas with higher-value fauna habitat as none are present within the development envelope. Vehicle speeds are limited to 40 km/h on construction roads, reducing the likelihood of vehicle strike. Putrescible waste will be stored so attraction of fauna is minimised. This will reduce the potential for aggregations of fauna in areas occupied by personnel. In the unlikely event interaction results in injury to fauna, a qualified Fauna Handler will manage the fauna.

Given these factors, potential impacts to fauna from human interactions will not be significant.

12.4.2 Indirect impacts

There are no indirect residual impacts to terrestrial fauna.

12.4.3 Cumulative impacts

As discussed in Section 12.2.3, given no significant impacts to threatened fauna or fauna habitats are likely, cumulative impacts with existing or future proposals from this Proposal are not expected.

12.5 Summary of the significance of residual impacts

Table 12-8 assesses the significance of residual impacts for terrestrial fauna in accordance with Section 5 of the EPA's Statement of Environmental Principles, Factors and Objectives (EPA, 2021b). The connections and interactions between other environmental factors are considered in the holistic impact assessment (Section 14).

Table 12-8: Assessment of significance for terrestrial fauna

Residual impact	Consideration of key EPA (2021) matters	Significance of residual impact	Recommended conditions and DMA regulation for significant residual impacts
Reduction and degradation of 13.5 ha of fauna habitat	**Values, sensitivity and quality of the environment** No core habitats for conservation-significant fauna species were identified; however, sufficient foraging and denning habitat exists for the Northern Quoll, marginal habitat exists for the Pilbara Olive Python and sufficient foraging habitat exists for the Lined Soil-Crevice Skink and Peregrine Falcon. No observations or evidence of these species was identified during field surveys (AECOM, 2021). **Extent** As above. **Resilience of the environment** Given no significant impacts are expected, the environment is expected to be resilient to the change. **Consequence of mitigation hierarchy** Due to the low abundance of fauna species expected, and lack of core habitat, the level of impact is not considered significant. **Cumulative effects** Given no significant impacts are expected and the habitat that will be disturbed is marginal, no cumulative impacts are expected. **Level of confidence in the prediction of residual impacts** There is a high level of confidence in this prediction as site surveys of the development envelope were completed.	**Not significant** Not considered significant due to fauna habitat mostly being in disturbed condition and widespread and common throughout the surrounding area.	No conditions are recommended.

Residual impact	Consideration of key EPA (2021) matters	Significance of residual impact	Recommended conditions and DMA regulation for significant residual impacts
Entrapment of fauna during excavation/ trenching activities	**Values, sensitivity and quality of the environment** No observations or evidence of Northern Quoll, Pilbara Olive Python, Lined Soil-Crevice Skink and Peregrine Falcon was identified during field surveys (AECOM, 2021); however, observations have previously been recorded in surrounding areas. **Extent** As above. **Resilience of the environment** Given no significant impacts are expected, the environment is expected to be resilient to the change. **Consequence of mitigation hierarchy** Due to the low abundance of fauna species expected, and lack of core habitat, the level of impact is not considered significant. **Cumulative effects** Given no significant impacts are expected, no cumulative impacts are expected. **Level of confidence in the prediction of residual impacts** There is a high level of confidence in this prediction as site surveys of the development envelope were completed.	**Not significant** Not considered significant due to the short timeframe during construction and localised nature of the potential impact.	No conditions are recommended.

Residual impact	Consideration of key EPA (2021) matters	Significance of residual impact	Recommended conditions and DMA regulation for significant residual impacts
Impacts to fauna from artificial light, noise and fauna-human interactions	**Values, sensitivity and quality of the environment** No observations or evidence of Northern Quoll, Pilbara Olive Python, Lined Soil-Crevice Skink and Peregrine Falcon was identified during field surveys (AECOM, 2021); however, observations have previously been recorded in surrounding areas. **Extent** As above. **Resilience of the environment** Given no significant impacts are expected, the environment is expected to be resilient to the change. **Consequence of mitigation hierarchy** Due to the low abundance of fauna species expected, and lack of core habitat, the level of impact will not be significant. **Cumulative effects** Given no significant impacts are expected, no cumulative impacts are expected. **Level of confidence in the prediction of residual impacts** There is a high level of confidence in this prediction as site surveys of the development envelope were completed.	**Not significant** Not considered significant due to the low abundance of conservation-significant fauna species.	No conditions are recommended.

12.6 Environmental outcomes

Based on the implementation of the mitigation hierarchy and management measures proposed, the residual impact of the Proposal to terrestrial fauna is the clearing of 13.5 ha of fauna habitat within the development envelope.

There is no important or critical habitat for listed fauna species within the development envelope. Given the fauna habitats are well represented regionally, the Proposal will not have a significant impact on terrestrial fauna or their habitat.

12.6.1 Conclusion

The EPA objective for terrestrial fauna is “to protect terrestrial fauna so that biological diversity and ecological integrity are maintained” (EPA, 2020). This EPA objective has been met for the Proposal.

13 OTHER ENVIRONMENTAL FACTOR – GREENHOUSE GAS EMISSIONS

EPA's objective for greenhouse gas emissions is *to reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change* [12]

GHG emissions for the Proposal have been quantified and assessed as per the Environmental Factor Guideline – Greenhouse Gas Emissions (EPA, 2020b). The Proposal falls well below the threshold for assessment as an environmental factor (100,000 tonnes of Scope 1 emissions each year measured in CO_2-e). However, emissions and potential impacts have been quantified to provide assurance of the predicted carbon emissions from the Proposal.

13.1 Receiving environment

13.1.1 Studies and information sources

An internal study has been conducted to estimate the GHG emissions relating to the Proposal. GHG emissions have been estimated for the Proposal using the methods and criteria in the National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Government of Australia, 2021b) (NGER Determination). The study includes estimates of the peak, annual average and total diesel fuel and electricity consumption for the Proposal.

13.1.2 Regional context

GHG emissions contribute to the changing climate in WA and globally. The effects of climate change in WA are expected to result in reduced rainfall in the south-west of the state, reducing areas of important habitat. Additionally, sea level rise and warming may impact our coastal communities and habitats. The susceptibility of environmental receptors to climate change varies with location and receptor.

13.1.3 Emissions reduction

Rio Tinto is working towards the aspiration to be carbon-neutral for its WA operations by 2050, consistent with the State GHG Policy. Emissions reductions will be achieved via abatement projects at the Pilbara system level, as a Pilbara-wide approach enables abatement projects to service multiple developments and is a more cost-efficient, flexible approach.

The emitting assets subject to this Proposal are included in the long-term emissions reduction pathway currently under investigation and will naturally see significant reductions over the longer timeframe, as technologies develop and alternatives to firm power generation and mobile diesel become available. The long-term emissions reduction target is anticipated to be achieved by implementing a range of existing or potential future GHG abatement opportunities. Some examples include:

- Energy efficiency projects
- Renewable energy (solar photovoltaic, wind energy)
- Energy storage
- Alternative fuels (lower emission fuels such as biofuels, renewable diesel)

[12] For the purposes of environmental impact assessment, the EPA Greenhouse Gas Emissions guideline relates to the six categories of GHGs covered by the United Nations Framework Convention on Climate Change Reporting Guidelines on Annual Inventories. These gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydro fluorocarbons (HFCs) and perfluorocarbons (PFCs) (EPA, 2020b).

- Zero-emission mobile fleet
- Hydrogen gas and/or fuel cell technology
- Efficiency upgrades to gas turbines and mobile fleet.

Rio Tinto is currently investigating alternative power solutions as part of the planning for future potential opportunities to lower carbon emissions across its Pilbara operations. In the Pilbara, Rio Tinto currently has under construction a battery energy storage system, with the potential to provide back-up power (spinning reserve), and a solar photovoltaic system comprising approximately 100,000 panels. Further alternative energy projects are progressing across various stages of study to deliver substantial emissions abatement across all of Rio Tinto's Pilbara assets, in many cases by 2030.

13.2 Potential environmental impacts

GHG emissions resulting from the Proposal will be directly generated through the combustion of hydrocarbons (e.g., vehicles, equipment and generators), and indirectly generated through the consumption of electricity from the Rio Tinto Pilbara Power Generation Network. This power network comprises predominantly gas-powered turbines across several sites between Karratha, Cape Lambert and Hope Downs (Figure 13-1). Therefore, any increase of load on this network is distributed between these disparate generation points.

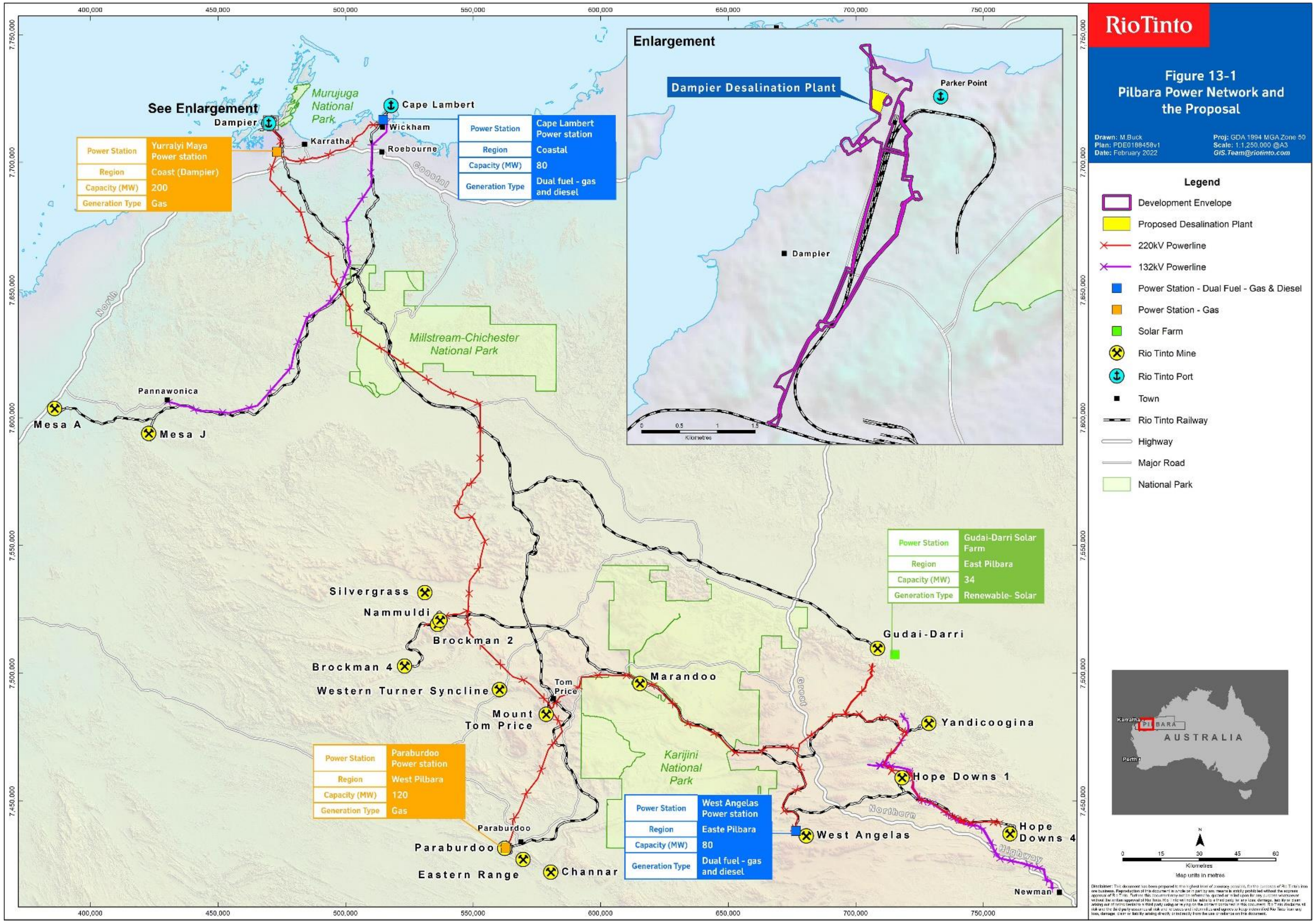


Figure 13-1: Pilbara power network and the Proposal

National and international GHG reporting standards categorise emissions (‘scopes’) based on emission sources and associated responsibilities (EPA, 2020b). GHG emissions are defined as:

- Scope 1 – GHG emissions released to the atmosphere as a direct result of an activity (also known as ‘direct emissions’). These include emissions from the burning of diesel fuel in vehicle fleets and generators, fugitive emissions, clearing of native vegetation and production of electricity using fossil fuels.
- Scope 2 – GHG emissions from the consumption of an energy product (also known as ‘indirect emissions’). For example, Scope 2 emissions come from the use of electricity produced by the burning of fossil fuels in another facility. Scope 2 emissions from one facility are part of the Scope 1 emissions from another facility.
- Scope 3 – indirect GHG emissions other than Scope 2 emissions, that are generated in the wider economy. Scope 3 emissions occur as a consequence of the activities of a facility, but from sources not owned or controlled by that facility’s business.

For the purposes of this Proposal, GHG emissions were based on estimates of the peak, annual average and total diesel fuel and electricity consumption over an estimated 16-year life of the Proposal. GHG emissions have been estimated for the Proposal using the methods and criteria in the NGER Determination (Government of Australia, 2021b). For Scope 2 emissions, the Pilbara Power Generation emission factor from the FY2020 National Greenhouse and Energy Report of 0.54 t CO_2-e/MWh was used.

The primary emissions of GHG from the Proposal are carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4). The principal sources of GHG emissions include:

- Stationary and transport diesel combustion (Scope 1)
- Consumption of electricity from the Pilbara Power Generation Network (Scope 2).

For the construction phase of the Proposal, preliminary engineering estimates that 3,060 kL of diesel fuel will be required.

Modelling of the operation of the Proposal assumes a conservative 100% capacity requiring 68,992 MWh of electricity per year. Transport fuel consumption was based on the use of one 8-tonne flatbed truck delivering chemicals and consumables per week and one 8-tonne CO_2 tanker per fortnight to the Proposal from Perth and an average fuel consumption of 28 L/100 km. Based on these assumptions, it is estimated 65,520 L (65.52 kL) of diesel fuel would be combusted per year to operate the Proposal.

Table 13-1 presents a summary of the estimated peak, annual average and total GHG emissions over an estimated 16-year life of the Proposal.

Table 13-1: Summary of estimated construction phase, peak annual, annual average and total fuel combustion, electricity consumption and greenhouse gas emissions for the Proposal

Emission source		Scope 1: Diesel combustion	Scope 2: Electricity consumption	Total emissions (t CO_2-e)
Construction phase	Usage	3,060 kL	-	-
	Emissions (t CO_2-e)	8,292 t CO_2-e	-	8,292 t CO_2-e
Peak annual	Usage	65.52 kL	68,992 MWh	-
	Emissions (t CO_2-e)	178 t CO_2-e	37,256 t CO_2-e	37,433 t CO_2-e
Annual average	Usage	36.01 kL	37,946 MWh	-
	Emissions (t CO_2-e)	98 t CO_2-e	20,491 t CO_2-e	20,588 t CO_2-e
Total life of the Proposal[13]	Usage	4,136.17 kL	1,138,369 MWh	-
	Emissions (t CO_2-e)	11,257 t CO_2-e	614,719 t CO_2-e	625,976 t CO_2-e
	Percentage of total CO_2-e emissions	1.8%	98.2%	100%

The annual peak throughput of the Proposal is 8.0 GL corresponding to annual operational GHG emissions of 37,433 t CO_2-e. This results in an estimated Scope 1 and 2 emissions intensity of 5,200 t CO_2-e/GL.

13.2.1 Reduction of emissions from Bungaroo aquifer system

It has been estimated that on average the annual electrical power demand for the Bungaroo system is approximately 11,255 MWh and supplies marginally less water per year than the Proposal. Therefore, the proposed plant is anticipated to offset the entire water and thus power demand from the Bungaroo aquifer. The anticipated reduction in total Scope 2 emissions from the Bungaroo aquifer system equates to 6,078 t CO_2-e per year.

13.2.2 Benchmarking

Benchmarking of the Proposal's forecast annual emissions and emissions intensity against comparable desalination operations is presented in Table 13-2. Facility emissions information has been sourced from publicly available information.

Table 13-2: Benchmarking of greenhouse gas emissions

Facility	Emission intensity (t CO_2-e/GL)	Forecast annual emissions (t CO_2-e)	Contribution to WA emissions (%)
This Proposal	5,200	37,433	0.04%
Alkimos Seawater Desalination Plant (25 GL per annum)	3,250	81,156	0.09%

As per GHG Protocol[14], Scope 3 emissions relate to the circular economy and value chain associated with the Proposal. It is estimated these emissions are relatively small compared against the construction and operational Scope 1 and 2 emissions.

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[13] Based on the peak annual usage; however, actual consumption is likely to be much lower.

[14] https://ghgprotocol.org/

13.3 Mitigation measures

As stated in Section 13.1.2, Rio Tinto is aspiring to be carbon-neutral for its WA operations by 2050. It has already commenced implementation of alternatives to abate emissions from its Pilbara power sources and is investigating the use of alternative low-emission fuel sources and technologies to achieve a zero-emissions mobile fleet.

Proposal-specific mitigation measures for GHG emissions were considered during the design to minimise emissions associated with the Proposal:

- The selected site is located within the existing disturbance footprint for the port operations and utilises existing infrastructure wherever possible to minimise the power demand for construction and operation. The Proposal is located in proximity to the port operations, which is the primary demand for the water. Therefore, the power demand is reduced to supply the water to the required locations.
- An energy recovery device will be used on the first-pass reverse osmosis to capture energy from the high-pressure reject stream and transfer energy to the reverse osmosis feed stream. Pressure exchangers are used on the seawater reverse osmosis high-pressure circuit to recover waste energy from the brine side. By recovering this energy, the high-pressure pump duty is reduced and less power is consumed to maintain the system operating pressure. This saves energy consumption by reducing the pressure requirements of the high-pressure pumps (which are the desalination plant's largest power consumer).
- Plant design, particularly in the reverse osmosis process configuration and membrane selection, is intended to optimise overall plant efficiency, reducing the volume of seawater that is required to be pumped and pre-treated at the desalination plant, which saves energy.

13.4 Assessment and significance of residual impacts

Estimated peak annual emissions for the Proposal have been compared with national and state GHG emissions totals.

Australia's national GHG emissions, broken down by sector, for the year to December 2019 are presented in Table 13-3. Total annual emissions are 532.5 Mt CO_2-e. Annual peak emissions from the Proposal (37,433 t CO_2-e), would account for approximately 0.01% of Australia's annual emissions.

The most recently published state-based emissions inventory is for 2018. WA's GHG emissions for the 2018 year are also presented in Table 13-3. Total annual emissions in WA are 91.5 Mt CO_2-e. Annual peak emissions from the Proposal would account for approximately 0.04% of WA's annual emissions.

Table 13-3: National and state-wide annual greenhouse gas emissions by sector

Emission source		Year to December 2019 Australia-wide GHG emissions (Mt CO2-e)	2018 WA GHG emissions (Mt CO2-e)
Energy	Electricity	175.4	35.3
	Stationary energy, excluding electricity	102.1	20.2
	Transport	100.2	14.7
	Fugitive emissions	56.7	14.2
Industrial processes and product use		34.7	5.0
Agriculture		68.8	9.4
Waste		13.0	1.6
Land use, land use change and forestry		-18.5	-9.0
Overall total		**532.5**	**91.5**

13.5 Environmental outcomes

The predicted GHG emissions from the Proposal were assessed against comparable projects to benchmark. On an emissions per gigalitre basis, the Proposal was predicted to be less efficient than the Alkimos Seawater Desalination Plant, however, has less than half of the forecasted total annual emissions, with estimated peak emissions of 37,433 t CO_2e per year. This is approximately 0.04% of WA's predicted annual GHG emissions, 0.01% of Australia's predicted annual emissions, and is considered to be an acceptable level of GHG emissions. In the context of State and National emissions, the additional GHG emissions associated with the Proposal are negligible, and therefore the Proponent considers the Proposal will meet EPA's objective for GHG emissions.

Noting also that Rio Tinto is working towards the aspiration to be carbon-neutral for its WA operations by 2050 and has already commenced implementation of alternatives to abate GHG emissions from its Pilbara power sources.

14 OFFSETS

The assessment of residual impacts in Section 7 to Section 12 has demonstrated there are no significant residual impacts to environmental values resulting from the Proposal, therefore no offsets are proposed. The residual impacts are assessed against the residual impact significance model provided in the WA Environmental Offsets Guidelines (EPA, 2014). The findings of this assessment are provided in Table 14-1.

Table 14-1: Assessment against residual impact significance model

Part IV environmental factors:								
	Vegetation and flora							All factors
							MEQ	
					Marine fauna			
		BCH			BCH			
				Terrestrial fauna				
	Rare flora	Threatened ecological communities	Remnant vegetation	Wetlands and waterways	Conservation areas	High biological diversity	Habitat for fauna	Other
Residual impact that is environmentally unacceptable or cannot be offset	No residual impacts are considered to meet these criteria							
Significant residual impacts that will require an offset – All significant residual impacts to species and ecosystems protected by statute or where the cumulative impact is already at a critical level	No significant residual impacts are predicted when the mitigation measures are implemented							
Significant residual impacts that may require an offset – Any significant residual impact to potentially threatened species and ecosystems, areas of high environmental value or where the cumulative impact may reach critical levels if not managed	No significant residual impacts are predicted when the mitigation measures are implemented							
Residual impacts that are not significant	All vegetation communities were considered locally common and were in better condition outside the footprint	Targeted field surveys found that no species listed as Threatened under the BC Act, or under the EPBC Act, were recorded in the development envelope	Vegetation communities within the development envelope are considered locally common and are in better condition outside the development envelope	NA	NA	The very sparse mixed benthic community approximately 120 m south of the proposed discharge is of low diversity and is well represented in the surrounding area	No core habitats for conservation fauna species were identified in the development envelope	NA

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15 HOLISTIC IMPACT ASSESSMENT

This holistic impact assessment applies EPA's principles and objectives for environmental factors. The holistic impact assessment considers the effect of the Proposal on the environment as a whole, where the combination of the environmental effect of two or more environmental factors has the potential to result in significant impact.

Where feasible and practical, environmental risks associated with the Proposal have been avoided, reduced or minimised through engineering design. A significant number of studies and field surveys have been completed to inform the assessment of potential impacts. The Proponent acknowledges the relationships between environmental factors and that those interrelationships may require consideration and management to achieve good environmental outcomes.

Figure 15-1 shows the interaction between the environmental factors and the Proposal during construction and Figure 15-2 shows the interaction during operations.

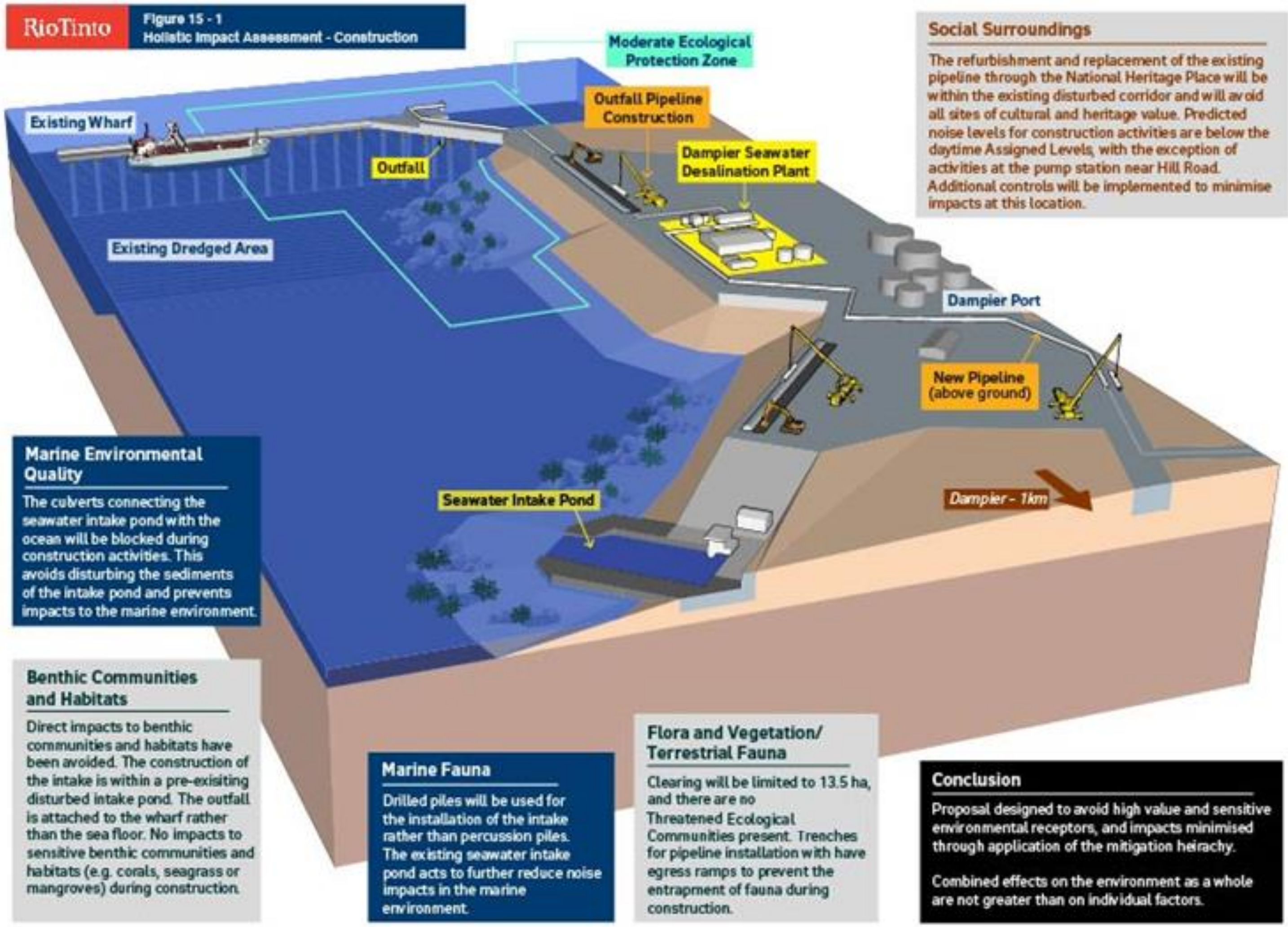

Figure 15-1: Holistic impact assessment – construction

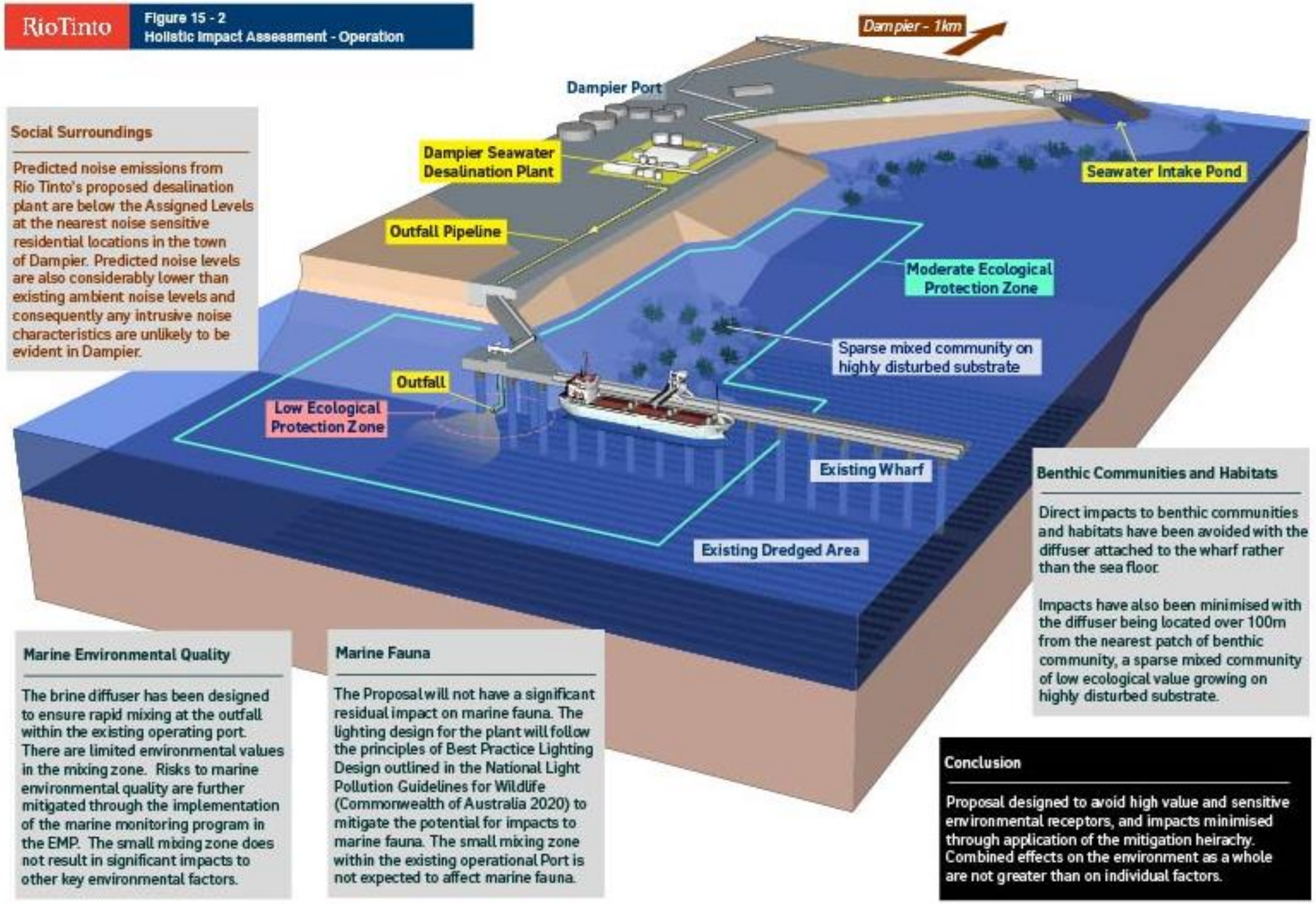

Figure 15-2: Holistic impact assessment – operations

15.1 Marine environment

A holistic view of interconnections between factors for the marine environment is shown in Figure 15-3.

Marine environmental quality

The Proposal has been designed to minimise impacts to marine environmental quality (sediment load, temperature and toxicity) through:

- Applying specific construction methods for the refurbishment of the seawater intake pond (e.g., culvert connecting the existing intake pond with the ocean will be blocked during construction activities to avoid disturbing sediments).
- Not disposing waste to the ocean.
- Designing and locating the diffuser(s) to facilitate rapid mixing of the discharge within the existing operating port.
- Burying the pipeline overland from the desalination plant to the start of the Parker Point wharf to minimise heat transfer from higher ambient air temperatures and minimise the elevation in the discharge water temperature compared with ambient water temperatures.

The Proposal will result in impacts to water quality in waters surrounding the proposed discharge location; however, these are not considered to be significant due to the localised nature of the impacts and the implementation of management and monitoring measures (Figure 15-2).

To ensure the environmental outcomes are achieved, management and monitoring measures for some of the potential impacts have been identified. Based on the mitigation measures and the monitoring and management program presented in the EMP, it is considered that environmental impacts to key environmental factors will not be significant and have been reduced to an acceptable level and meet EPA's objectives.

Benthic communities and habitats

The Proposal has been designed to avoid direct impacts to benthic communities and habitats, through locating the Proposal in the existing port area and having no direct disturbance of the sea floor (Figure 15-1).

Changes to water quality may result in potential impacts on BCH. This has been considered in the modelling and the assessment of impacts. A small one-hectare patch of sparse mixed community is located on a shallow rock outcrop approximately 120 m south of the proposed discharge outfall. There is a low likelihood that this habitat may be lost as part of this Proposal due to a reduction in water quality considered under the MEQ environmental factor (Figure 15-2). The one-hectare patch supports occasional small (<30 cm width) corals (predominantly *Turbinaria* spp.), with sparse sponges and zoanthids and a percentage of live coral cover estimated at 3 to 5%. This small patch is considered to be altered and is located on highly disturbed substrate which is a result of port development activities at Parker Point in the 1960s (i.e., rocks dumped into the ocean).

The mixed community habitat type found in this small area is widespread across the turbid nearshore environments of the Pilbara region, and characteristic of disturbed areas with high turbidity. As such, it does not represent habitat of conservation significance and the potential loss of this small patch of mixed community habitat is not considered to be significant.

Marine fauna

With impacts to marine environmental quality and benthic communities and habitats unlikely to be significant, the Proposal is also unlikely to significantly impact on marine fauna (Figure 15-1 and Figure 15-2). The Proposal will result in:

- No impacts to important habitats for conservation-significant marine fauna species (e.g., nesting, nursery, foraging or breeding areas)
- No reduction in populations of marine species of local and regional importance
- No reduction in the biodiversity of marine fauna within the development envelope or surrounding area in the development envelope or surrounds.

Social surroundings

The Proponent recognises the intrinsic link between the factors of marine environmental quality, benthic communities and habitats, marine fauna, and people's values of their social surroundings. The Proposal is expected to result in negligible impacts to the recreational or community uses of the area as the development envelope is situated within an industry-controlled area that is not accessible to the public. The Proposal has a limited marine footprint and is located within an existing port industrial area where recreational fishing is not possible.

The Proposal has been designed to minimise and mitigate impacts to social surroundings elements, such as Aboriginal heritage and noise. The potential for disturbance to submerged cultural archaeological heritage has been avoided by limiting the Proposal's marine disturbance to existing disturbed and dredged areas, which have been heavily modified through dredging and construction of the Port (Figure 15-1 and Figure 15-2). The use of noise-sensitive construction methods during construction and noise controls during operation of the Proposal have minimised amenity impacts on marine social surroundings (Figure 15-1 and Figure 15-2).

The Proposal will be managed in accordance with the Proponent's project specific DSDP CHMP (2022) which has been prepared in consultation with MAC, to provide robust management provisions and controls for construction activities. The DSDP CHMP will be implemented in conjunction with the CEMP to ensure that potential impacts are minimised.

With impacts to marine environmental quality, marine fauna and benthic communities and habitats unlikely to be significant, the Proposal is also unlikely to significantly impact on marine-relevant social surrounds.

Combined effect – marine

The Proponent recognises the intrinsic interactions and connectivity between marine environmental quality, marine fauna and benthic communities and habitats. The Proposal has been designed to avoid high-value and sensitive marine environmental receptors, primarily by locating the Proposal within the existing Port of Dampier in an area that has been dredged for shipping movements and ship berthing. This area has already been disturbed and has negligible benthic habitat and therefore low productivity.

Figure 15-1 shows the interaction between the marine environmental factors and the Proposal during construction and Figure 15-2 shows the interaction during operations.

The combined effects on the marine environment as a whole are no greater than the effects on individual factors (marine environmental quality, marine fauna, benthic communities and habitats and social surrounds). These effects have been minimised by applying the mitigation hierarchy (avoid, minimise and rehabilitate) to each factor. A monitoring plan has also been developed for marine environmental quality to be implemented during constructions and operations (included in the OEMP, Appendix F).

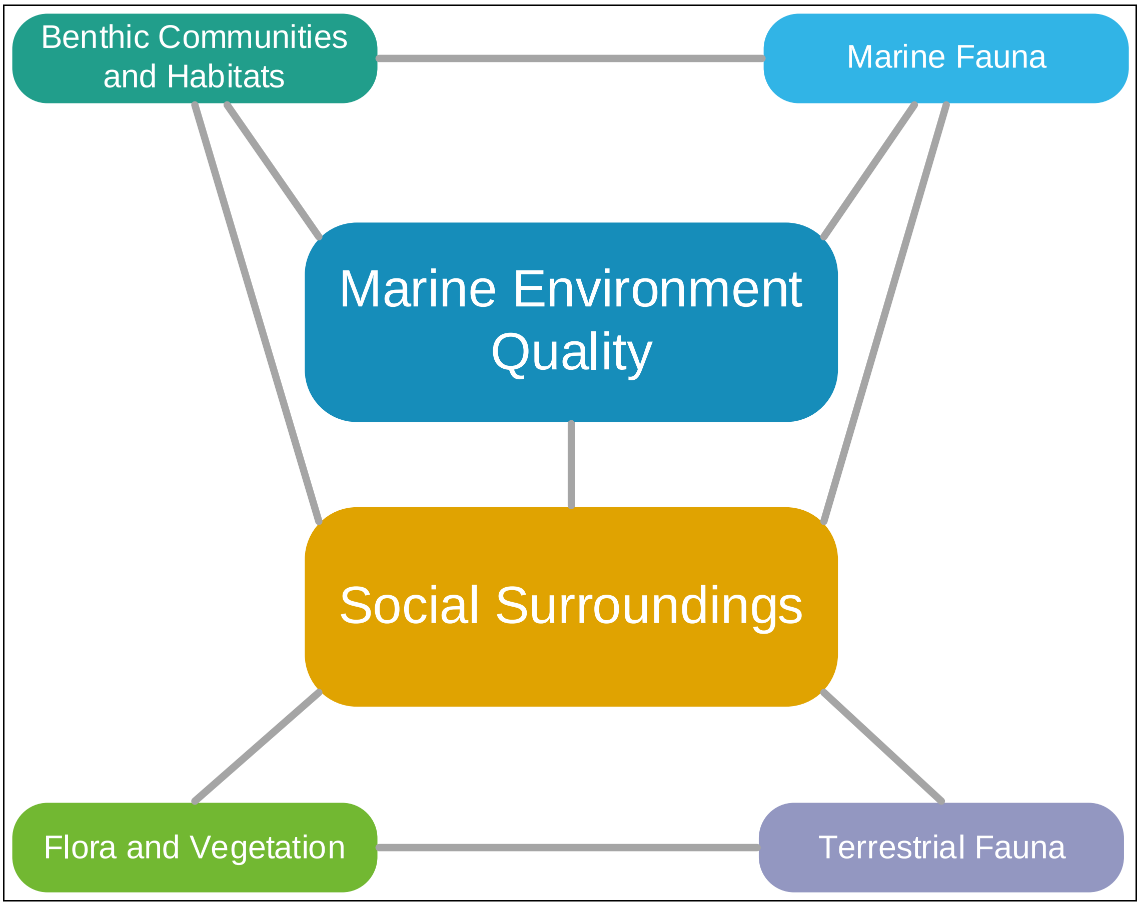

Figure 15-3: Intrinsic interactions between relevant environmental factors

15.2 Terrestrial environment

A holistic view of interconnections between factors for the terrestrial environment is shown in Figure 15-3.

Flora and vegetation / Terrestrial fauna

The Proposal has been designed to avoid clearing of native vegetation and utilise existing cleared areas. The Proposal will result in clearing of up to 13.5 ha of native vegetation within the 57.5 ha development envelope, including 2.5 ha (19 %) in good to very good condition (Figure 15-1).

The Proposal has been designed to minimise clearing of fauna habitats and utilise existing cleared areas (Figure 15-1). The Proposal will result in clearing of up to 13.5 ha of native vegetation; however, this does not include any habitat critical for conservation-significant fauna. The Proposal also does not result in fragmentation of key fauna movement corridors and no fauna species are likely to be restricted to or reliant on the habitats present. Furthermore, the disturbed nature of the development envelope and the large portion of which is cleared (43.2 ha, 75%) indicates the development envelope is unlikely to provide important habitat linkages.

The Proposal has the potential to impact on terrestrial fauna and change the relationship between flora and vegetation and reduce people's social surroundings and interactions with nature.

Social surroundings

The Proposal has been designed to minimise and mitigate impacts to social surroundings elements, such as Aboriginal heritage and amenity (noise and visual). The location of the desalination plant within the existing Port of Dampier, utilising existing cleared areas and use of noise-sensitive construction methods during construction and noise controls during operation of the Proposal, have minimised amenity impacts on social surroundings (Figure 15-1 and Figure 15-2). In addition, the development envelope has been designed and a section of the water transfer pipeline has been re-routed to avoid significant impacts to cultural heritage values.

The Proponent recognises the intrinsic link between the factors of terrestrial fauna, flora and vegetation and people's values of their social surroundings. The Proposal has the potential to impact on social surroundings and change the relationship with flora and vegetation and terrestrial fauna.

Combined effect – terrestrial

The combined effects on the terrestrial environment as a whole are no greater than the effects on individual factors (flora and vegetation, terrestrial fauna and social surroundings). These effects have been minimised by applying the mitigation hierarchy (avoid, minimise and rehabilitate) to each factor.

Figure 15-1 shows the interaction between the terrestrial environmental factors and the Proposal during construction and Figure 15-2 shows the interaction during operations.

By applying the proposed mitigation and management measures, the Proponent considers impacts to the health of other factors of the environment, including the values associated with flora and vegetation, terrestrial fauna and social surroundings, are likely to be consistent with EPA’s objectives for environmental factors and, when assessed together holistically, are not greater in impact than that of each individual factor.

15.3 Summary

When the separate environmental factors of the Proposal are considered together in a holistic assessment, the interactions between impacts from the Proposal would not lead to any additional impacts over and above those assessed against each individual factor. Therefore, the Proposal as a whole is considered to be able to meet EPA’s objectives for the environmental factors

16 CUMULATIVE ENVIRONMENTAL IMPACT ASSESSMENT

Cumulative environmental impacts are defined as 'the successive, incremental and interactive impacts on the environment of a proposal with one or more past, present and reasonably foreseeable future activities' (EPA, 2021b).

The Proposal is located in the Roebourne IBRA sub-region along the west coast of the Pilbara, which is predominantly undeveloped with the exception of certain activities, such as onshore and offshore gas projects, port operations and salt mining occurring in targeted locations and more broadly grazing and pastoral activities.

Within the context of this Proposal, other proposals, projects and activities in proximity to the development envelope are described below.

The Proposal is located within the Proponent's existing Dampier Port industrial area approximately 1 km north-east of Dampier township. The area immediately surrounding the Proposal is dominated by existing industrial land uses as well as the residential area of Dampier. Industrial operations include the ports at Parker Point and East Intercourse Island, the Pilbara Port Authority and Dampier Salt operations.

More broadly the Proposal is located at the southern end of the Burrup Peninsula, and further north other existing industry uses near King Bay includes (Figure 16-1):

- North West Shelf Project (a large LNG production facility project with onshore facilities that process gas from offshore fields) – 7.4 km north-east of the Proposal
- Pluto LNG (a major LNG gas project with onshore facilities that process gas from offshore fields) – 5.2 km north-east of the Proposal
- Yara Pilbara Fertilisers and Nitrates operations – 6.7 km north-east of the Proposal

The remainder of the Burrup Peninsula and broader Dampier Archipelago is covered by conservation, heritage and recreation areas.

Figure 16-1 shows the current and reasonably foreseeable projects near the Proposal. In addition to the projects listed above, the following projects are either approved to operate or currently under assessment by the EPA:

- Perdaman Urea Project (Proponent: Perdaman Chemicals and Fertilisers Pty Ltd) – Ministerial Statement 1180 – 5.4 km north-east of the Proposal
- Ammonia Plant, Murujuga (Burrup Peninsula), Renewable Hydrogen Project (Proponent: Yara Pilbara Fertilisers Pty Ltd) – currently under assessment by the EPA – 6.3 km north-east of the Proposal
- Downstream Processing Chemical Production Facility (Proponent: Wesfarmers Chemicals Energy & Fertilisers Limited) – currently under assessment by the EPA – 7.5 km north-east of the Proposal

Although there are a number of different industries in the area, to date there has been minimal vegetation clearing and a significant extent of native vegetation remains with large areas of undeveloped land.

There is a low potential for cumulative impacts to marine environmental quality from existing approved discharges within the vicinity of the Proposal, due to the distance between discharge points and the type of activities having limited impacts immediately outside of the discharge point at the outfall for the Proposal. Existing discharges that have the potential to alter MEQ are shown in the existing DWER Environmental Quality Plan for Mermaid Sound (see Figure 16-2 below, published in Pilbara Coastal Water Quality Consultation Outcomes report by the Marine Ecosystems Branch). The four relevant discharge points include (in order of proximity to the Proposal):

- Discharge point 4 – Old power station discharge

  This point is located immediately adjacent to the Proposal at Parker Point, however is now redundant and decommissioned. It therefore has no potential cumulative impacts with the Proposal.

- Discharge point 3 – Brine and process water discharge

  This point relates to the multi-user brine return line (MUBRL) which discharges into King Bay and is located 2.9 km north-east of the discharge point at the outfall for the Proposal. The Perdaman Urea Project proposes to discharge from the MUBRL and Yarra Fertilisers also discharge through the MUBRL, however the discharges are expected to remain well within the limits stipulated in Ministerial Statement 594 (2002) for the Desalinated Water and Seawater Supplies Project. It is therefore expected that a high level of ecological protection would be met and therefore not expected to result in cumulative impacts with this Proposal.

- Discharge point 5 (two locations) – Treated sewerage wastewater discharge

  These points are located 3.5 km south-west and 7.2 km north-west of the discharge point at the outfall for the Proposal and are only expected to have small effects on social values in close proximity to those discharge location. Also a high level of ecological protection is expected to be met within 70 m of the administration drain at discharge point 5 (Woodside 2019). Therefore, it is not expected to result in cumulative impacts with this Proposal given the distance from the Proposal discharge.

- Discharge point 1 – LPG/LNG plant discharge

  This point is associated with the North West Shelf and Pluto LNG projects and is located 7 km north-east of the discharge point at the outfall for the Proposal. These are not expected to result in cumulative impacts as a high level of ecological protection is expected to be met within 400m of discharge point 1 (Woodside 2019).

Overall, the Proposal presents a low likelihood of contributing to cumulative impacts to marine environmental quality given the limited spatial extent of the revised low and moderate levels of ecological protection (LEP), and that these LEPs do not overlap with the low or moderate LEPs from other proponent's discharges within Mermaid Sound (given the large distances between).

Furthermore, cumulative impacts from concurrent emissions of different noise sources (e.g. vessel operations and drilling) are not considered to increase the level of impact. Therefore, cumulative impacts from noise and light are not expected to result in significant impacts to marine fauna given the low levels of additional marine noise and light when compared to existing sources.

There is a low likelihood that a small 1 ha patch of sparse mixed community (approximately 120 m south of the outfall discharge) may be lost as part of this Proposal due to a reduction in water quality considered under the MEQ environmental factor. This small patch is considered to be altered and is located on highly disturbed substrate which is a result of port development activities at Parker Point in the 1960s (i.e. rocks dumped into the ocean). The loss of the small sparse mixed community represents 1.3% of BCH within the Local Assessment Unit (LAU) number 11. The historical area of BCH within LAU number 11 was 76 ha and the current area is 59.8 ha (Woodside 2019). The mixed community habitat type found in this small area is widespread across the turbid nearshore environments of the Pilbara region, and characteristic of disturbed areas with high turbidity (MScience 2019). The cumulative additional 1.3% loss of this small patch of BCH (with a low likelihood of occurring) is therefore not considered significant.

The Proposal has been designed to avoid clearing of native vegetation and utilise existing cleared areas. The Proposal will result in clearing of up to 13.5 ha of native vegetation within the 57.5 ha development envelope. The majority of the vegetation is in Poor to Degraded condition (11 ha, 81%) with the remaining 2.5 ha (19 %) in Good to Very Good condition. Of the existing and reasonably foreseeable projects near the Proposal described above (Figure 16-1), the predicted extent of vegetation clearing includes:

- Perdaman Urea Project – 73.05 ha
- Ammonia Plant, Murujuga (Burrup Peninsula) – 23.04 ha
- Yara Pilbara Fertilisers and Nitrates – Ammonium Nitrates (Ministerial Statement 870 – 35 ha), Ammonia Plant (Ministerial Statement 586 – 29 ha)
- Pluto LNG – 125.9 ha (Ministerial Statement 757)

The current extent of vegetation within the Roebourne IBRA sub-region accounts for an area of 1,811,160.61 ha (based on 2018 state-wide vegetation statistics, Government of Western Australia, 2018), which is 98% of the pre-European extent. Based on the potential clearing of up to 13.5 ha for the Proposal, combined with the clearing of approximately 286 ha from existing and reasonably foreseeable projects, the cumulative impact will contribute approximately 0.016% (approximately 300 ha) to the total vegetation clearing in the Roebourne IBRA sub-region. As a result, the Proposal will not contribute to any significant cumulative impacts associated with clearing in the Roebourne IBRA sub-region.

Overall, the Proposal is unlikely to contribute to significant cumulative impacts combined with existing and reasonably foreseeable future activities.

Figure 16-1: Reasonably foreseeable projects

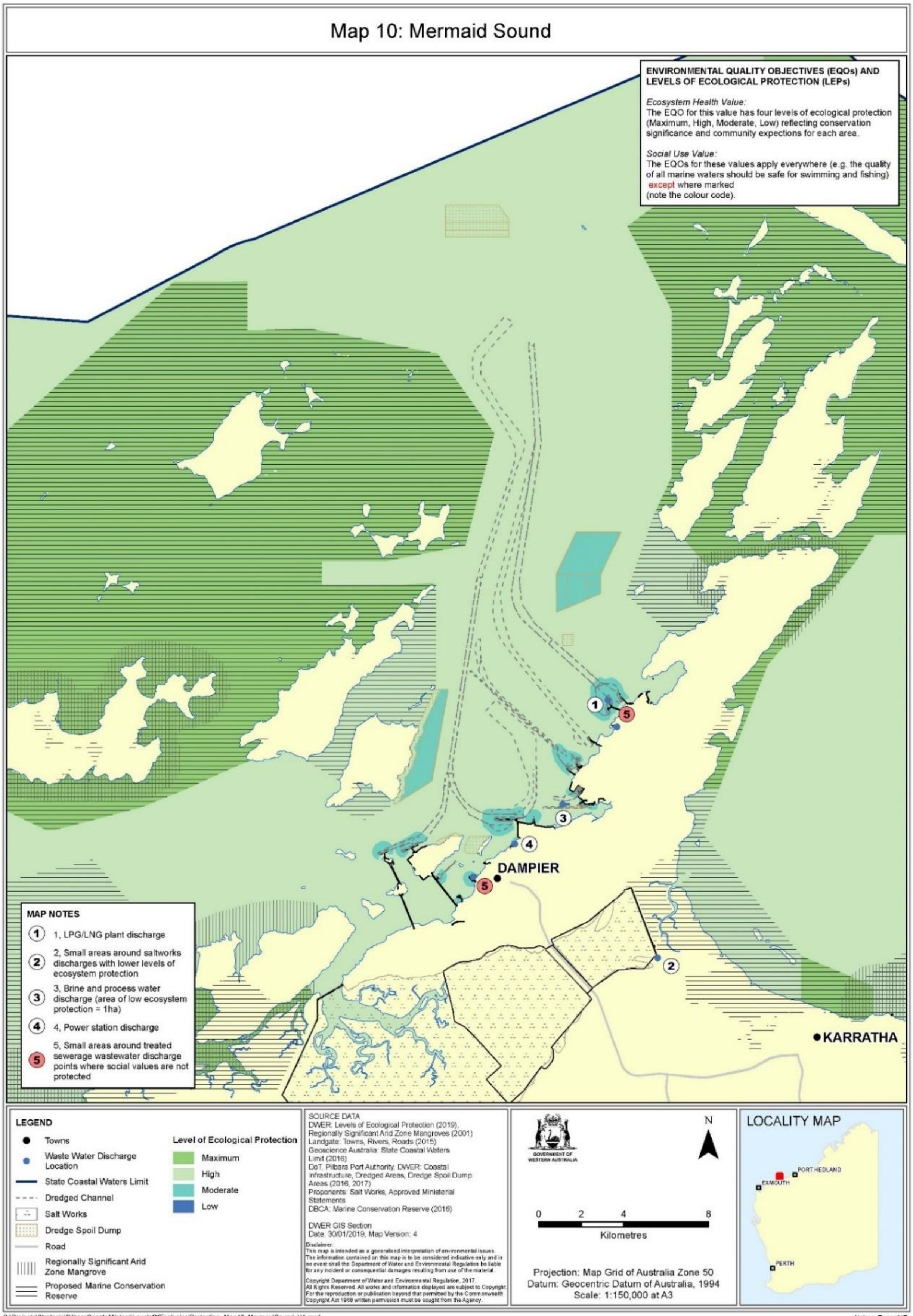

Figure 16-2: Existing environmental quality plan – Mermaid Sound – showing existing discharges

17 OVERALL ASSESSMENT CONCLUSION

This Supporting Document provides an environmental impact assessment of the Proposal in accordance with the relevant policy and guidance. The assessment has concluded that the Proposal is expected to be able to meet EPA's objectives for MEQ, BCH, marine fauna, flora and vegetation, terrestrial fauna, social surroundings and greenhouse gas emissions environmental factors, subject to the proposed limits and mitigation measures.

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APPENDIX E – Policy and Guidance

Environmental Factor	Policy and Guidance
Key Environmental Factors	
Marine Environmental Quality	• Environmental factor guideline – Marine Environmental Quality (EPA, 2016b) • Technical guidance – Protecting the quality of Western Australia's marine environment (EPA, 2016c) • Pilbara coastal water quality consultation outcomes: Environmental values and quality objectives (Department of Environment, 2006) • Statement of environmental principles, factors and objectives (EPA, 2021b) • Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018).
Benthic Communities and Habitat	• Environmental factor guideline – Benthic Communities and Habitats (EPA, 2016) • Technical guidance – Protection of benthic communities and habitats (EPA, 2016a) • Statement of environmental principles, factors and objectives (EPA, 2021b).
Marine Fauna	• EPA (2016) Environmental factor guideline – Marine fauna • EPA (2021b) Statement of environmental principles, factors, objectives and aims of EIA • Commonwealth of Australia (2017a) Recovery plan for marine turtles in Australia • Commonwealth of Australia (2020) National light pollution guidelines for wildlife: including marine turtles, seabirds and migratory shorebirds • Commonwealth of Australia (2017b) EPBC Act Policy Statement 3.21: Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed Migratory shorebird species.
Flora and Vegetation	• Statement of environmental principles, factors, objectives and aims of EIA (EPA, 2021b) • Environmental factor guideline – Flora and Vegetation (EPA, 2016a) • Technical guidance – Flora and vegetation surveys for EIA (EPA, 2016b).
Terrestrial Fauna	• Statement of principles, factors and objectives (EPA, 2018) • Environmental factor guideline – Terrestrial Fauna (EPA, 2016c) • Technical guidance – Sampling of short-range endemic invertebrate fauna (EPA, 2009) • Technical guidance – Terrestrial vertebrate fauna surveys for EIA (EPA, 2021b).

Environmental Factor	Policy and Guidance
Social Surroundings	• Statement of environmental principles, factors and objectives (EPA, 2016; revised 2020) • Environmental factor guideline – Social Surroundings (EPA, 2016) • *Aboriginal Heritage Act 1972* • Department of Aboriginal Affairs and Department of the Premier and Cabinet due diligence guidelines (Version 3.0) (DAA, 2013) • Engage Early: Guidance for proponents on best practice Indigenous engagement for environmental assessments under the EPBC Act (DoE, 2016).
Other Environmental Factors	
Greenhouse Gas Emissions	• Environmental factor guideline – Greenhouse Gas Emissions (EPA, 2020b) • *National Greenhouse and Energy Reporting Act 2007* (Government of Australia, 2019a) • National Greenhouse and Energy Reporting Regulations 2008 (Government of Australia, 2019b) • National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Government of Australia, 2021b) • Emissions Reduction Fund and associated carbon credits (Carbon Farming Initiative) Rule 2015 (Government of Australia, 2021a) • Greenhouse Gas Emissions Policy for Major Projects (Government of Western Australia, 2019) • Climate change in Western Australia: Issues paper – September 2019 (DWER, 2019) • Western Australian Climate Policy (DWER, 2020). Rio Tinto has announced a corporate policy ambition to reach net zero emissions by 2050 across all operations. To support this ambition, new medium-term global targets have been introduced for Scope 1 and Scope 2 emissions, effective from 2020, to: • reduce emissions intensity by 30% by 2030 • reduce absolute emissions by 15% by 2030 (approximately 4.8 Mt CO2-e). Both of the above targets are to be measured against a 2018 baseline, adjusted for divestments and acquisitions. In some cases, developments may be sought, with emissions abatement projects implemented at alternative locations, depending on the technical constraints of the network to ensure security, reliability and stability is upheld. Carbon abatement projects are treated holistically in their application across Rio Tinto's Pilbara operations, providing net emissions reduction regardless of their physical location.